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DOUBLE TAXATION AND CORPORATE CAPITAL COST

by

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Abstract:

Several attempts have been made to determine the tax differential between the corporate and noncorporate sectors of the economy, implied by the present double taxation of corporate source income. A common feature of these studies is the assumption that the retention of corporate profits gives rise to capital gains on a one-for-one basis. By this assumption, the tax burden on retained earnings is identified with the tax on capital gains.

In view of the preferential tax treatment given to capital gains, it is, however, quite rational for a management to undertake investments that produce less than a dollar's worth of capital gains for the marginal dollar of retention. To establish this assertion and its implications for the firm's effective tax burden, a theoretical model of firm behaviour is introduced. Specifically, the cost of capital to a firm maximizing stockholders' wealth is derived, with due adjustments to the corporation income tax, stockholders' income tax and capital gains tax. In this way, the differential tax burden on corporate source income may be determined with explicit reference to the firm's cost of capital.

1. Introduction*

The corporate income tax has recently received much attention. Its efficiency costs and incidence have been analyzed. Prominent studies in this field include Harberger's pathbreaking article of 1962, creating a framework for a general equilibrium analysis of capital income taxation. The empirical analysis of the corporate income tax following upon Harberger [1962] has dealt with the size and character of the tax differential between capital income from the corporate and non corporate sectors. Rosenberg [1969], for instance, makes empirical estimates of the tax differential in the US economy, while other economists, including Bailey [1969] and Holland [1958], have developed formal measures for the tax differential against corporate earnings.

Bailey's analysis includes taxes paid directly by the shareholders, i e personal income tax on dividends and capital gains, as well as the corporate income tax. He holds that the total effective marginal tax rate on corporate earnings is the sum of the corporate tax rate, stockholders' marginal tax rate on dividends multiplied by the fraction of profits paid as dividends and the tax rate on capital gains (on an accruals basis) multiplied by the fraction of profits ploughed back into the firm.

Behind Bailey's method lies the simple assumption, that retained profits give rise to capital gains on a one-for-one basis. By this assumption, the tax burden on retained earnings is identified with the tax on capital gains.

Basically the same assumption - one dollar of capital gain for one dollar of ploughed back profit - has been used by several other economists, including Holland [1958], Slitor [1966], McLure [1975] and Break & Pechman [1975] in their attempts to determine the total tax burden on corporate earnings.

The assumption that the retention of corporate profits produces an equivalent rise of the market value of the firm's shares is not, however, a tenable starting point for an economic analysis of the tax differential between the corporate and the noncorporate sectors. In view of the preferential tax treatment given to capital gains (as demontrated by i.e. Bailey) it is,in fact, quite rational for a mangement, attempting to maximize the value of the firm in the portfolios of the stockholders, to undertake investments that produce less than a dollar's worth of capital gains for the marginal dollar of corporate retention.

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In this paper, we will introduce an explicit theoretical model of firm behavior. Specifically, we will derive the cost of capital to a firm maximizing stockholders' wealth taking into account (i) the corporation income tax recognizing the existence of accelerated depreciations for tax purposes, (ii) personal income tax on dividends and (iii) capital gains tax.

In section 2 we establish the assertions stated above about the one-to-one relation between corporate retention and capital gains. Section 3 derives the net cost of capital demonstrating i.a. the different costs to the firm of using retained earnings and new issues as sources of finance. The total effective marginal tax rates on capital income from the corporate and noncorporate sectors of the economy may then be determined in section 4 with explicit reference to the firms' costs of capital. We then go further by constructing numerical examples of the tax burden on corporate capital income as compared to noncorporate. In the last section, finally, the analysis is extended to appreciate the effects of recent schemes to mitigate double taxation of corporate source income on capital cost and tax differentials.

2. Shareholder taxation and stock valuation [1]

Define a rate of return, k_i, demanded by a stockholder on his financial investments in common stocks, net of all taxes. This rate of return can be seen as partially determined by what can be earned on, say, savings accounts or on government bonds after tax. Call such a basic rate of return $\bar{p}$, exogenously given to the national economy by opportunities on capital markets in the world economy.

The rate of return demanded by the stockholder would then - disregarding risk - be $k_i = \bar{p}(1-\tau_i)$, where τ_i is the marginal income tax rate of the i:th stockholder. The value of a share in a company to the stockholder is then defined as the capital value of his cash flow from one common stock:

[1] In this article we disregard risk and uncertainty despite the fact that we deal with expectations of long run future developments.

