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TAXATION OF CORPORATE CAPITAL INCOME: TAX REVENUES VS. TAX DISTORTIONS

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ABSTRACT

Since the average tax rate on corporate capital income is very high, economists often conclude that taxes have caused a substantial fall in corporate investment, a movement of capital into noncorporate uses, and a fall in personal savings. The combined efficiency costs of these distortions are believed to be very important.

This paper attempts to show that when uncertainty and inflation are taken into account explicitly, taxation of corporate income leaves corporate investment incentives basically unaffected, in spite of the sizable tax revenues collected. In addition, in some plausible situations, such taxes can result in a gain in efficiency. The explanation for these surprising results is that the government, by taxing capital income, absorbs a certain fraction of both the expected return and the uncertainty in the return. While investors as a result receive a lower expected return, they also bear less risk when they invest, and these two effects are largely offsetting.

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Many papers over the past twenty years have emphasized the high average tax rates on corporate capital income resulting from the combination of corporate and personal income taxes as well as property taxes. For example, Feldstein and Summers (1979) calculate that the average combined personal and corporate income tax rate on corporate income is on the order of 66%. Many studies have then calculated the efficiency costs of this heavy tax burden on the corporate sector. Harberger (1962), Shoven and Whalley (1972), and Fullerton, Shoven, and Whalley (1978), in increasingly elaborate models, estimate the efficiency costs arising from the movement of capital out of the corporate sector into other uses. Feldstein (1978) also emphasizes the efficiency cost of the heavy tax burden discouraging savings and investment in general.

This paper departs from that tradition. It shows that when uncertainty and inflation are incorporated into the model, the taxation of corporate income leaves corporate investment incentives basically unaffected, despite the sizeable tax revenues collected. Further, in some plausible situations, such taxes can cause a gain in efficiency. The explanation for these surprising results is that the government, by taxing capital income, absorbs a certain fraction of both the expected return to corporate capital and the uncertainty in that return. As a result, while investors receive a lower expected return, they also bear less risk when they invest, and these two effects are largely offsetting.

This argument that the taxation of corporate income is nondistorting is entirely different from that of Stiglitz (1973). Stiglitz's argument, developed in a certainty setting, relied on the possibility of 100% debt finance for marginal investments. For much of the argument in this paper, firms will be constrained to use only equity finance. When debt finance is allowed, the changes in the results are minor.

The argument will first be developed intuitively in section I in a mean-variance setting. In section II, a more general and formal version of the argument will be presented. In section III, some generalizations of the model will be explored. Section IV is the conclusion.

I. Analysis of Taxes Given Inflation and Uncertainty: An Example

Since corporate capital income is subject not only to corporate taxes but also to personal taxes and property taxes, there is a strong presumption in the literature, e.g. Feldstein (1978), that there is too little corporate capital, with large efficiency costs. To express this argument in notation, let r^a equal the after tax rate of return required by corporate shareholders, which by utility maximization must equal their marginal time preference rate. Also, let ρ equal the value of the marginal product of capital net of depreciation. Without any tax distortions, competition (and efficiency) requires that $\rho = r^a$.

However, with a corporate tax at rate τ, a property tax at rate t, and a personal tax on income from shares at rate e, the after tax return to corporate capital becomes only $(1-e)(1-\tau)(\rho-t)$. Competition requires that this return equal r^a. It then follows that

$$\rho = t + \frac{r^a}{(1-e)(1-\tau)}.$$

The three taxes in this setting compound to drive the marginal product of corporate capital sharply above the investors' marginal time preference rate. To illustrate the size of this distortion, let us set $\tau = .5$, a representative average corporate tax rate during the 1970's according to the figures in the *Economic Report of the President*. Also, assume that $e = .16$, which is approximately the personal tax rate on income to equity holders calculated by Feldstein and Summers (1979), and assume that $t = .013$, a representative property tax on corporate capital according to the figures in Fullerton-Gordon (1981).[1] Finally, assume that the after tax return required by corporate investors is $r^a = .06$, which is a representative rate of return on municipal bonds during the 1970's. These figures together imply that the equilibrium value of ρ equals .156, suggesting that a substantial excess burden is created by these taxes, given that the marginal time preference rate of investors equals .06. This procedure for modelling the effects of taxes is basically that used by Harberger (1962), Feldstein (1978), and Fullerton, Shoven, and Whalley

1. The figures in Fullerton-Gordon (1981) equal half of property tax payments relative to the value of the capital stock. This halving of the tax rate was intended to capture, however crudely, the benefits from local public services that firms receive, which to a degree offset the tax payments they make.

(1978), among others.

However, the above argument ignores the effects of inflation and uncertainty. When we take these factors into account, the results change dramatically. Investors would now require that the expected nominal after tax rate of return on an investment at least equal the after tax nominal risk free interest rate, which we denote by r_z^a, plus enough to compensate for the risk in the return on the investment. In the context of the capital asset pricing model, the required risk premium on an investment would equal $\delta = \frac{cov(\rho, r_m)}{var(r_m)} \cdot \bar{r}_m$, where r_m is the excess rate of return on the market portfolio and $\bar{r}_m$ is its expected value. The before tax nominal rate of return on capital, with inflation, would be $\rho + \pi$, where π is the inflation rate. Were there no taxes, then in equilibrium investment would occur until

$$\rho + \pi = r_z^a + \delta \ . \tag{1}$$

How do taxes affect the equilibrium value of ρ? After corporate taxes and property taxes, the rate of return would be $(1-\tau)(\rho-t) + \pi$, since the inflationary capital gain is not included in the corporate tax base. This then leaves $(1-e)(1-\tau)(\rho-t) + (1-c)\pi$ after personal taxes, where we assume that purely inflationary capital gains are taxed at a rate c, which presumably is smaller than e.

