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A NOTE ON COST OF CAPITAL FORMULAS

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The purpose of the paper is to analyze the effects of the proposed reform of the Finnish capital income tax code on the user cost of capital. The analysis focuses on the proposed switch from a dividend deduction to an imputation system to eliminate the double taxation of dividends.

The novelty of the paper is its focus on some details in the tax code. Thus the effects of a »leaking» corporate tax system is analyzed as well as the effects of the minimum tax proposed to guarantee that dividends are taxed at least once.

1. *Introduction*

The recent debate on a reform of the Finnish corporate income tax system has at least to some extent centered around the question of how to eliminate the double taxation of dividends. It has been argued that the current system, which allows firms to make a dividend deduction,[1] is too »favourable» for the firms. This argument is based on the fact that the taxable income of the firm quite frequently is far smaller than the accounting profit, which can be used for paying dividends. This, again, is due to the fact that some sources of income are given tax preferred status (e.g. income from forestry, capital gains of the firm) or are totally tax exempt (eg. interest on delivery loans in metal industries, interest on investment fund deposits). As an alternative to the current dividend deduction system, the imputation system (avoir fiscal) has been proposed. The proposal includes a »minimum tax», a constraint on the firm's income tax liability which is designed to guarantee, that the firm actually pays the full corporate income tax on distributed dividends. The minimum tax is included in the proposal for two reasons:

(i) First, it has been argued that the minimum tax guarantees that distributed profits are taxed at least once. Since it is thought that the owner (dividend receiver) can *assume* that his gross dividend (G) is $G = \frac{D}{1-\tau}$, where D is net dividend and τ is the statuory corporate tax rate and that he is allowed to deduct the (*assumed*) income tax paid by the firm (τG) from his own income tax bill, the minimum tax guarantees that this assumption holds. This is an important aspect especially if the income tax base of the firm is narrow (if the firm can distribute untaxed income).

(ii) Second, it has been argued that the minimum tax prevents tax incentives (fast depreciation for tax purposes, the accumulation of reserves etc.) to be passed over to the owners. This argument is, of course, of less value. If corporate income is undertaxed, this

[1] *The firm is allowed to deduct 60 % of dividends paid from its taxable income in the state income taxation (100 % of dividends on newly acquired equity). In the calculations we assume that 80 % of dividends paid are deductible.*

means that the income of the owner is undertaxed as well, regardless of the form of undertaxation.[2]

The purpose of this paper, then, is to derive cost of capital formulas according to the present Finnish corporate tax system and according to the proposed new one. In doing this we make some effort to model first, the effects of tax exempt corporate income (differences between taxable and accounting profits) and second, the effects of the minimum tax.

The note is structured in the following way. In part 2 we outline the basic model assuming that a dividend deduction is used to eliminate the double taxation of dividends. In part 3 we derive the cost of capital formulas for the imputation system (avoir fiscal). In part 4 we present some cost of capital calculations. In part 5, finally, we present some concluding remarks.

2. *The Model with a dividend deduction*

2.1. *The valuation equation*

The money yield on the portfolio of an investor in the firm at time t (Y_t) is given by

(1) $Y_t = (1-m_d)D_t \quad -E_t \quad -t(\dot{V}_t - E_t).$

net dividend; increase in equity; cap. gains tax (nominal, accrual basis)

The owner can invest in alternative assets, which yield ρ, i.e.

(2) $\rho = (1-m_i)\, i$

where i is the nominal market interest rate.[3]

In order for the investor to acquire shares in the firm, he requires this investment to yield at least as much as the return from the alternative asset, i.e.

(3) $\rho V_t = Y_t + \dot{V}_t.$

Combining equations (1) and (3) we get

(4) $\dot{V}_t - RV_t + \frac{1-m_d}{1-t} D_t - E_t = 0,$

where $R = \frac{1-m_i}{1-t} i.$

A solution to the differential equation (4) is given by

(5a) $V_t = \int_t^{\infty} \left(\frac{1-m_d}{1-t} D_s - E_s\right) e^{-Rs} ds.$

Setting t = 0, we get

(5) $V_0 = \int_0^{\infty} \left(\frac{1-m_d}{1-t} D_s - E_s\right) e^{-Rs} ds.$

2.2. *The determination of dividends*

The financial constraint of the firm at time s is given by

(6) $p_s f(K_s) + \dot{B}_s + E_s = q_s I_s + iB_s + D_s + \tau\{\alpha p_s f(K_s) - \theta i B_s - Z_s - \beta D_s\}$

where

B_s = the stock of debt
E_s = new equity
K_s = the capital stock
I_s = gross investment
τ = the corporate tax rate
$f(.)$ = the production function[4]
p_s = the price of the firm's output
q_s = the price of investment goods
Z_s = depreciation allowances for tax purposes
α = the part of corporate income, which is included in the tax base
β = the dividend deduction
θ = the part of interest payments that is deductible for tax purposes.