It should be mentioned that personal taxes and corporate taxes have been introduced into models of stock values before, for instance by Stapleton [1972] and King [1974], mainly to study the effects of financia policies on the firm's stock value or derive criteria for the firm's optimal financial policy.

$$(1)\quad V_i(s) = \int_{t=s}^{\infty} [\tilde{U}(t)(1-\tau_i) - \gamma_i \tau_i \frac{d\tilde{V}(t)}{dt}] e^{-k_i(t-s)} dt.$$

Here $\tilde{U}(t)$ is the expected dividend per share and $\frac{d\tilde{V}(t)}{dt}$ the expected capital gain (or loss) at time t. Further γ_i is a parameter that takes care of the fact that only a fraction of capital gains are taxed as personal income and also that accrued capital gains are taxed only at the time of realization. The deferred capital gains tax, imposed at the time of realization, can always be transformed to a tax on the accrued gain if the holding period of the stock is known. Therefore $\gamma_i \tau_i$ is the annual effective rate (a "shadow rate") of capital gains taxation implied by the nominal rate of deferred capital gains taxation and the holding period.[1)]

The value of a share to the stockholder is then, according to (1), the capital value of the payment stream net of taxes generated by the share, when discounting is undertaken by $k_i(\tau_i)$. Now, to continue we will assume that we are dealing with the "representative stockholder" whose valuation of the share, $V_i(s)$ coincides with the market value, V(s). We therefore skip the index referring to individuals below and also let V(s) stand for the value of all shares, i.e. the value of the firm.

It can easily be shown from (1) that ploughing back of profits does not require a one-for-one dollar's worth of capital gains. To show this take the derivative of (1) with respect to the lower limit of integration, s, to get:

$$\frac{dV(s)}{ds} = kV(s) - [U(s)(1-\tau) - \gamma\tau \frac{dV(s)}{ds}]$$

which can be rearranged to:

$$(2)\quad k = \frac{U(s)(1-\tau) + \frac{dV(s)}{ds}(1-\gamma\tau)}{V(s)}.$$

Now, (2) can be seen as describing market equilibrium: The sum of dividends and capital gains net of taxes must be a fraction of the value of the firm equivalent to the stockholders' required rate of return, k. For kV(s) to stay constant, the following equation must hold:

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1) Confer Bailey [1969], p. 15 ff.

$$d[U(s)(1-\tau)] + d[\frac{dV(s)}{ds}(1-\gamma\tau)] = 0$$

implying the marginal rate of substitution of dividends for capital gains as:

$$\frac{d[\frac{dV(s)}{ds}]}{d[U(s)]} = -\frac{1-\tau}{1-\gamma\tau}.$$

Thus it would be worthwhile to reallocate profits from distribution to retention as long as the absolute amount of the marginal rate of substitution is larger than the ratio of the after tax part of a dollar of dividend income to the after tax part of a dollar of capital gain.

Because $\gamma < 1$, reflecting the preferential tax treatment of capital gains, this marginal rate of substitution is smaller than one:

$$(1-\tau)/(1-\gamma\tau) < 1.$$

Shareholders would be prepared to give up more than a dollar of dividends for retention to obtain a dollar of capital gain. For the analysis of "marginal total" tax rates on corporate profits, therefore, it is not justified - as done by Bailey et al - to presuppose equivalence of the amount of retention and capital gains.[1)]

Now let us introduce issues of new common stocks into the model. The cash flow to stockholders in (1) is thereby altered so that the value of the firm now is:

$$(3)\quad V(s) = \int_{t=s}^{\infty} \{U(t)(1-\tau) - \gamma\tau[\frac{dV(t)}{dt} - N(t)] - N(t)\}\, e^{-k(t-s)}dt.$$

1) Bailey's empirical analysis (op cit) of capital gains compared with retention in Table 1, p.18 and Appendix A does not - in our opinion - give an unambiguous support of his assumption, and that also goes for other studies (surveyed by Break [1969]) of the same problem. Furthermore, our proposition is not "tested" by Bailey's data because we only discuss a marginal condition, whereas Bailey's data on capital gains and retention concern totalities. Even if our marginal condition is fulfilled, capital gains on intramarginal retentions can drive the ratio of total capital gains to total retention to a figure equal to or greater than one. Nevertheless, it is wrong to assume this ratio to be equal to one for the analysis of effective marginal tax rates.

In (3) N(t) is the proceeds of new stock issues. The above model expresses how the firm is valued - in principle - by rational investors on the market. As seen from (3) marginal personal income taxes on current income and the marginal tax rate on capital gains are very much involved in the pricing of stocks.