In equilibrium, this after tax return ought just to equal the rate of return required by investors, given the risk. Let us assume that the excess return on the market portfolio remains unchanged. (We will return to this assumption below.) Then the risk premium required on this marginal investment will equal only $(1-e)(1-\tau)\delta$ since the covariance of the *after tax* return on the investment with that on the market is reduced by the factor $(1-e)(1-\tau)$. Therefore, in equilibrium, we find that

$$(1-e)(1-\tau)(\rho-t) + (1-c)\pi = r_z^a + (1-e)(1-\tau)\delta$$

which implies that

$$\rho = t + \frac{r_z^a - (1-c)\pi}{(1-e)(1-\tau)} + \delta \ . \tag{2}$$

To what degree does this differ from the equilibrium without taxes, where $\rho = r_z - \pi + \delta$? For purposes of illustration, let us assume that $\pi = .065$ and that $r_z^a = .05$, a figure slightly lower than r^a to account for a small risk premium in the observed interest rates. Also assume $c = .05$ is the effective capital gains tax rate. With these figures along with the tax rate assumptions used previously, we find that the equilibrium ρ is left almost exactly unchanged in spite of the taxes. While these parameter values were chosen with a bit of care, each one is quite representative of the values used in other papers.

While the value of ρ is basically unaffected by these taxes, however, considerable tax revenue is still collected. According to the above formulas, total tax revenue collected per year on this dollar investment by the corporate, property, and personal income taxes together will equal $\tau(\rho - t) + t + e(\rho - t)(1-\tau) + c\pi$. If we assume that $\delta = .12$, a number consistent with the figures in Fullerton and Gordon (1981),[2] together with the previous parameter assumptions, then the expected tax revenues equal .070 per year. Since with these figures, the total expected return ρ equals .105, the average tax rate on corporate income is .663.

How can ρ be left basically unaffected by a set of taxes producing an average tax rate of .663? The simple explanation is that while investors receive much less after tax as a return on their investment, they also require much less in return since the investment is no longer as risky. In the example above, the fall in the risk premium required by investors just matches the fall in the expected after tax return, leaving the equilibrium ρ unaffected. The government, in taxing away part of the return, is charging the market price for the risk that it absorbs.

So far we have assumed that the investment was entirely equity financed. As Stiglitz (1973) pointed out, the tax law treats debt-financed investment more favorably. We have also ignored the investment tax credit and the effects of tax vs. true depreciation rates. Fullerton and Gordon (1981) incorporate these further complications into the model. After much effort in measuring the needed parameters, they conclude that taxes on corporate income, rather than merely leaving corporate investment unaffected, should cause a slight increase in corporate

2. Note that the risk premium on the marketed securities would equal $(1-\tau)\delta$.

investment.

Let us return now to the assumption that the excess return on the market portfolio remains unchanged when taxes are introduced. Given that the government absorbs a sizeable fraction of the risk as a result of the taxes on corporate income, one might have expected the market risk premium to fall as well. However, the government cannot freely dispose of the risk that it bears. Individuals must ultimately bear this risk, whether through random tax rates on other income, random government expenditures, or random government deficits, so a random inflation rate. Given that individuals must ultimately bear all the risk in the return on the investment, with or without taxes, it is natural to assume that the risk premium on the market portfolio remains unchanged, where the market portfolio now embodies, as it should, all the sources of risk that the individual faces.[3] The government, however, might be able to reallocate the risk more efficiently, in which case the market risk premium ought to fall, stimulating investment as well as increasing efficiency.

II. General Two-Period Analysis

The results in the previous section do not rely on the special assumptions underlying a mean-variance analysis of risk. To show this, we redevelop the argument in this section using a general two-period utility function in a setting similar to that used by Diamond (1967) and Leland (1974). We first characterize the equilibrium amount and allocation of capital when there are no taxes, and then investigate how the equilibrium changes when taxes are introduced.

A. Equilibrium Without Taxes

Let us assume that there are J^* potential firms. The jth firm, if it invests K_j units of capital in the first period, will produce a stochastic real return in the second period of $R_j = f_j(K_j)\theta_j + h_j(K_j)$.[4] Here, f_j and h_j are nonstochastic nonconvex functions, and θ_j is a

3. While many papers have been written previously on the effects of taxes on the amount of risk bearing, e.g. Domar and Musgrave (1944), Mossin (1968), and Stiglitz (1969), almost all assume that individuals no longer bear what risk is passed to the government. Atkinson and Stiglitz (1980, pp. 109-10) do point out, however, that a utility compensated increase in the tax on risk taking has no effect on behavior.

4. As Leland (1974) points out, many alternative stochastic models are special cases of this formulation. For example, the formulation can be consistent with either price or production uncertainty, and with either competitive or

random variable with mean $\bar{\theta}_j$.[5] In the second period, the firm pays back to its owners its initial capital stock, now worth $(1+\pi)K_j$, plus the return R_j.

The firm in the first period "goes public" and sells shares of ownership in this return to individual investors. Denote the market value of these shares by V_j, where V_j implicitly depends on the amount of capital K_j that the firm promises to acquire. The initial owners of the firm when it goes public then divide the residual $V_j - K_j$ among themselves.

Before going public, the firm must decide how much capital K_j it will promise to acquire. We assume that in doing so the firm maximizes the value of the residual $V_j - K_j$ going to its initial owners. (We show below that each of the initial owners will find this policy to be utility maximizing.) If $V_j < K_j$ for all positive values of K_j, then the potential firm would never come into existence. Assume that the first J firms choose to go public and acquire positive amounts of capital.

For these J firms, K_j will be chosen such that $\dfrac{\partial V_j}{\partial K_j} = 1$ at this K_j. This implies that in equilibrium investors are willing to accept a stochastic real return in the second period of $\rho_j = f_j'(K_j)\theta_j + h_j'(K_j)$, with expectation $\bar{\rho}_j$, on a dollar invested in the first period.

Let there be I individuals. Individual i has a utility function $U_i(C_i^1, C_i^2)$ which depends on consumption in each of the two periods. For convenience, both C_i^1 and C_i^2 are expressed in nominal dollars, in spite of the presence of inflation.

Individual i's initial wealth is W_i plus an initial percent ownership $\bar{s}_{ij}$ in each of the J firms which decide to go public. He can lend to (or borrow from) other individuals at a nonstochastic nominal interest rate r, with the amount lent being denoted by D_i. He can also buy a percent s_{ij} of the shares issued by each of the J firms when they go public. In doing so, he is subject to the budget constraint

$$C_i^1 + D_i + \sum_{j=1}^{J} s_{ij} V_j = W_i + \sum_{j=1}^{J} \bar{s}_{ij}(V_j - K_j) . \qquad (3)$$

noncompetitive firm behavior.