From equation (6) we can solve for dividends paid. Doing this we get (leaving out the time-subscript)

(7) $D = \frac{1}{1-\beta\tau} \{(1-\alpha\tau)\, pf(K) - (1-\theta\tau) iB + \dot{B} + E - (qI - \tau Z)\}$

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[2] *This statement needs a reservation, however. It depends, of course, on whether capital gains are taxed or not.*

[3] *We usually assume that there is only one interest rate at which households can invest and firms borrow. An alternative assumption might be that $i_L = i_D + X$, where i_L is the interest rate at which firms can borrow (from the banking system), i_D is the yield on deposits and X is the (profit) margin of the banks. In this case $\rho = (1-m_i) i_D$.*

[4] *We assume, for simplicity, that capital is the only factor of production.*

2.3. *Derivation of the cost of capital*

In order to derive the cost of capital, we make the usual assumption that the firm chooses its investment policy as if it were maximizing the wealth of its owners (V_0). Hence, by combining equations (5) and (7), we get

$$\text{(8)}\quad \max_{\{I\}} V_0 = \int_0^\infty \Big\{\frac{1-m_d}{(1-t)(1-\beta\tau)}\big[(1-\alpha\tau)pf(K) - (1-\theta\tau)iB + \dot{B} + E - (qI-\tau Z)\big] - E\Big\} e^{-Rt}dt$$

$$\text{(9)}\quad \text{s.t. } \dot{K} = I - \delta K$$

where δ is the rate of »true» depreciation of the capital stock.[5]

In order to investigate the cost of capital and its dependence on the source of finance (in the spirit of King & Fullerton (1984)), we discuss the following cases[6]

(i) the firm finances all its investment *internally*. In this case we have $\dot{B} = E = B = 0$.

(ii) the firm finances (all) its investment by borrowing. In this case we have $E = 0$, $\dot{B} = \dot{q}K + q(I-\delta K)$, $B = qK$.[7]

(iii) the firm finances (all) its investment by issuing equity. In this case we have $\dot{B} = B = 0$, $E = \dot{q}K + q(I-\delta K)$.

At this stage it might be worthwhile to point out that borrowing (ii) and equity (iii) are not really pure modes of financing (the word all in parenthesis). In all three modes of financing (internal, borrowing and equity) deferred taxes are also used to finance the investment (if $\gamma > \delta$, $\dot{q}/q = 0$). Deferred taxes can be classified as internal financing but hardly as borrowing or equity financing.

In the case where the firm finances all its investment internally, equation (8) can be written as

$$\text{(8a)}\quad V_0 = \int_0^\infty \Big\{\frac{1-m_d}{(1-t)(1-\beta\tau)}\big[(1-\alpha\tau)pf(K) - (qI-\tau Z)\big] e^{-Rt}dt.$$

The current-valued Hamiltonian of the maximization-problem is given by[8]

$$\text{(10)}\quad \tilde{H} = \frac{1-m_d}{(1-t)(1-\beta\tau)}\big\{(1-\alpha\tau)\,pf(K) - q(1-\tau z)I\big\} + \tilde{\lambda}(I-\delta K).$$

The first-order conditions for a maximum require

$$\text{(11a)}\quad \frac{\partial\tilde{H}}{\partial I} = -\frac{q(1-\tau z)(1-m_d)}{(1-t)(1-\beta\tau)} + \tilde{\lambda} = 0$$

and

$$\text{(11b)}\quad \frac{\partial\tilde{H}}{\partial K} = -\frac{(1-\alpha\tau)(1-m_d)}{(1-t)(1-\tau\beta)}pf' - \delta\tilde{\lambda} = -\dot{\tilde{\lambda}}$$

Manipulations of equation (11) yield the (real) user cost of capital when internal finance is used (CR_I^D) as[9]

$$\text{(12a)}\quad CR_I^D \equiv \frac{pf'}{q} = \frac{1-\tau z}{1-\tau\alpha}(\delta + R - \dot{q}/q).$$

In the case where the firm finances all its investment by *borrowing*, the (real) user cost of capital (CR_B^D) can be shown to be

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[5] *At this point we make some simplifying assumptions, the most important of which is that the optimization yields an »interior» solution. thus we do not for example worry about negative dividends. For an elaboration, see eg. King (1974).*

[6] *For a similar technique, see Atle-Berg (1987).*

[7] *The case where the firm finances all its investment by borrowing requires that the value of the capital stock and the value of debt are equal, i.e.*

(i) $B = qK$.

Differentiating w.r.t. time yields

(ii) $\dot{B} = \dot{q}K + q\dot{K}$.