To simplify (3) take the derivative with respect to the lower limit of integration, s. By integrating and rearranging terms, the stock value, V(s), can be written as [1)]

$$(4)\quad V(s) = \int_{t=s}^{\infty} \left[\frac{1-\tau}{1-\gamma\tau} U(t) - N(t)\right] e^{-\frac{k}{1-\gamma\tau}(t-s)}\, dt.$$

In the simplified valuation formula (4) the capital gains taxation is technically taken care of by an adjustment of the dividend stream and the rate by which it is discounted.

3. Corporate capital cost

Our purpose now is to go one step further and ask, given the above principle of valuation, what is the cost of capital to the firm, when not only personal income taxes are considered but also profit taxes. We proceed by defining U(t) and N(t) in (4).

To simplify, we will abstract from debt financing. Hereby, we focus on that part of business capital - equity capital - of which yields are treated differently in the corporate and noncorporate sectors of the economy. Including debt finance would not change the character of our results.[2)] Furthermore, we assume that the firm finances a constant

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1) Taking the derivative of V(s) with respect to s gives

$$\frac{dV(s)}{ds} = kV(s) - [\text{Integrand of (3)}].$$

After rearranging we get

$$\frac{dV(s)}{ds} = \frac{k}{1-\gamma\tau} V(s) - \left[\frac{1-\tau}{1-\gamma\tau} U(s) - N(s)\right].$$

From the solution of this differential equation we get expression (4) above.

2) Assuming debt finance would be introduced in such a way that the proportions of new issues and retained earnings in equity capital is not changed.

fraction, n, of its net investments by new issues of common stocks.[1]

Let P_K be the price of capital goods, K(t) the firms capital stock and I(t) its gross investment. Net investment is then, if a is a constant fraction to take account of capacity depreciation:

$$P_K(t)\frac{dK(t)}{dt} = P_K(t)[I(t) - aK(t)].$$

The amount of new issues, N(t), is then

$$N(t) = nP_K(t)\,[I(t) - aK(t)].$$

By these assumptions the volume of investment will be bounded at certain points in time by the fact that dividends in our formulation cannot be negative. To see the implication of this define dividends in the following way:

$$U(t) = P(t)F[K(t), L(t)] - W(t)L(t) - P_K(t)I(t) + nP_K(t)[I(t) - aK(t)] - \text{Taxes}$$

where P(t) is the output price, W(t) the wage rate and L(t) input of labor.

The bound on (net) investment can be expressed as:

$$(5)\quad (1-n)P_K(t)\,[I(t) - aK(t)] \leq P(t)F[K(t), L(t)] - W(t)L(t) - aP_K(t)K(t) - \text{Taxes},$$

i e that portion of the firm's net investments not financed by new issues, must not exceed the firm's profits, net of depreciation and taxes.

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1) In this paper, we do not attempt to explain why such a financial pattern is actually chosen. Rather, we pose the question, given the firm's financial behavior, what is capital cost?

To actually explain the firm's choice between retained earnings, new issues and debt, a more elaborate model would be required. Such a model would have to take into account e.g. the existence of positive dividends from firms having unexploited profitable investment opportunities and the often noted coexistence of dividends and issues of new stocks.

To compute the amount of taxes paid we have to introduce the book value, C(t), and depreciation for tax purposes, b, a constant fraction of the book value, C(t). The amount of profit taxes is then:

$$T\{P(t)F[K(t), L(t)] - W(t)L(t) - bC(t)\}$$

where T is the rate of corporate profit tax.

Substituting the above expression for dividends, new issues, and taxes into (4) and dropping time indices will give the market value of the firm as

$$(6)\quad V(s) = \int_{t=s}^{\infty} \left[\frac{1-\tau}{1-\gamma\tau} \{(1-T)\ [PF(K,L) - WL] - P_K I + \right.$$

$$\left. + n(P_K I - aP_K K) + T\,bC\} - n(P_K I - aP_K K) \right] e^{-\frac{k}{1-\gamma\tau}(t-s)}\, dt.$$

Assume now that the firm tries to maximize its value in stockholders' portfolios. Given this assumption, there is a lowest rate of return before taxes the firm can accept from a real investment in order not to lower the value of the stocks. This minimum rate of return we shall call the cost of capital. We look, then, for a necessary condition for real investments to be positive.

It should be pointed out again that the assumptions on financial behaviour used in our model mean that the investment plan will be bounded from above as seen from (5). We do not take this bound into account but treat the problem as if there were no bounds meaning that we study only free intervals, where bounds are ineffective[1].