5. The joint distribution of the θ_j is unrestricted.

Individual i chooses values for C_i^1, D_i, and s_{ij}, subject to his budget constraint, so as to maximize his expected utility $E\ U_i(C_i^1, C_i^2)$, where

$$C_i^2 = (1+r)D_i + \sum_{j=1}^{J} s_{ij}((1+\pi)K_j + R_j) \tag{4}$$

The resulting first order conditions characterizing his optimal choices can be expressed as

$$E\ U_{i1} = (1+r)E\ U_{i2} \tag{5a}$$

$$E[((1+\pi)K_j + R_j - (1+r)V_j)U_{i2}] = 0 \quad \text{for } all\ \ j \tag{5b}$$

where $U_{i1} = \frac{\partial U_i}{\partial C_i^1}$ and $U_{i2} = \frac{\partial U_i}{\partial C_i^2}$. Given the definition for R_j, we can infer from equation (5b) that

$$f_j\bar{\theta}_j + h_j = (r-\pi)K_j + (1+r)(V_j - K_j) - f_j\frac{E[(\theta_j - \bar{\theta}_j)U_{i2}]}{EU_{i2}} \quad \text{for } all\ j\ . \tag{6}$$

The last term on the right represents the risk premium. It must have the same value for all individuals, since the equation holds for all i, and it will increase the right hand side given that individuals are risk averse.

These equations must be satisfied for each individual. There is also an overall market clearing condition in the debt market which requires that

$$\sum_{i=1}^{I} D_i = 0\ . \tag{7}$$

We know in addition that a dollar marginal investment in any of the J firms is valued at a dollar by the market. Since the "marginal investment" is itself not a separate freely traded security, in general any individual might value the resulting returns differently from a dollar. In this model, however, the return pattern of a marginal investment is identical to that from a suitably chosen portfolio of freely traded securities. In particular, the nominal return from a dollar's marginal investment in the jth firm will have exactly the same distribution as the combined returns from an amount $\frac{f_j' V_j}{f_j}$ invested in shares of the jth firm and an amount

$\frac{1}{f_j(1+r)}$ $[f_j(1+\pi+h_j') - f_j'(h_j+(1+\pi)K_j)]$ lent to other individuals. (That is, the return pattern of the marginal investment is within the span of the return patterns from these two other available assets.) Therefore, all individuals can implicitly trade in a composite security with a return pattern equal to that from a marginal investment in the jth firm so all must assign the same value, one dollar, to this composite security. This implies that

$$\frac{f_j' V_j}{f_j} + \frac{1}{f_j(1+r)} [f_j(1+\pi+h_j') - f_j'(h_j + (1+\pi)K_j)] = 1 \tag{8}$$

or that

$$(1+r)(V_j-K_j) = \left[\frac{f_j}{f_j'} - K_j\right](r-\pi) - \frac{h_j' f_j}{f_j'} + h_j \tag{9}$$

If an individual is willing to pay just one dollar for the returns from the marginal investment in the jth firm, it follows that

$$E[((1+\pi) + f_j'\theta_j + h_j' - (1+r))U_{i2}] = 0 \quad \text{for } all \;\; j\,. \tag{10}$$

This implies that

$$\bar{\rho}_j \equiv f_j'\,\bar{\theta} + h_j' = r - \pi - f_j'\,\frac{E[(\theta_j-\bar{\theta}_j)U_{i2})]}{E\;U_{i2}}\,. \tag{11}$$

Note that this equation is very similar to equation (1) derived above characterizing the equilibrium without taxes in the mean-variance context. The set of equations (3), (4), (5a), (6), (7), (9), and (11) jointly determine the equilibrium values for D_i, C_i^1, C_i^2, s_{ij}, r, V_j, and K_j for all i and j.

B. Equilibrium with Taxes

Now let us calculate the implications of imposing a corporate and a personal income tax, as well as a property tax, with the tax revenue redistributed back to individuals in the second period in a lump sum fashion. The lump sum transfers will be designed to eliminate any income effects from the tax, so that we can focus on the effects of the price distortions.

Let us assume that the personal income tax is uniform across individuals and is imposed at a flat rate m on income from bonds and at a flat rate e on income from stocks. As before, assume that purely inflationary capital gains are taxed at a lower rate c. We assume there is full loss offset.

In addition, assume that the effects of the corporate and property taxes together are to tax income from capital at a rate τ and to tax the replacement cost of the capital stock at a rate t. As before, we assume that the tax payments $t\ K_j$ are deductible from corporate income before τ is imposed. To a degree, τ and t represent the corporate tax and the property tax respectively. However, the marginal corporate tax rate often differs substantially from the average corporate tax rate. We interpret τ to equal the marginal corporate tax rate, while t is assumed set so as to produce the correct average tax rate from both corporate and property taxes together.[6]

With these taxes, when K_j is invested in the jth type of capital, it produces an after corporate and property tax income of R_j^* where

$$R_j^* = (1-\tau)\ (f_j\theta_j + h_j - tK_j)\ . \tag{12}$$

The new market value of this capital will be denoted by V_j^*. As before, we assume that firms invest in this capital until the market value of the after tax return to a dollar additional investment just equals one. Also as before, the residual amount $V_j^* - K_j$ is divided among the initial owners of the firm.

When an individual now invests in bonds and stocks, his second period income will equal

$$C_i^2 = (1+(1-m)r^*)D_i + \sum_{j=1}^{J} s_{ij}\left[(1+(1-c)\pi)K_j + (1-e)R_j^*\right] + T_i \tag{13}$$

where r^* denotes the new equilibrium interest rate, and where T_i is the lump sum transfer

6. For example, let us introduce an investment tax credit at rate k. Also, let the true depreciation rate be d while the allowed tax depreciation rate is d_t. Gross returns to capital, when K_j is invested, will now equal $f_j\theta_j + h_j + dK_j$. The return to capital after true depreciation, property taxes, and corporate income taxes, would now be

$$(f_j\theta_j+h_j+dK_j) - dK_j - tK_j - \tau(f_j\theta_j+h_j+dK_j-d_tK_j-tK_j) + kK_j$$
$$= (1-\tau)[f_j\theta_j+h_j - (t+\frac{\tau(d-d_t)-k}{1-\tau})\ K_j]\ .$$