Using equation (9) in the text one gets the formula

(iii) $\dot{B} = \dot{q}K + q(I-\delta K)$.

A similar procedure is used for the case of equity finance.

[8] *In the maximization problem we assume that the firm always makes maximum depreciations in which case the present value of the depreciation charges for each investment project is given by* zqI, *where* $z = \frac{\gamma}{\gamma+R}$ *and* γ *is the maximum depreciation deduction allowed for tax purposes. See eg. Koskenkylä (1985).*

[9] *Alternatively, if product prices change as well as investment prices, we have (12'a)* $CR_I^D = \frac{1-\tau z}{1-\tau\alpha}\{\delta + R - \dot{p}/p - (\dot{q}/q - \dot{p}/p)\}$.

Assuming $\dot{q}/q = \dot{p}/p$, *i.e. that relative prices do not change, formula (12) holds.*

(12b) $$CR_B^D = \frac{1-\tau z}{1-\tau\alpha}(\delta + R - \dot{q}/q) + \frac{(1-\theta\tau)i - R}{1-\tau\alpha}.$$

In the case where the firm finances all its investment by issuing *equity*, finally, the (real) user cost of capital is

(12c) $$CR_E^D = \frac{1-\tau z}{1-\tau\alpha}(\delta + R - \dot{q}/q) + \frac{R}{1-\tau\alpha}\left(\frac{(1-\tau\beta)(1-t)}{1-m_d} - 1\right).$$

In order to get an intuitive feel for the user cost formulas in equation (12), we note that they can be written in the following more familiar form (assuming $\dot{q}/q = 0$ for simplicity).

(12a') $$CR_I^D = \delta + \frac{R}{1-\tau}\left(1 - \frac{\tau(\gamma-\delta)}{\gamma+R}\right) = \delta + \frac{1-m_i}{(1-t)(1-\tau)}i - \frac{R}{1-\tau}\frac{\tau(\gamma-\delta)}{\gamma+R}$$

(12b') $$CR_B^D = \delta + i - \frac{R}{1-\tau}\frac{\tau(\gamma-\delta)}{\gamma+R}$$

(12c') $$CR_E^D = \delta + \frac{(1-\tau\beta)(1-m_i)}{(1-\tau)(1-m_d)}i - \frac{R}{1-\tau}\frac{\tau(\gamma-\delta)}{\gamma+R}$$

From equation (12') we note that if the tax code does not allow the firm to defer tax payments ($\gamma = \delta$), the (financial) cost of capital [$CC_i^D = CR_i^D - \delta$] are the ones usually found in the literature [see eg. King & Fullerton (1984)]. If taxes are deferred, however, the (financial) cost of capital is decreased for *all* modes of finance. The firm then finances part of the investment with deferred taxes $\left(\frac{\tau(\gamma-\delta)}{\gamma+R}\right)$, the cost of which is zero. Since the *owners* requires a (gross) return on their investment of $\frac{R}{1-\tau}$, the required return on the »normal» mode of finance is reduced by $\frac{R}{1-\tau}\frac{\tau(\gamma-\delta)}{\gamma+R}$. Another way to relate the results of equation (12) [or (12')] to the results presented in the literature is as follows. Assume that the firm finances its investment by a (given) mix of the three (or actually four) modes of finance described above. The weights of the financial basket are assumed to be s_1 (borrowing), s_2 (equity) and $1-s_1-s_2$ (internal). The »total», weighted average (financial) cost of capital (CC_T^D) is then given by

(12'') $$CC_T^D = s_1 CR_B^D + s_2 CR_E^D + (1-s_1-s_2)CR_I^D = s_1 i + s_2\frac{(1-\tau\beta)(1-m_i)}{(1-\tau)(1-m_d)}i + (1-s_1-s_2-\frac{\tau(\gamma-\delta)}{\gamma+R})\frac{R}{1-\tau} + \frac{\tau(\gamma-\delta)}{\gamma+R}.\ 0.$$

The formula in equation (12'') is in fact the one that was presented in Koskenkylä (1985, p. 111, equation (4.27)) and in Bergström & Södersten (1982, equation (6)). The intuition of formula (12'') is the following. The firm uses a financial basket consisting of four parts and the total financial cost is a weighted average of the cost of the four parts. The cost of borrowing is the market interest rate (i), the cost of equity is $\frac{(1-\tau\beta)(1-m_i)}{(1-\tau)(1-m_d)}i$, the cost of taxed retained earnings is $\frac{R}{1-\tau} = \frac{(1-m_i)}{(1-\tau)(1-t)}i$, and the cost of deferred taxes is zero.

After relating our basic results to the results presented in the literature we proceed to analyze the Finnish tax system in some more detail.