We will simply assume that a solution exist, with a determinate firm size and a limited firm value (which would require the production function to exhibit diminishing returns to scale). Also, initial and transversality conditions can be disregarded.

Our simplified problem can now be handled by the calculus of variation method of maximizing Q in

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[1] Control problems with bounded investment plans have been studied by Appelbaum and Harris [1978] and before then by Arrow [1968].

$$Q = \int_s^\infty [M(t) + \lambda_1(I - \dot{K} - aK) + \lambda_2(P_K I - \dot{C} - bC)]\, e^{-\frac{k}{1-\gamma\tau}(t-s)}\, dt =$$

$$= \int_s^\infty f(K, \dot{K}, C, \dot{C}, I, L, t)\, dt$$

where $M(t)e^{-\frac{k}{1-\gamma\tau}(t-s)}$ is the integrand of (6) - the whole expression under the sign of integration - and where the time derivatives are written by putting a dot above the variables.

To compute capital cost we only need the following Euler necessary conditions for a maximum of (6), where we have set $\dot{\lambda}_1 = \dot{\lambda}_2 = 0$, to simplify from the outset[1]

$$\frac{\partial f}{\partial I} = [-\frac{1-\tau}{1-\gamma\tau}(1 - n)P_K - nP_K + \lambda_1 + \lambda_2 P_K]\, e^{-\frac{k}{1-\gamma\tau}(t-s)} = 0$$

$$\frac{\partial f}{\partial K} - \frac{d}{dt}\frac{\partial f}{\partial \dot{K}} = \{\frac{1-\tau}{1-\gamma\tau}[(1-T)PF'_K - naP_K] + naP_K - \lambda_1 a -$$

$$- \frac{k}{1-\gamma\tau}\lambda_1\}\, e^{-\frac{k}{1-\gamma\tau}(t-s)} = 0$$

$$\frac{\partial f}{\partial C} - \frac{d}{dt}\frac{\partial f}{\partial \dot{C}} = [\frac{1-\tau}{1-\gamma\tau}Tb - \lambda_2 b - \frac{k}{1-\gamma\tau}\lambda_2]e^{-\frac{k}{1-\gamma\tau}(t-s)} = 0.$$

Now, solve the second and third Euler equation above for λ_1 and λ_2 respectively and substitute into the first. By rearranging terms we get then, on the left hand side, PF'_K/P_K, the gross rate of return before taxes on real investment on the optimal path. This is the minimum gross rate of return that the firm can afford to earn on new investment while leaving shareholders no worse off, i e the gross cost of capital.

By subtracting from the gross cost of capital the rate of capacity depreciation, a, which by our assumption of "exponential decay", coincides with the rate of economic depreciation, we get the net cost of capital, r*:

$$(7)\quad r^* = \frac{kn}{(1-T)(1-\tau)} + \frac{k}{(1-T)(1-\gamma\tau)}\left[1 - n - \frac{T(b-a)}{\frac{k}{1-\gamma\tau} + b}\right]$$

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[1] The economic meaning of these assumptions is that all prices, including the wage rate, and tax rules (τ,γ,T and b) are expected to be constant.

For the interpretation of (7), let us first assume that b=a, i e the rate of tax depreciation equals the rate of capacity depreciation. Since n is the portion of the firm's investments financed by new issues, (1-n) is the portion financed by retained earnings, making the cost of capital a weighted average of the cost of new issues and the cost of retention. Thus, $k/(1-T)(1-\tau)$ can be identified as the cost of new issues, and $k/(1-T)(1-\gamma\tau)$ as the cost of retained earnings. Evidently, retained profits make up a less expensive source of equity capital than new issues, provided that $\gamma < 1$, i e capital gains are less heavily taxed than dividends in the hands of the shareholders.

If instead $b > a$, i e the firm is allowed to defer taxes through accelerated depreciation, the cost of retained earnings is weighted by

$$1 - n - \frac{T(b-a)}{\frac{k}{1-\gamma\tau} + b}.$$

This weight, in turn, is the portion of the firm's investment financed by ploughed back "true" profits net of tax. Thus, $b > a$ implies that a third part of capital growth, $T(b-a)/(\frac{k}{1-\gamma\tau} + b)$, is financed by deferred taxes, adding the weights up to one. However, this last cost of finance is zero and consequently does not show up in (7).

4. Tax and capital cost differentials

Having defined the net cost of capital r* to a firm maximizing stockholders' wealth, the marginal effective tax rate on corporate profits may be derived in a straightforward way.