Comparing this to equation (12) in the text, we see that this more complicated set of tax provisions is equivalent to a corporate income tax at rate τ and a property tax at rate $t + \frac{\tau(d-d_t)-k}{(1-\tau)}$

received by the individual in period 2. The individual's budget constraint is

$$C_i^1 + D_i + \sum_{j=1}^{J} s_{ij} V_j^* = W_i + \sum_{j=1}^{J} \bar{s}_{ij} (V_j^* - K_j) . \tag{14}$$

Solving again for the first-order conditions characterizing the individual's optimal choices, we find

$$EU_{i1} = (1+(1-m)r^*)\, EU_{i2} \tag{15a}$$

$$E\left[\left((1+(1-c)\pi)K_j + (1-e)R_j^* - (1+(1-m)r_j^*)\,V_j^*\right)U_{i2}\right] = 0 \text{ for all } j. \tag{15b}$$

Substituting for R_j^* as before, we obtain

$$f_j \bar{\theta}_j + h_j = tK_j + \frac{(1-m)r^* - (1-c)\pi}{(1-e)(1-\tau)} K_j + \frac{(1+(1-m)r^*)}{(1-e)(1-\tau)} (V_j^* - K_j) \tag{16}$$
$$- f_j \frac{E[(\theta_j - \bar{\theta}_j)U_{i2}]}{EU_{i2}} \quad \text{for all } j .$$

A dollar marginal investment in any of the J firms must still be valued at a dollar both by the market and by each individual. This is true since the distribution of the after tax return from a marginal investment is identical to the distribution of the combined after tax returns from an amount $\frac{f_j' V_j^*}{f_j}$ invested in stock of the jth firm and an amount

$$A = \frac{1}{f_j(1+(1-m)r^*)} \left[(1-e)(1-\tau)(f_j h_j' - f_j' h_j + t f_j' K_j - t f_j) + (1+(1-c)\pi)(f_j - f_j' K_j)\right],$$

lent to other individuals. This implies that the market value of the latter portfolio must equal one dollar, so that $\frac{f_j' V_j^*}{f_j} + A = 1$. Substituting for A, it follows that

$$\frac{(1+(1-m)r^*)}{(1-e)(1-\tau)} (V_j^* - K_j) = \left(\frac{f_j}{f_j'} - K_j\right)\left(t + \frac{(1-m)r^* - (1-c)\pi}{(1-e)(1-\tau)}\right) - \frac{h_j' f_j}{f_j'} + h_j . \tag{17}$$

Since each individual is willing to pay just one dollar for the returns from the marginal investment in the jth firm, it follows that

$$E\left[\left((1+(1-c)\pi) + (1-e)(1-\tau)(f_j'\theta_j + h_j' - t) - (1+(1-m)r^*)\right)U_{i2}\right] = 0 . \tag{18}$$

This implies that

$$\bar{\rho}_j = f_j'\bar{\theta}_j + h_j' = t + \frac{(1-m)r^* - (1-c)\pi}{(1-e)(1-\tau)} - f_j' \frac{E[(\theta_j - \bar{\theta}_j)U_{i2}]}{EU_{i2}} . \tag{19}$$

The equilibrium with these taxes and transfers can be characterized by the joint solution of equations (13), (14), (15a), (16), (17), and (19), along with equation (7). Taxes enter these equations in many ways, so clearly this equilibrium will differ in general, and in complicated ways, from the equilibrium without any taxes. However, as shown above in a mean-variance setting, there are conditions under which the equilibrium allocation remains precisely unchanged in spite of the various taxes. In particular, we can prove the following theorem:

Theorem: Imposing property taxes as well as corporate and personal income taxes on corporate income, with the revenue returned in a lump sum fashion to individuals, will not affect the equilibrium values for the C_i^1 and K_j, or the distribution of values for the C_i^2, as long as the following conditions are satisfied:

a) $(1-e)(1-\tau)t + (r-\pi)(\tau+e(1-\tau)) + c\pi = 0$

b) $T_i = (\tau+e(1-\tau))\sum_{j=1}^{J} \left[(V_j-K_j)(\bar{s}_{ij}-s_{ij}) + s_{ij}(R_j-(r-\pi)K_j)\right]$, evaluated at the values for s_{ij} and K_j in the no tax equilibrium.

Proof: In order to prove this theorem, we will show that at the equilibrium prices

$$r^* = \frac{r}{1-m} \text{, and} \tag{20a}$$

$$V_j^* = K_j + (1-e)(1-\tau)(V_j - K_j) , \tag{20b}$$

the set of equations (7), (13), (14), (15a), (16), (17), and (19), together characterizing the equilibrium with taxes, are all satisfied at the values for C_i^1 and K_j, and the distribution of values for C_i^2, implied by the no tax equilibrium, whenever conditions (a) and (b) from the theorem are both satisfied. In addition, we will show that the same number of firms J will choose to go public with and without taxes. These results are sufficient to prove the theorem. In doing so, we find that the equilibrium values for the s_{ij} remain unchanged, but the equilibrium values for D_i do change.

As a first step, it is straightforward to verify that if the values for C_i^1, s_{ij}, and K_j remain unchanged, then the distribution of C_i^2 implied by equations (13) and (14) with taxes is identical to that implied by equations (3) and (4) without taxes, given conditions (a) and (b) and equations (20a) and (20b). Condition (b) is designed so as to ensure this result. (The tedious algebra is left to the reader.) This result implies that the equilibrium C_i^1 and C_i^2 when there are no taxes remain just feasible for each individual when there are taxes. Since V_j^* and V_j are not equal, we see comparing equations (14) and (13) that the values for D_i cannot be the same, however.

If C_i^1 and C_i^2 remain unchanged, then it follows that EU_{i1}, EU_{i2}, and $E[(\theta_j-\bar{\theta}_j)U_{i2}]$ all remain unchanged. Given this result and equation (20a), it follows immediately that equation (15a) will be satisfied whenever equation (5a) is satisfied. In addition, given condition (a), equation (19) will also be satisfied whenever equation (11) is satisfied.