2.4. *A neutral, nominalistic capital income tax system*

2.4.1. *The »traditional» solution*

The traditional neutral, nominalistic capital income tax system is derived in two steps. First we define the (nominal) income tax base of the corporation. Second we define alternative sets of tax parameters which make the tax system neutral.

The nominal income tax base of the corporation is defined as follows:

(i) tax deductible depreciation charges (γ) are equal to the »true depreciation» (δ) corrected for the change in the price of investment goods ($\dot{q}/q$) or

(13a) $$\gamma = \delta - \dot{q}/q.$$

Note that this requirement holds regardless of the inflation rate of product prices.

(ii) all nominal interest payments are deductible for tax purposes, i.e.

(13b) $\theta = 1.$

(iii) all income is included in the tax base, i.e.

(13c) $\alpha = 1.$

In this case the user cost formulas of equation (12) become

(14a) $CR_I^D = \delta - \dot{q}/q + \frac{1-m_i}{(1-t)(1-\tau)} i$

(14b) $CR_B^D = \delta - \dot{q}/q + i$

(14c) $CR_E^D = \delta - \dot{q}/q + \frac{1-m_i}{1-m_d} \frac{1-\beta\tau}{1-\tau} i.$

As can be seen from equations (14), we have two traditional solutions to the neutrality problem, or

(i) a (proportional) tax on all capital income received by households, i.e.

(15a) $t = m_i = m_d, \ \tau = 0.$

In this case, of course, it does not matter how the depreciation charge (γ) and the inclusion rate of corporate income into taxable profit (α) are defined. We note, too, that nominal capital gains are taxed on an accrual basis.

(ii) a (proportional) tax on dividends and interest income received by households and the same tax rate on corporate income combined with a 100 % deduction for dividends paid, i.e.

(15b) $m_i = m_d = \tau, \ t = 0, \ \beta = 1.$

In this case capital gains are taxed at the firm level and not when they are »received» by households. Interest income and dividends are taxed when received by the households ($\beta = 1$).

2.4.2. *A leaking corporate income tax system*

One of the main arguments for reforming the Finnish corporate income tax system is the fact that some sources of corporate income is tax exempt, i.e. the corporate income tax system is »leaking» ($\alpha < 1$ in our model). Implicitly it is argued that since this is the case, a full (100 %) dividend deduction implies a too favorable tax treatment of dividends.[10]

Let us therefore investigate the conditions for neutrality in the case where $\alpha < 1$.

In this case we first note that one cannot talk about a genuine income tax system since some part of corporate income is untaxed by definition. We therefore concentrate on the »neutrality» of the capital income tax system w.r.t. the sources of finance of the corporation.

The formulas in equation (12) are well suited for this purpose: we can ignore the first part of the user cost in each formula since it is the same for all sources of finance. Let us therefore define the »quasi financial cost of capital» (X_i^D, i = internal, debt, equity) as

(16a) $$\begin{cases} X_I^D = 0 \\ X_B^D = \dfrac{(1-\theta\tau)i - R}{1-\alpha\tau} \\ X_D^D = \dfrac{R}{1-\alpha\tau}\left[\dfrac{(1-\tau\beta)(1-t)}{1-m_d} - 1\right] \end{cases}$$

or, more familiarly (adding $\frac{R}{1-\alpha\tau}$ to each expression),[11]

(16) $$\begin{cases} Y_I^D = \dfrac{R}{1-\alpha\tau} = \dfrac{1-m_i}{(1-t)(1-\alpha\tau)} i \\ Y_B^D = \dfrac{(1-\theta\tau)}{(1-\alpha\tau)} i \\ Y_E^D = \dfrac{(1-\tau\beta)(1-t)}{(1-\alpha\tau)(1-m_d)} R = \dfrac{(1-\tau\beta)(1-m_i)}{(1-\tau\alpha)(1-m_d)} i \end{cases}$$

From equation (16) we note that there are two capital income tax systems, which are neutral w.r.t. the sources of finance, i.e.[12]

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[10] *See eg. Ingberg (1987).*

[11] *These formulas are comparable to the financial cost of capital derived by King (1974) and are usually used in so-called King & Fullerton (1985) -calculations. In the original article by King (1974) the formulas were derived assuming true economic depreciation for tax purposes, ie $\gamma = \delta - \dot{q}/q$.*

[12] *One solution is, of course, the trivial case where $\tau = 0$ and $t = m_i = m_d$, i.e. corporate income is only taxed*

(i) $\tau = m_i = m_d \equiv m,\ t = \frac{m(1-\alpha)}{1-\alpha m} > 0,$

$\theta = \alpha = \beta.$

If capital income received by the households (interest and dividends) is taxed at the same rate as corporate source income ($m = \tau$), we require that deductions for interest and dividends be of the same magnitude as income is taxable ($\theta = \alpha = \beta$).

In this case the capital gains tax has to be positive since part of the income yielding capital gains avoids taxation at the corporate level.