By definition, r* is the rate of return before tax on an investment yielding the required rate of return k - that is $\bar{p}(1-\tau)$ - net of all taxes on stockholders' financial investment. The relation between r* and k, being determined by the tax system and the firm's financial policy, actually implies the existence of an effective marginal tax rate T_c^* on corporate profits, such that

$$r^*(1-T_c^*) = k.$$

Using the expression for r* given by (7), this means that

$$(8)\quad T_c^* = 1 - \frac{(1-T)(1-\tau)(1-\gamma\tau)}{n(1-\gamma\tau) + \left[1 - n - \frac{T(b-a)}{\frac{k}{1-\gamma\tau} + b}\right](1-\tau)}.$$

To clarify the meaning of (8), let us consider two special cases. Ruling out the possibility of defering taxes through accelerated depreciation (i e setting b=a), we will first assume that the firm finances its investments entirely through new issues (i.e. n=1). T_c^* then becomes

$$(9)\quad T_c^*\ (n=1,\ b=a) = T + \tau(1-T),$$

which means that the effective marginal tax rate would coincide with the total marginal tax rate - corporate and personal - on distributed profits.

Assuming instead that investments are financed exclusively by the retention of "true" profits (i.e. n=0, b=a), would cause (8) to collapse into

$$(10)\quad T_c^*(n=0,\ b=a) = T + \gamma\tau(1-T),$$

which in turn may be intuitively seen as the marginal tax rate on retained profits, determined by the corporate tax rate T and the tax rate on accrued capital gains, $\gamma\tau$.

Next, looking at the noncorporate sector, we assume that profits are fully taxed with the owners of equity as personal income, i.e. at tax rate τ. Ruling out, by this assumption, plough back and tax deferral as sources of finance, net capital cost for the non corporate sector, becomes

$$r_{nc}^* = \frac{k}{1-\tau}$$

i e the capital cost is simply the net rate of return demanded by the owner of equity, expanded to allow for the individual income tax. By definition, then, r_{nc}^* concides with $\bar{p}$, the rate of return exogenously given to the economy, as assumed at the outset.

Some numerical comparisons between marginal tax rates, T_c^* and τ - determining the tax differential - and between the capital costs, r_c^* and r_{nc}^* - indicating a capital cost differential - are presented in Table 1. Calculations are carried out on the assumption that $\bar{p}$ equals 10 % and include several alternatives regarding individual income tax rates. It should be pointed out that this table (as well as tables 2A and 2B on page 19) must be interpreted with care. Two interpretations are allowed, namely (i) that the household tax system is progressive and all shareholders are taxed at one of the marginal tax rates indicated in column one and (ii) that the household tax system is proportional. In this latter case column one indicates alternative tax rates of the proportional system.

The taxation of capital gains poses a special problem, since γ, expressing that fraction of each dollar of capital gain that must be declared as taxable income, is a rather complex entity, depending e.g. on holding periods. To approximate the effective tax burden on capita gains, prevailing e.g. in the US, we have chosen $\gamma=0.15$ throughout Table 1[1] The assumptions regarding n, T and b appear below.

The calculations presented in Table 1 indicate a differential tax burden on corporate source income varying from +50 % to some -13 % and a capital cost differential ranging from +10.0 to -3.9 percentage points, depending on the income levels of "the representative stockholders". These results largely agree with those presented by Bailey and others.[2]

Our analysis is different from previous studies, therefore, mainly by being based on an explicit model of neoclassical firm behavior rather than on an untenable assumption regarding the consequences of corporate retention. Furthermore, our approach makes it possible to appreciate the effects on capital cost and tax differentials of various schemes of fiscal policy, such as accelerated depreciation and the investment tax credit. By distinguishing between the rate of tax depreciation, b, and the rate of capacity depreciation, a, we have in fact hinted at how such measures may be handled.

5. Efficiency aspects

The analysis carried out above of the effective marginal tax rate on corporate profits and of the net capital costs in the corporate

1) Cf. Bailey, p.29 (op.cit) and Break & Pechman [1975], p.92.
2) See Bailey [1969].

Table 1. Marginal tax rates and net costs of capital in corporate and noncorporate sectors

Per cent

Marginal individual tax rate (τ)	Effective tax rate on corporate profits (T^*_c)	Tax differential ($T^*-\tau$)	Net cost of capital	
			Corporate sector (r^*_c)	Noncorporate sector (r^*_{nc})
0	50	50	20	10
30	53,9	23,9	15,2	10
50	57,4	7,4	11,7	10
60	59,6	-0,4	9,9	10
70	62,6	-7,4	8,0	10
80	67,2	-12,8	6,1	10

Special assumptions: $n = 10\ \%$, $T = 50\ \%$, $b = a$, $\bar{p} = 10\ \%$, $\gamma = 15\ \%$.

and noncorporate sectors is of obvious importance to much discussed questions about the efficiency of the investment process in the economy. Two aspects of efficiency are involved here.