In the case of equation (16), condition (a) and equation (20a) imply that $tK_j + \frac{(1-m)r^*-(1-c)\pi}{(1-e)(1-\tau)}K_j = (r-\pi)K_j$. Equations (20a) and (20b) imply that $\frac{(1+(1-m)r^*)}{(1-e)(1-\tau)}(V_j^*-K_j) = (1+r)(V_j-K_j)$. Together these results imply that equation (16) is satisfied whenever equation (6) is satisfied.

Comparing equation (17) with equation (9), we see that when condition (a) holds, the right-hand side of the two equations are equal as long as K_j remains unchanged. But equations (20a) and (20b) imply that the left-hand sides must be equal. Therefore, equation (17) will also be satisfied at the no tax allocation and at the proposed prices.

The last equation to be checked is equation (7). As noted, the values of D_i will differ between the two allocations. However, if we solve for D_i using equation (14) and then add across individuals, we find that

$$\sum_{i=1}^{I} D_i = \sum_{i=11}^{I}(W_i-C_i^1) - \sum_{j=1}^{J} K_j$$

since $\sum_{i=1}^{I}\bar{s}_{ij} = \sum_{i=1}^{J}s_{ij}=1$. The same expression is implied by equation (3), implying that equation

(7) is satisfied at the proposed allocation in the equilibrium with taxes, since it is satisfied in the equilibrium without taxes. Therefore, all the first order conditions characterizing the equilibrium with taxes are satisfied at the no tax equilibrium values for C_i^1, C_i^2, s_{ij}, and K_j, and at the proposed prices in equations (20a) and (20b).

We next show that the government budget is balanced. Government revenues, collected from property taxes, corporate income taxes, and personal taxes, equal

$$\sum_{j=1}^{J} tK_j + \sum_{j=1}^{J} \tau(R_j - tK_j) + \sum_{i=1}^{I} \left[m\ D_i r^* + \sum_{j=1}^{J} (c\,\pi K_j + e(1-\tau)(R_j - tK_j)) \right] . \tag{21}$$

Using equations (7) and (20a), this simplifies to

$$(\tau + e(1-\tau)) \sum_{j=1}^{J} (R_j - (r-\pi)K_j) . \tag{22}$$

Total transfers, however, equal

$$\sum_{i=1}^{I} T_i = (\tau + e(1-\tau)) \sum_{j=1}^{J} (R_j - (r-\pi)K_j)$$

since $\sum_{i=1}^{I} s_{ij} = \sum_{i=1}^{I} \bar{s}_{ij} = 1$. Since revenues equal transfers, the budget is balanced.

As a final step, we show that the same number of firms choose to go public. A firm will go public with no taxes if and only if $V_j - K_j \geq 0$. But equation (20b) implies that $V_j^* - K_j$ is proportional to $V_j - K_j$, so when one is non-negative the other is non-negative. Therefore the same set of J firms will choose to go public with and without taxes. Q.E.D.

Before proceeding, let us return briefly to confirm that the firm, when it chooses K_j so as to maximize $V_j^* - K_j$, is in fact acting in the interests of its shareholders. If initial owner i were to choose the value of K_j best for him, he would choose that value maximizing his utility, taking into account the effects on V_j^* but taking other prices as given. The resulting first-order condition would be:

$$E\left\{ \left[(1+(1-m)r^*)(\bar{s}_{ij}(V_j^{*'}-1) - s_{ij}V_j^{*'}) + s_{ij}((1+(1-c)\pi) + (1-e)R_j^{*'}) \right] U_{i2} \right\} = 0 . \tag{23}$$

Denote the value of $V_j^{*'}$ at his preferred choice for K_j by v_j. If the returns from the marginal investment are valued at v_j in the market, however, then individual i will also value these returns at v_j (since the pattern of returns is within the span of those available from marketed securities). This implies that

$$E\left\{\left[((1+(1-c)\pi) + (1-e)R_j^{*'}) - (1+(1-m)r^*)v_j\right]U_{i2}\right\} = 0 . \tag{24}$$

Given equation (24), however, equation (23) simplifies to

$$E\left[(1+(1-m)r^*)\bar{s}_{ij}(V_j^{*'}-1)U_{i2}\right] = 0 .$$

We conclude that the K_j for which $V_j^{*'} = 1$ is the optimal choice for any individual i. Therefore, all shareholders will want the firm to choose K_j so as to maximize $V_j^*-K_j$, the assumed policy. If all tax rates were set to zero, this result continues to hold.

Let us now explore the implications of the above theorem. Since tax revenues were returned in a lump sum fashion, the theorem gives assumptions under which taxation of capital income causes *no* efficiency loss whatever. Condition (b), while necessary to prevent any change in the equilibrium allocation, however, is not necessary to prevent any efficiency costs from the taxes. The equilibrium will certainly remain efficient with any alternative set of non-stochastic lump sum transfers. Redistributing the lotteries θ_j among individuals will also have no efficiency effect, as shown in Diamond (1967). Individuals trade freely in these lotteries, and will arrive at an efficient allocation of them regardless of government transfers.

The key assumption, therefore, implying that these taxes are nondistorting, is condition (a). This condition requires that no net tax revenues be collected from any risk free investment, which would earn a nominal rate of return in this case of $r=(1-m)r^*$. The parameter values used in the argument in section I just satisfy this condition. As in section I, however, the average tax rate can still be quite high. Equation (22) provides an expression for total tax revenues. Since real earnings to capital equal $\sum_{j=1}^{J} R_j$, the average tax rate in this economy would equal

$$(\tau+e(1-\tau))\left(1-\frac{(r-\pi)\sum_{j=1}^{J}K_j}{\sum_{j=1}^{J}R_j}\right).$$

The ratio $\sum_{j=1}^{J}R_j/\sum_{j=1}^{J}K_j$ is the average before tax real rate of return to capital. Feldstein and Summers (1977) estimate that for U.S. nonfinancial corporations, this rate of return has averaged .106 for the period 1948-1976. Using this estimate along with the parameter value assumptions from section I, the average tax rate would be .662. Since

$$\left\{E\left[\sum_{j=1}^{J}R_j/\sum_{j=1}^{J}K_j\right]\right\}^{-1} < E\left[\sum_{j=1}^{J}K_j/\sum_{j=1}^{J}R_j\right],$$

the expected average tax rate would in fact exceed .662.