(ii) $m_i = m_d \equiv m,\ t = 0,\ \tau = \frac{m}{\alpha} > m,\ \theta = \alpha = \beta.$

If capital gains are not taxed (at the household level), neutrality is achieved by setting the corporate tax rate at a higher level than the tax rates facing the households ($\tau > m$).

2.5. *A neutral, real capital income tax system*

Having considered the neutrality conditions of a capital income tax system based on a nominal income consept (both for households receiving capital income and for firms creating capital income), we now turn to a discussion of a capital income tax system based on a real income consept.

We start by redefining the valuation equation to take account of the fact that the income-receiving household is taxed according to real capital income.

When the income tax system is based on real capital income, we note that the base (Y_c) of the capital gains tax (accrual basis) is[13]

(17a) $\quad Y_c = \dot{V} - \dot{p}/p\ V - E$

The real increase in the value of the firm is defined as the nominal increase minus the inflation part and the increase in equity capital. When interest income received by households is taxed on a real basis, the yield of the alternative asset is

(17b) $\quad \rho = (1-m_i)i + m_i \dot{p}/p.$

In this case the discount rate of the corporation is given by

(17c) $\quad R = \frac{(1-m_i)i + (m_i - t)\dot{p}/p}{1-t}.$

The traditional neutral, real capital income tax system can then be derived through defining the (real) income tax base of the corporation. We then require that

(i) tax deductible depreciation charges (γ) are equal to the »true depreciation» (δ) corrected for real capital gains on investment goods ($\dot{q}/q - \dot{p}/p$), or

(18a) $\quad \gamma = \delta - (\dot{q}/q - \dot{p}/p)$

(ii) all corporate income is included in the tax base, i.e.

(18b) $\quad \alpha = 1.$

In this case the user cost formulas of equation (12) are[14]

(19a) $\quad \hat{CR}_I^D = \delta - (\dot{q}/q - \dot{p}/p) + \frac{(1-m_i)}{(1-\tau)(1-t)}(i - \dot{p}/p)$

(19b) $\quad \hat{CR}_B^D = \delta - (\dot{q}/q - \dot{p}/p) + \frac{(i-\dot{p}/p) - \tau\theta i}{1-\tau}$

(19c) $\quad \hat{CR}_E^D = \delta - (\dot{q}/q - \dot{p}/p) + \frac{(1-\beta\tau)(1-m_i)(i-\dot{p}/p) + [(1-\beta\tau)(1-t) - (1-m_d)]\dot{p}/p}{(1-m_d)(1-\tau)}$

As can be seen from equation (19) we have two solutions to the neutrality problem, i.e.

(i) a (proportional) tax on all capital income received by households, i.e.

(20a) $\quad m_i = m_d = t,\ \tau = 0.$

(ii) a (proportional) tax on dividends and interest received by households and the same tax rate on corporate source income combined with a 100 % deduction for dividends paid. Furthermore we require that firms deduct only the real part of their interest payments, i.e.

(20b) $\quad m_i = m_d = \tau,\ \beta = 1,\ t = 0,\ \theta = \frac{i - \dot{p}/p}{i} < 1.$

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when distributed to households. Note, however, the assumption of a capital gains tax on an accrual basis.

[13] *See appendix 1 for derivations.*

[14] *See Appendix 2 for derivations.*

3. The model with an imputation system

The main idea of the imputation system is that gross dividends (dividends + corporate tax paid on dividends) is defined as taxable income by the dividend receiving household. In its own income taxation the household then is allowed to deduct the (assumed) tax paid by the corporation. Net dividends (D_N) received by the household is thus given by

$$(21)\quad D_N = D - \underbrace{}_{\text{Dividends received}}[\underbrace{m_d\frac{D}{1-\tau}}_{\text{Tax required to be paid by the household}} - \underbrace{\tau\frac{D}{1-\tau}}_{\text{Deduction received for taxes paid by corporation}}]$$

$$= (1-\frac{m_d-\tau}{1-\tau})D = \frac{1-m_d}{1-\tau}D.$$

In this case the (present) value of the firm is given by

$$(22)\quad V_0 = \int_0^\infty \Big(\frac{1-\frac{m_d-\tau}{1-\tau}}{1-t}D_t - E_t\Big)e^{-Rt}dt.$$

The financial constraint of the firm is given by

$$(23)\quad pf(K) + \dot{B} + E = qI + iB + D + \tau Y_v + T,$$

where Y_v is the taxable income of the firm and T is the »extra tax» which guarantees the »minimum tax» discussed in the introduction of the paper.