First, there is the allocation problem between the corporate and noncorporate sectors, at stake in the writings of Harberger and others. Table 1 illustrates marginal tax rates and net costs of capital relevant to this question, making it clear that present tax regimes provide quite varying sets of inducements for reallocating capital between the sectors. Thus, the differential tax burden on corporate profits turns out to be a somewhat ambiguous concept, varying not only in size but also in sign between different income levels of the "representative shareholder".

Second, there is the question of the relative costs to the firm of using retained earnings, new debt or new issues as sources of finance. Baumol et al [1970] in their empirical study of earnings retention and growth of firm found the rate of return on new equity capital to be very much higher than the rate of return on either ploughback or new debt. These authors ran their explanation to these findings in terms of the transaction costs involved with different sources of finance. Our analysis, however, suggests that the firms' apparent preference for financing investments out of retained earnings also may be explained in terms of the tax differential between capital gains and dividend income.

Referring to page 9 above, the ratio between the cost of new issues and the cost of retention may be written[1]

$$\frac{r^*(n=1)}{r^*(n=0)} = \frac{1-\gamma\tau}{1-\tau}.$$

To appreciate the size of this tax effect, let the marginal individual income tax rate be 70 % (τ=0.7) and the effective tax burden on capital gains be 15 % of the individual tax rate (γ=0.15). Then $r^*(n=1)/r^*(n=0)$=2.98. Given a 15 per cent cost of new equity capital, it would thus be quite rational for the firm to accept a rate of return on the marginal dollar of retention of as little as 5.0 per cent. In fact, the differences in rates of return found by Baumol et al are not far outside the range of this example.

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[1] This ratio is equivalent to the marginal rate of substitution of dividends for capital gains, defined on p. 5.

6. Mitigating double taxation

The efficiency aspects touched upon here are the motivating forces behind the recent discussions in Europe and U.S. about integrating the personal and corporate income taxes. Serveral proposals have been put forth that tend to reduce the tax differentials between capital gains and dividend income and betweeen corporate source income and non-corporate income. This is accomplished by partially eliminating the "double taxation" of corporate dividends, which characterizes the tax regimes analyzed above.

Two different methods have been discussed in this context. One, referred to as the imputation credit system, places a reduction in the total tax burden on distributed profits at the shareholder level, while the other, called the split rate system, implies the use of a lower corporate tax rate for distributed earnings. The effects of these methods on capital cost and tax differentials between the corporate and non-corporate sectors of the economy will be studied below. Furthermore, in this section, we will demonstrate the workings of the special scheme used in Sweden to reduce the cost of new equity capital.

The split rate system, used e.g. in Japan and West Germany, can be described as follows. Let T^d and T^r be the corporate tax rates on distributed and retained profits, respectively, and $\Pi(t)$ be the firm's total taxable income. Assume as before that the firm distributes $U(t)$ to the shareholders. Since $U(t)$ is defined net of corporation tax, then $U(t)/1-T^d$ represents the firm's distributed profits before tax and $\Pi(t)-U(t)/1-T^d$ retained profits, also before tax. The corporation tax liability, due at time t, may then be expressed as

$$(11)\quad S(t) = \frac{T^d U(t)}{1-T^d} + T^r \left[\Pi(t) - \frac{U(t)}{1-T^d}\right] = T^r \Pi(t) - (T^r - T^d)\frac{U(t)}{1-T^d}$$

which makes it clear that a reallocation of profits from retention to distribution will reduce the firm's tax payments, provided $T^d < T^r$. Then, using the definition of $\Pi(t)$ implied on page 7, the effects of the split rate system on the stockholders' cash flow and the value of the firm may be determined by inserting (11) into (6).

According to the imputation system, used e.g. in France and the United Kingdom, part of the corporation tax paid by the firm on distributed profits is regarded as an advance payment on account of the shareholders' eventual income tax liability. Shareholders therefore receive a credit in their income tax assessments for part of the tax already paid by the corporation.

In order to describe the imputation system in a general way, it is convenient to introduce a parameter, ϕ, representing a "rate of tax credit" given to the shareholders. For the interpretation of ϕ we may note that full compensation to the shareholders for the corporation tax on dividends requires that $\phi = T$, i.e., the rate of tax credit should equal the corporate tax rate. Consequently, $\phi < T$ - as is the case for France and the United Kingdom - implies that shareholders are given credit only for part of the corporation tax.