Expected tax revenues, from equation (22), equal

$$(\tau+e(1-\tau))\sum_{j=1}^{J}(ER_j-(r-\pi)K_j).$$

Substituting from equation (16) for ER_j, and simplifying using condition (a) and equations (20a) and (20b), we conclude that expected tax revenues can be expressed as[7]

$$(\tau+e(1-\tau))\sum_{j=1}^{J}\left\{(1+r)(V_j-K_j)-f_j\frac{E[(\theta_j-\bar{\theta}_j)U_{i2}]}{EU_{i2}}\right\} \tag{25}$$

Therefore tax revenues in effect come from a tax on pure profits plus a tax on the risk premium. The pure profits tax is clearly nondistorting. The tax on the risk premium leaves incentives unaffected, as in section I, because the government provides just offsetting benefits to investors by absorbing the same fraction $(\tau+e(1-\tau))$ of the risk in the return from the investment.

We therefore conclude that taxes on capital income are distorting in this model only to the degree that the total taxes paid from the returns to a risk free investment are non zero. If these taxes are negative, then the tax law provides a net stimulus to savings and investment,

7. Note that the last term in equation (25) has the same value for all i, since equation (16) holds simultaneously for all i.

even though the average tax rate can still remain very high. If the parameter value assumptions made above are close to correct, then the net distortion is at least very small.[8]

The net distortion also depends in unexpected ways on some of the tax rates. For example, if the tax rate e on equity income were larger than .16, then there would be a net *subsidy* to savings and investment. Similarly, if the marginal corporate income tax rate is higher than .5, then there is also a net subsidy. These counterintuitive results arise because taxable income $(r-\pi-t)$ on a risk free investment is negative,[9] given the other assumed parameter values. In either case, however, total tax revenue should go up, as seen in equation (21).

III. Exploration of Underlying Assumptions

The model in section II, while in some ways very general, still contains many restrictive assumptions. In this section, we will briefly explore how the results are affected if several of these assumptions are relaxed. We will find, as we relax assumptions, that the taxation of capital income can well result in an efficiency gain.

A. Introduction of Noncorporate Investment

In the above model, all capital was assumed to be in the corporate sector. Let us now introduce a noncorporate sector with J_n active firms.[10] When the amount of capital K_j^n is invested by the jth noncorporate firm, the real return in period two will be $f_n^n(K_j^n)\theta_j^n + h_j^n\,(K_j^n)$. For simplicity, let each firm be owned by one individual. Without loss of generality, let the owner of firm j be individual j.

Let us first recharacterize the no tax equilibrium with these additional firms. The proprietor of firm j has to decide how much of his wealth to invest in the capital stock of his firm. The first order condition characterizing his optimal choice is

$$E\left[(f_j^{n'}\theta_j^n - h_j^{n'} + (1+\pi)-(1+r))U_{j2}\right] = 0 \tag{26}$$

8. Recall, however, that to the degree that the average corporate income tax rate is below the marginal rate, then the appropriate estimate for t ought to be smaller, suggesting a net subsidy to savings and investment.

9. Recall that $r = (1-m)r^*$, where r^* is the nominal market interest rate, with taxes.

10. Firms are assumed to be corporate or noncorporate by fiat, and not by choice.

which implies that

$$f_j^{n'}\bar{\theta}_j^n + h_j^{n'} = r - \pi - f_j^{n'}\frac{E[(\theta_j^n - \bar{\theta}_j^n)U_{j2}]}{EU_{j2}} \tag{27}$$

While equation (26) is identical in form to equation (11), it holds only for individual j, and not for all individuals. Risk from noncorporate capital is borne entirely by the proprietor, while proportional shares in the risk from corporate capital are distributed efficiently across individuals.

Let us now reexplore how the equilibrium conditions would be different when taxes exist. Assume that noncorporate firms face a property tax rate t_n, and that proprietors have a personal income tax rate n on real income from their firm, and a personal tax rate c_n on inflationary capital gains. Now, the first order condition for the proprietor's investment decision is

$$E\left\{\left[(1-n)(f_j^{n'}\theta_j^n + h_j^{n'} - t_n) + (1+(1-c_n)\pi) - (1+(1-m)r^*)\right]U_{j2}\right\} = 0 \tag{28}$$

which implies that

$$f_j^{n'}\bar{\theta}_j^n + h_j^{n'} = t_n + \frac{(1-m)r^* - (1-c_n)\pi}{(1-n)} - f_j^{n'}\frac{E[(\theta_j^n - \bar{\theta}_j^n)U_{j2}]}{EU_{j2}} \tag{29}$$

For this tax structure to leave the equilibrium unaffected, it is easy to show that the following conditions, in addition to those in the previous theorem, must be satisfied:

a1) $t_n(1-n) + n(r-\pi) + c_n\pi = 0$

b1) The lump sum transfer to individual j must be larger by $n(f_j^n\theta_j^n + h_j^n - (r-\pi)K_j^n)$

Three interesting conclusions follow from this. First, capital will normally be misallocated between the corporate and noncorporate sectors, since the first two terms on the right hand sides of equations (19) and (29), which measure the value of the marginal product in each sector net of risk bearing costs, will differ in general. However, the nature of the resulting misallocation of capital will likely be counterintuitive. For example, assume that $t_n = t$ and $c_n = c$ but $n < \tau + e(1-\tau)$, so that proprietors face a lower net tax rate on real income. Then with our previous parameter assumptions (which imply that $r-(1-c)\pi = (1-m)r^* - (1-c)\pi < 0$), the tax law would induce capital to flow *out of* the noncorporate sector *into* the corporate sector.[11]

Second, if proprietors were given the option of incorporating, their choice would be surprisingly complicated. Let us assume that the only tax difference is that $n < \tau + e(1-\tau)$, and consider whether the proprietor's utility goes up when n is increased. The derivative of his utility with respect to n equals

$$-E\left[(f_j^n\theta_j^n + h_j^n - tK_j^n)U_{j2}\right].$$

Using equation (28), this can be reexpressed as

$$-E\left\{\left[(f_j^n\theta_j^n + h_j^n) - (f_j^{n'}\theta_j^n + h_j^{n'})K_j^n + \frac{(1-m)r^* - (1-c_n)\pi}{(1-n)}K_j^n\right]U_{j2}\right\}$$