The taxable income of the firm is given by

$$(24)\quad Y_v = \alpha pf(K) - \theta iB - Z.$$

The extra tax, T, is given by

$$(25)\quad \begin{array}{ll} T = 0 & \text{if } \tau Y_v \geq \dfrac{\tau D}{1-\tau} \\ T = \dfrac{\tau D}{1-\tau} - \tau Y_v & \text{if } \tau Y_v < \dfrac{\tau D}{t-\tau} \end{array}$$

In order to simplify the analysis, we make the assumption that the firm either never is bound by the minimum tax constraint, i.e. that $T = 0$, $\forall t$, or that it always is, i.e. that $T = \frac{\tau D}{1-\tau} - \tau Y_v$ $\forall t$.

3.1. The imputation system without the minimum tax

In the case where the minimum tax constraint is not binding we have

$$(26)\quad D = (1-\tau\alpha)pf(K) - (1-\theta\tau)iB - (1-\tau z)qI + \dot{B} + E.$$

The (present) value of the firm is given by

$$(27)\quad V_0 = \int_0^\infty \Big\{\frac{1-m_d}{(1-t)(1-\tau)}[(1-\tau\alpha)pf(K) - (1-\theta\tau)iB - (1-\tau z)qI + \dot{B} + E] - E\Big\}e^{-Rt}dt.$$

The appropriate cost of capital formulas are given by

$$(28)\quad \begin{cases} CR_I^A = \dfrac{1-\tau z}{1-\tau\alpha}(\delta + R - \dot{q}/q) \\ CR_B^A = \dfrac{1-\tau z}{1-\tau\alpha}(\delta + R - \dot{q}/q) + \dfrac{(1-\theta\tau)i - R}{1-\tau\alpha} \\ CR_E^A = \dfrac{1-\tau z}{1-\tau\alpha}(\delta + R - \dot{q}/q) + \dfrac{R}{1-\tau\alpha}\Big[\dfrac{(1-t)(1-\tau)}{1-m_d} - 1\Big]. \end{cases}$$

Comparing the formulas in equation (28) with those of equation (12) we note, that they are identical.[15]

3.2. The imputation system with a minimum tax

In the case where the minimum tax constraint is binding we have

$$(27)\quad \tau Y_v < \frac{\tau D}{1-\tau} \text{ or } (1-\tau)\ Y_v < D.$$

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[15] *Assuming, of course, that $\beta = 1$, i.e. that the dividend deduction is 100 % of distributed dividends. If $0<\beta<1$ the systems can be made identical by taking account of the imputation factor when grossing up dividends and by allowing the dividend receiver less than full deduction of corporate taxes from his own tax on gross dividends, i.e.*

$$(21a)\quad D_N = D - [m_d\frac{D}{1-\beta\tau} - \beta\tau\frac{D}{1-\beta\tau}] = \frac{1-m_d}{1-\beta\tau}D$$

The inequality in (27) can be written in the following form $(1-\tau)[\alpha pf(K)-\theta iB-Z] < (1-\tau\alpha)pf(K)-(1-\theta\tau)iB-qI+\tau Z+\dot{B}+E-T$ or

$$(27a) \quad qI < (Z+\dot{B}+E-T)+(1-\alpha)pf(K)-(1-\theta)iB.$$

From the inequality in (27a) it is clear that firms, whose investments are low, are more apt to paying the minimum tax. Setting $\alpha=\theta=1$, we note that

(i) a firm financing its investment internally ($\dot{B}=E=0$) pays the minimum tax if current investments are below depreciation charges,

(ii) a firm financing its investment by borrowing [$\dot{B}=\dot{q}K+q(I-\delta K)$, $E=0$] pays the minimum tax if depreciation charges are higher than the economic depreciation of the capital stock i.e. if

$$(28) \quad Z > qK(\delta-\dot{q}/q),$$

(iii) a firm financing its investment by equity [$E=\dot{q}K+q(I-\delta K)$, $\dot{B}=0$] also pays the minimum tax if depreciation charges are higher than the economic depreciation.

In the case where the minimum tax constraint is binding the whole tax burden of the corporation ($\hat{T}$) is given by

$$(29) \quad \hat{T}=\tau Y_v+T=\tau Y_v+\frac{\tau}{1-\tau}D-\tau Y_v=\frac{\tau}{1-\tau}D.$$

Combining equations (23) and (29) we note that dividends are determined as

$$(30) \quad D=(1-\tau)[pf(K)+\dot{B}+E-qI-iB]$$

As can be seen from equation (30), the minimum tax requirement yields a tax on corporate cash flows. In this case, of course, the user cost of capital depends only on personal income tax parameters, i.e.

$$(31) \quad \begin{cases} CR_I^{AM}=\delta-\dot{q}/q+\dfrac{1-m_i}{1-t}i \\ CR_B^{AM}=\delta-\dot{q}/q+i \\ CR_E^{AM}=\delta-\dot{q}/q+\dfrac{1-m_i}{1-m_d}i \end{cases}$$

4. *Some calculations of the financial cost of capital*

In this part we present some calculations of the financial cost of capital[16] under fairly realistic parameter assumptions. The results are, of course, very rough and can only be thought of to give some indication of the direction of change in the financial cost that would occur if the corporate tax system is changed according to the plans presented.