According to this system, the dividends received, $U(t)$, would first be "grossed up" to $U(t)/(1-\phi)$, to represent a corporate pre-tax income behind the dividend. $U(t)/(1-\phi)$ is then interpreted as an imputed shareholder income, implying an income tax liability of $\tau \cdot U(t)/(1-\phi)$. For this amount, however, shareholders would receive a tax credit of $\phi \cdot U(t)/(1-\phi)$, reducing the income tax on the dividends to $(\tau-\phi)U(t)/(1-\phi)$.

After the deduction of $(\tau-\phi)U(t)/(1-\phi)$ from the dividends paid by the firm, there remains $U(t)(1-\tau)/(1-\phi)$ for the shareholders. The firm's objective function with due adjustment to the imputation system therefore becomes

$$(12)\quad V(s) = \int_{t=s}^{\infty} \left[\frac{(1-\tau)(U(t))}{(1-\gamma\tau)(1-\phi)} - N(t) \right] e^{-\frac{k}{1-\gamma\tau}(t-s)}\, dt$$

Having introduced the split rate system through expression (11) and the imputation system through expression (12), the analysis may be carried out in exactly the manner outlined in section 3. Ruling out - for simplicity - the possibility to defer corporate texes through accelerated depreciation, capital cost then becomes

$$(13)\quad r^* = \frac{kn}{\left[1-T^d-\frac{\tau-\phi}{1-\phi}(1-T^d)\right]} + \frac{k(1-n)}{\left[1-T^r-\gamma\tau(1-T^r)\right]}$$

The interpretation of (13) is the same as that of (7). Measures implemented to mitigate double taxation of dividend income, either through an imputation credit system ($\phi < 0$) at the shareholder level, or through a split rate system ($T^d - T^r$) at the corporate level, ceteris paribus, tend to lower the cost of new issues. Neutrality as to the firm's choice between new issues and retained earnings obviously requires that

$$(14)\quad T^d + \frac{\tau-\phi}{1-\phi}(1-T^d) = T^r + \gamma\tau(1-T^r),$$

which means that the total tax burden on distributed profits, the left-hand side of (14), equals what may intuitively be regarded as the total tax burden on retained profits. Clearly, fulfillment of condition (14) may be secured not only through a reduction in the total tax burden on dividends, but also through an increase in the rate of tax on capital gains, or on retained profits.

A third way of mitigating double taxation appears in Sweden. Putting it generally, Swedish firms are allowed to deduct against current profits over a period of w years a fraction α of the amount raised by issuing new shares. For analytical purposes, we shall assume that the subsequent savings in corporate taxes reduce the need for raising equity capital through new issues. Precisely, we assume that the firm finances a fraction n of its net investment by new share capital and the tax savings due to the special deduction. Our definition of $N(t)$, the amount of new issues (p.7), then changes into

$$(15)\quad N(t)[1+\beta] = nP_K(t)[I(t)-aK(t)]$$

where β is the present value of corporate tax savings from a \$ 1 issue of new share capital:

$$\beta = \int_0^w T\alpha e^{-kt}dt = \frac{T\alpha}{k}\left[1-e^{-wk}\right]$$

(15) means then that the firm's capital growth will be financed by new share capital and subsequent corporate tax savings in proportions

$n/(1+\beta)$ and $n\beta/(1+\beta)$.[1]

Using (15) and assuming as before that the rate of tax depreciation equals the rate of capacity depreciation (i.e. b=a), our expression for capital cost (cf. equation (7)) turns out

$$(16)\quad r^* = \frac{kn}{(1-T)(1-\tau)(1+\beta)} + \frac{k(1-n)}{(1-T)(1-\gamma\tau)} \cdot$$

The weight attached to the cost of new share capital now has changed into $n/(1+\beta)$, as explained above.

Tables 2A and 2B illustrate the effects on capital cost and tax differentials between the corporate and non-corporate sectors of the various schemes to mitigate double taxation outlined above. It should be pointed out, as may be seen from equation (13), that using the imputation credit system with $\phi = 0.33$ (as is approximately the case for France and the United Kingdom) is equivalent to reducing the rate of corporate tax on distributed earnings from 50 to 25 % (i.e. T^r = 50 %, T^d = 25 %). Furthermore, $\phi = 0.50$ has the same effect on capital cost as completely abolishing the corporate tax on distributed profits (i.e. T^r = 50 %, T^d = 0 %). For the understanding of the tables it must also be noted that $\phi = 0$ (the first columns) corresponds to the classical system of double taxation discussed above. The Swedish sheme, as represented by the last column, finally, includes a 5 % deduction against current profits of the amounts raised by new issues for a period of 10 years. Table 2A assumes n = 10 %, Table 2B n = 30 %.