We find that there are two offsetting aspects affecting the proprietor's decision. The difference between the first two terms reflects the pure profits earned by the firm. These profits would be taxed at a higher rate were the firm to incorporate, thus discouraging incorporation. (Of course, if the firm were in a competitive industry with free entry, then pure profits would be zero.) Whether the increased tax rate on *normal* profits is a net cost or a net benefit depends on whether the real before tax risk free return (the last term) is positive or negative. Any extra taxes paid on the risk premium are entirely offset by the fact that the government also absorbs more of the risk. With the above parameter value assumptions, the before tax risk free return is negative, so the higher tax rate is a net gain. Therefore, in general, the proprietor's optimal choice would depend on the characteristics of his profit function as well as on the tax rates.[12]

Third, condition (b1) above prevents any redistribution of the risk in the return from noncorporate capital. This risk, however, is *not* distributed efficiently initially. Therefore, the government can create an efficiency gain by redesigning the lump sum transfers so as to shift the risk from a noncorporate firm away from the proprietor. The higher the tax rate n, the more of the risk the government can reallocate, so the larger the potential efficiency gain.

11. This occurs because the first two terms on the right hand side of equation (29) exceed those in equation (19) with taxes, but are equal without taxes.

12. This analysis ignores any gains to incorporation from public trading of equity, and the resulting sharing of risk by a larger group of individuals.

A high tax rate n can cause condition (a1) to be substantially violated, however, distorting noncorporate investment decisions. This counterbalancing cost can be lessened (or even eliminated), however, by suitable readjustment of the tax rate t_n. Recall that t_n incorporates effects from the difference between the marginal and the average personal income tax rates, as well as from property taxes. Therefore, if the net tax rate on the left hand side of condition (a1) is positive, at any given n, investment tax credits or a more liberal tax depreciation policy can be introduced so as to lower t_n. This lessens the violation of condition (a1) while maintaining n, and so the potential for redistributing risk in a more efficient manner.[13]

B. Inefficient Distribution of Corporate Risk

We have assumed so far that corporate risk would be allocated efficiently by the private market, with or without taxes. Therefore, unlike in the situation with noncorporate risks, the government has no potential to improve on the allocation of corporate risk. However, there is some reason to presume that the private sector has not distributed this risk efficiently. According to the *Statistics of Income* for 1977, only 15.5% of tax returns reported any dividend income whatsoever, and only 10.6% reported dividend income exceeding the exempt amount of $200 for married couples and $100 for single individuals. Yet, in the above model, the optimal value of s_{ij} for an individual would almost always be nonzero.

Why then do such a large percent of the population not own stock? Much of the explanation probably lies in the standard forms of market "imperfections." Trading itself is costly, and the percentage cost is higher for small trades. In addition, the minimum trading size - one share - may be large relative to an individual's desired holding. (Index funds now lessen this problem.) Individuals also face borrowing constraints, preventing them from buying stock when their *current* wealth, ignoring expected future earnings, is too small. Moral hazard problems presumably inhibit lenders from providing funds to such people, since future earnings cannot be used as collateral. Market institutions undoubtedly develop so as to minimize the importance of these problems, but do so conditional on the true resource costs involved in running a

13. One further problem, however, is that n is also the tax rate on the labor income to the proprietor, inhibiting the use of a high n to redistribute risk.

market, and on the statutory regulations governing individual bankruptcies.

If the government, however, faced no such costs in reallocating risk, or at least lower costs than the private sector, then it could potentially create an efficiency gain by shifting risk towards those who face a trading constraint preventing them from reaching the optimal amount of risk bearing.[14] As with taxation of noncorporate income, the incentive would be to set a high corporate income tax rate, so that a large part of the risk goes to the government, to be reallocated hopefully towards those who can bear it more cheaply. Any resulting distortions to investment incentives can then be corrected by suitable changes in the nonstochastic components of the tax structure, such as the investment tax credit or tax depreciation policies.[15]

For this to be worthwhile, however, the government must face lower costs than the private sector in reallocating risk. One situation where the government should clearly find it cheaper is in the intergenerational reallocation of risk. In principle, efficiency would require that even unborn generations share in the risk in the return on existing capital. Yet these individuals do not trade currently in equity for the obvious reason that they are not yet alive. Also since they are not alive yet, there is no alternative way to set up a mutually beneficial contract ex ante to spread the risk across generations. If parents choose to leave bequests, or children choose to aid their parents, however, then the transfer can be adjusted to reflect the outcomes of current lotteries, without need of an ex ante contract. Otherwise, such sharing of risk is unlikely to occur through the private market.

The government can easily reallocate wealth across generations in this context through its debt management policy. When there is an unfavorable outcome, causing tax revenues to fall, it can run a deficit, creating government debt. This new debt replaces real capital in individual portfolios, implying a smaller capital stock available to following generations. By lowering their wage rate, and so their utility, this shifts some of the risk onto them. (Diamond (1965) develops this argument very generally in a nonstochastic setting.) Allowing the deficit to be sto-

14. If individuals face no constraint, however, then the government cannot create an efficiency gain by reallocating risk, even if risk is distributed inefficiently, since individuals will trade so as to undo any reallocation by the government.

15. Current tax credit and depreciation policy, however, distorts the firm's choice concerning the durability of its capital, as shown in Auerbach (1979) or Bradford (1980).

chastic is probably the main way in which the government does in fact handle stochastic revenue from capital income.

Thus this argument provides a rationale for high corporate tax rates, perhaps generous investment incentives, and a variable government deficit. It is intriguing that government policy has in fact evolved in this direction.

C. Variation in Corporate Tax Rates

So far, we have assumed that corporate and property tax rates are equal for all firms. What if these tax rates vary by firm? Introducing a noncorporate sector was in effect a special case of this.

Let us now assume that firm j faces a property tax rate t_j and a corporate income tax rate τ_j. Then, in equilibrium, equation (19) becomes

$$\rho_j = t_j + \frac{(1-m)r^* - (1-c)\pi}{(1-e)(1-\tau_j)} - f_j' \frac{E[(\theta_j - \bar{\theta}_j)U_{i2}]}{EU_{i2}} \tag{19a}$$

In general, the sum of the first two terms on the right hand side of equation (19a), which measures the marginal product of capital net of risk bearing costs, will vary by firm. Therefore, capital will indeed be misallocated across firms. However, if $(1-m)r^* < (1-c)\pi$, then capital will move *towards* those firms facing higher values for τ_j.