It might be worth while to point out that the calculations *do not* exactly coincide with those of King—Fullerton (1984). The difference between our approach[17] and the approach taken by King—Fullerton is illustrated in Appendix III.

Since our calculations can be looked upon only as indicating the direction of change in the financial cost of capital due to the proposed reform, we only present calculations for one type of investment, i.e. machinery.

4.1. *The real required rate of return according to present tax rules*

In table 2 we present the real required rate of return on investment (the financial cost of capital) in machinery according to the present tax rules when the real rate of interest is 5 %. The parameter values used in the calculations are given in table 1.[18]

Table 1. Parameter Values of Present Tax Rules.

$m_i = m_d = \tau$	$= 0.5$	$\delta = 0.077$
t	$= 0.1$	$\beta = 0.526$[19]
γ	$= 0.3$	$\theta = 1$

[16] *We define the financial cost of capital (ρ) as*
(i) $\rho = CR-\delta$.
See also King & Fullerton (1984).

[17] *As was stated earlier we follow the line of thought first introduced by Atle-Berg (1987).*

[18] *See also eg. Airaksinen (1986).*

[19] *The dividend deduction, which is assumed to be 80 %, is allowed only in the state income taxation (β^*). Letting τ_1 be the municipal income tax rate, τ_2 the state income tax rate and $\tau=\tau_1+\tau_2$ we have*
(i) $\beta\tau=\beta^*\tau_2$
or
(ii) $\beta=\dfrac{\beta^*\tau_2}{\tau}$

If $\tau_1=0.17$, $\tau_2=0.33$ *and* $\beta^*=0.8$, *we get* $\beta=0.526$.

Table 2. The real required return on investment in machinery (%), when the real rate of interest is 5 % (present tax system).

α/Source of finance	Rate of inflation		
	0	5	10
Internal			
α = 1.0	3.7	1.9	—0.4
α = 0.8	1.8	0.3	—1.6
α = 0.6	0.4	—0.8	—2.5
Borrowing			
α = 1.0	3.1	0.7	—2.0
α = 0.8	1.3	—0.7	—2.9
α = 0.6	0.0	—1.7	—3.6
Equity			
α = 1.0	5.5	5.6	5.0
α = 0.8	3.3	3.4	2.0
α = 0.6	1.7	1.8	1.4

4.2. *The real required rate of return according to avoir fiscal*

4.2.1. *The minimum tax constraint is not binding*

Comparing the formulas of equation (12) and equation (28) we note that for a firm, which is not constrained by the minimum tax requirement, the cost of capital would change only in the case of equity financing.[20] In table 3 we present a comparison of the current system and the avoir fiscal.

Table 3. The real required return on investment in machinery (%), when the real interest rate is 5 % (only equity financing).

	Rate of inflation		
	0	5	10
Dividend paid deduction			
α = 1	5.5	5.6	5.0
α = 0.8	3.3	3.4	2.9
α = 0.6	1.7	1.8	1.4
Avoir fiscal			
α = 1	3.1	0.7	—2.0
α = 0.8	1.3	—0.7	—2.9
α = 0.6	0.0	—1.7	—3.6

[20] *Our purpose here is to compare the system of dividend paid deduction and the imputation system. Therefore we do not take other proposed changes in tax parameters into account.*

As can be seen from table 3, the real required return on investment financed by equity would clearly fall if the dividend paid deduction is abandoned in favor of the imputation system (assuming that the minimum tax requirement is not binding). This is, of course, due to the fact that the current dividend paid deduction is only partial (80 % and only in state taxation), while the imputation system would totally eliminate the double taxation of dividends. As a matter of fact the imputation system proposed would treat equity financing in exactly the same way as borrowing (compare table 2 and table 3), allowing full (implicit) deductability of the financial cost of the investment (interest on debt, dividends on equity).[21,22]

4.2.2. *The minimum tax constraint is binding*

If the minimum tax constraint is binding, the imputation system yields the required returns on investment reported in table 4. Since the personal tax parameters are assumed to be the same for interest and dividend income ($m_d = m_i$), the required returns on investment financed by debt and by equity are the same. Due to the fact that capital gains are given a preferred tax treatment, the required return on investment financed internally is lower, however.

Table 4. The real required return on investment in machinery (%), when the real interest rate is 5 %: the minimum tax case.