Tables 2A and 2B make it clear that the alternatives discussed above to mitigate double taxation do not change the general pattern of tax and capital cost differentials between the corporate and non-corporate sectors of the economy, as already demonstrated by Table 1. $\phi = 0.33$, (cf France and the United Kingdom), implies a tax differential ranging from + 48 % to -17 %, when 10 % of capital growth is financed by new issues, and from +44 % to -8 % when n = 30 %.

Since the imputation credit system - as well as the split rate system - is designed to reduce the total tax burden on distributed earnings and therefore, the cost of new issues, the effect on tax- and capital cost differentials will be stronger the larger the share of capital growth financed by new equity capital. Thus, when n = 10 %

[1] Note that $n/(1+\beta) + n\beta/(1+\beta) = n$.

Table 2A Capital cost and tax differentials between the corporate and non-corporate sectors when mitigating double taxation

n = 10 %

Marg. individual tax rate (τ)	Rate of tax credit (φ)						Swedish system	
	0		0.33		0.50		α=0.05 ω=10	
	Δr*	ΔT*	Δr*	ΔT*	Δr*	ΔT*	Δr*	ΔT*
0	10.0	50.0	9.3	48.3	9.0	47.4	9.7	49.3
30	5.2	23.9	4.5	21.8	4.2	20.7	4.9	23.0
50	1.7	7.4	1.1	4.8	0.7	3.4	1.4	6.2
60	-0.1	-0.4	-0.8	-3.3	-1.1	-4.9	-0.4	-1.8
70	-2.0	-7.4	-2.6	-10.7	-2.7	-12.7	-2.3	-9.1
80	-3.9	-12.8	-4.6	-16.9	-4.9	-19.3	-4.3	-15.0

Note: Capital cost differentials are indicated by Δr*, tax differentials by ΔT*. The first column of the table which comes from Table is included for comparison. Special assumptions: see Table 1.

Table 2B Capital cost and tax differentials between corporate and non-corporate sectors when mitigating double taxation

n = 30 %

Marg. individual tax rate (τ)	Rate of tax credit (φ)						Swedish system	
	0		0.33		0.50		α=0.05 ω=10	
	Δr*	ΔT*	Δr*	ΔT*	Δr*	ΔT*	Δr*	ΔT*
0	10.0	50.0	8.0	44.4	7.0	41.2	9.2	47.9
30	6.3	27.0	4.3	20.9	3.3	17.2	5.3	24.4
50	3.6	13.1	1.6	6.8	0.6	2.7	2.6	10.3
60	2.2	7.1	0.2	0.6	-9.8	-3.7	1.1	4.1
70	0.7	1.9	-1.4	-4.5	-2.3	-9.0	-0.4	-1.2
80	-0.8	-1.8	-2.8	-7.8	-3.8	-12.4	-1.9	-4.8

Note: Capital cost differentials are indicated by Δr*, tax differentials by ΔT*.

putting ϕ=0.33 will eliminate roughly 1/3 of capital cost and tax differentials for "representative" shareholders in the 50 % bracket. Assuming instead, as in Table 2B, the share of new equity financing to be 30 % ϕ=0.33 will half tax and capital cost differentials in the same brackets.

The stimulus to increased reliance on financing by new share capital brought about though the imputation credit system and the special Swedish scheme is illustrated in Table 3. Referring to page 14, the table indicates the ratios between the (average) costs of new issues and the (average) costs of retention, on the assumption that the marginal individual income tax rate of the "representative" shareholder is 70 %.

Table 3 Relation between costs of new issues and retained earnings when mitigating double taxation

ϕ	$r^*(n=1)/r^*(n=0)$
0	3
0.33	2
0.50	1.5
Swedish system	2.4

As explained on page 14, a 5 % cost of retained earnings would correspond to a 15 % cost of new issues with full double taxation of corporate distributions (ϕ=0). Putting ϕ=0.33 (cf. the French and Brittish systems) the cost of new issues would fall to 10 %.

The Swedish system is at present less effective, implying a cost of new share capital of 12 %.[1]

[1] According to a recent proposal, α will be raised from 5 to 6 % and ω from 10 to 15 years. This implies $r^*(n=1)/r^*(n=0)$=2.2, i.e., a cost of equity of 11 %.

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