In the special case where $(1-m)r^* = (1-c)\pi$, we find that any variation in τ_j creates no additional distortions, so no reallocation of capital. More generally, the difference $(1-m)r^* - (1-c)\pi$ would normally be very much smaller than the risk premium. As a result, the implied percent distortion in the required marginal product of capital (the right hand side of equation 19a) would be very small, even with wide variations in τ. For example, with the parameter values from section I, the equilibrium ρ is .105. If, for any firm, the corporate tax were to be entirely eliminated, the equilibrium ρ increases to .119, a change of only 13.3%. Similarly, if any firm were to face twice as large a property tax rate, its equilibrium ρ would increase to .118, a change of just 12.4%.[16] We find that even very large changes in tax rates

16. Recall that ρ equals the value of the marginal product net of depreciation. The percent change in the value of the

should cause only modest changes in the allocation of capital.

Therefore, while variation in τ will still cause a misallocation of capital across industries, capital may well be shifted *towards* more highly taxed industries, and the degree of misallocation, and so the distortion costs, caused by the varying tax rates ought to be very small. These conclusions are in sharp contrast to those from certainty models, as in Harberger (1962).

D. Availability of Debt Finance

So far, we have assumed that firms use only equity finance. In allowing for debt finance, let us first assume that debt is riskless, and that all firms are constrained to maintain a debt-capital rate equal to γ. We can also assume, without loss of generality, that all investors buy a proportionate share in both the debt and the equity of the firm, since private lending is a perfect substitute for debt purchases.

The after personal tax return from a dollar marginal investment now becomes

$$(1-m)\gamma r^* + (1-e)(1-\tau)(f_j'\theta_j+h_j'-t-\gamma r^*) + (1+(1-c)\pi)$$

$$= (1-e)(1-\tau)\left[f_j'\theta_j+h_j'-(t-\frac{\tau+e(1-\tau)-m}{(1-e)(1-\tau)}\gamma r^*)\right] + (1+(1-c)\pi) \qquad (30)$$

Comparing this expression with the after personal tax return to capital in the previous model, we conclude that introducing risk free debt is equivalent to lowering the effective property tax rate, on the assumption that $m < \tau+e(1-\tau)$. This reduction in the effective t would cause there to be more savings and investment, and perhaps more than would have occurred without any taxes.

Allowing the firm to choose its debt-capital ratio, with debt becoming risky as a result, makes the model very much more complicated, as described in Auerbach-King (1979). In a mean-variance setting, however, the analysis remains straightforward. When risk is measured solely by the covariance of the return with that on the market portfolio, dividing the risk arbitrarily between debt and equity does not affect the total risk premium demanded by the market. Therefore, without taxes, the firm finds all debt-capital ratios equally attractive - the

marginal product gross of depreciation, the value of the physical marginal product of capital, would be yet smaller.

Modigliani-Miller (1958) conclusion. With taxes, we see from equation (30) that an increase in the debt-capital ratio γ causes an increase in the after tax rate of return received from a given capital stock. Therefore, considering tax effects alone, the firm would prefer to set the fraction γ equal to one.

If there is to be an internal optimum for the debt-capital ratio, extra costs must arise as the debt-capital ratio increases. At an internal equilibrium, these extra costs at the margin would just offset the tax advantage favoring debt finance. These extra costs are presumably real costs, and represent efficiency costs from the tax distortion favoring debt finance.

Introducing the possibility of debt still lowers the cost of capital to the firm, however. The debt-capital ratio would be chosen so as to minimize the cost of capital. At equilibrium, the tax advantages of further debt would just be outweighed by real leverage costs from further debt.[17] However, the real leverage costs are true costs created by extra investment, which ought to be taken into account for efficient investment incentives, while the tax inventive to use debt artificially lowers the cost of capital to the firm from that calculated assuming solely equity finance. Therefore, the initial analysis above, where the firm used a fixed debt-capital ratio γ, provides a full description for how taxes distort investment incentives. The only needed change to the formula when debt is risky is to add a leverage cost term comparable to the risk premium term, each measuring real costs created by the investment.

IV. Conclusions

By treating uncertainty and inflation explicitly in modelling the effects of taxes on capital income, we have produced conclusions sharply at variance with those in earlier papers, where uncertainty and inflation are ignored. The principle contrasting conclusions are:

1) Many previous papers suggest that taxes on corporate income cause the amount of corporate capital to fall to an inefficiently low level. We find that the amount of corporate capital is largely unaffected by these taxes, and may well have increased.

17. DeAngelo-Masulis (1980) and Miller (1977) argue that as more debt is used, the tax advantage to debt erodes. The argument in the text ignores, but is not incompatible with this possibility.

2) Many previous papers suggest that taxes induce the noncorporate sector to expand relative to the corporate sector. We find that the opposite is likely, though only to a very small degree.

3) Many previous papers suggest that there are important efficiency costs created by the current level of taxation of capital income. This model suggests that at worst these distortion costs ought to be very small, and that there could well be an efficiency gain resulting from the taxes.

4) The tax policy change recommended in some previous papers has normally been to reduce sharply the tax rates on capital income, perhaps through a shift to a consumption tax. The tax changes suggested by the analysis in this paper would be to maintain high marginal tax rates on capital income, but then maintain adequate investment incentives though a suitable selection of such instruments as tax depreciation policy and the investment tax credit. Also, the government probably ought to react to the resulting variations in tax revenues by allowing the deficit to fluctuate. This paper therefore seems to provide justification for some aspects of current tax and debt management policies.

It should be pointed out, however, that the analysis in this paper ignores certain distortions created by the taxation of capital income. No attempt was made to estimate the efficiency costs created by the tax distortion favoring debt over equity finance, the tax distortion affecting the firm's choice for the durability of its capital, or the tax distortion affecting whether or not the firm chooses to incorporate. Also, the analysis ignored the variation in individual marginal tax rates. The resulting variation in individual marginal time preference rates reflects an inefficiency in the allocation of savings across individuals. What we did conclude is that with the current tax treatment of capital income, both the total amount of savings and the allocation of the resulting capital across firms should be close to efficient. Also, the reallocation of risk by the government may create an efficiency gain.

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