	Rate of inflation		
	0	5	10
Internal	2.8	0.6	—1.7
Borrowing	5.0	5.0	5.0
Equity	5.0	5.0	5.0

5. *Summary and conclusions*

The purpose of this paper is to investigate the effects of changing the current system of

[21] *From equation (28) it is clear that* $CR^A_B = CR^A_E$ *if* $m_d = m_i$, $\theta = 1$.

[22] *One would therefore expect that the imputation system would encourage firms to finance more of its investment by equity and less internally. This, of course, holds only if the minimum tax constraint is not binding.*

reducing the double taxation of dividends (the dividend paid deduction) to an imputation system including a minimum tax. In this context special considerations are given to the fact that the current corporate income tax system is leaking, i.e. that accounting profits usually are higher than the taxable income of the firm. The main results of the paper can be summarized as follows.

First, we note that in the case where the minimum tax requirement is not binding, the imputation system reduces the required rate of return on investment financed by equity. This is due to the fact that the double taxation of dividends (as compared e.g. to the tax treatment of interest on debt) is eliminated.

Second, if the minimum tax requirement is binding the imputation system seems to favor internal financing as compared to equity and borrowing. The real required rate of return on investment financed internally falls below the alternative modes of financing and the discrepancy increases as the rate of inflation increases.

Finally it might be worthwhile to point out that the model used is deficient especially in one respect. In the popular debate about the imputation system (and especially regarding the minimum tax) it is usually ascertained that the imputation system would cause the payout ratio of firms to fall. In the model used in this paper the distribution of the firm (dividends paid) is a residual (in the financial constraint of the firm), and *not* a decision variable per se.

Appendix 1

The valuation equation with a real capital gains tax

The nominal value of the firm (V) is defined as

$$\text{(A1.1)} \quad V = pA$$

where p is the (consumer) price of the output of the firm and A is the real value of the firm.

The nominal increase in the value of the firm, then, is

$$\text{(A1.2)} \quad \dot{V} = \dot{p}A + p\dot{A}$$

The real increase in its value is given by

$$\text{(A1.3)} \quad p\dot{A} = \dot{V} - \dot{p}A = \dot{V} - \dot{p}/pV$$

The (nominal) income received by the household, then, is

$$\text{(A1.4)} \quad Y = (1 - m_d)D - E - t\,(\dot{V} - \dot{p}/pV - E)$$

For the household to be indifferent between investing in the firm and in some interest-bearing asset yielding ρ we have

$$\text{(A1.5)} \quad \rho V = Y + \dot{V}$$

Combining (A1.4) and (A1.5) we get

$$\text{(A1.6)} \quad \dot{V} - \left(\frac{\rho - t\dot{p}/p}{1 - t}\right)V - \frac{1 - m_d}{1 - t}D + E = 0$$

or

$$\text{(A1.7)} \quad \dot{V} - RV - \frac{1 - m_d}{1 - t}D + E = 0$$

If $\rho = (1 - m_i)i + m_i\,\dot{p}/p$ we get

$$\text{(A1.8)} \quad R = \frac{(1 - m_i)i + (m_i - t)\,\dot{p}/p}{(1 - t)}$$

Appendix 2

User cost formulas in a real capital income tax system

Assuming

$$z = \frac{\delta - (\dot{q}/q - \dot{p}/p)}{\delta + R - \dot{q}/q}, \quad R = \frac{(1 - m_i)i + (m_i - t)\dot{p}/p}{1 - t}$$

we get

$$\text{(A2.1)} \quad \hat{C}R_I^p = \frac{1 - \tau z}{1 - \tau}(\delta + R - \dot{q}/q)$$

$$= \frac{1}{1 - \tau}\{(\delta + R - \dot{q}/q) - \tau\,[\delta - (\dot{q}/q - \dot{p}/p)]\}$$

$$= \frac{1}{1 - \tau}\{\delta + R - \dot{p}/p - (\dot{q}/q - \dot{p}/p) - \tau\,[\delta - (\dot{q}/q - \dot{p}/p)]\}$$

$$= \delta - (\dot{q}/q - \dot{p}/p) + \frac{R - \dot{p}/p}{1 - \tau}$$

$$= \delta - (\dot{q}/q - \dot{p}/p) + \frac{(1 - m_i)i + (m_i - t)\dot{p}/p - (1 - t)\dot{p}/p}{(1 - \tau)(1 - t)}$$

$$= \delta - (\dot{q}/q - \dot{p}/p) + \frac{(1 - m_i)(i - \dot{p}/p)}{(1 - \tau)(1 - t)}$$

(A2.2) $\hat{C}R_B^p = \frac{1-\tau z}{1-\tau}(\delta + R - \dot{q}/q) + \frac{(1-\theta\tau)i - R}{1-\tau}$

$= \delta - (\dot{q}/q - \dot{p}/p) + \frac{R - \dot{p}/p + (1-\theta\tau)i - R}{1-\tau}$

$= \delta - (\dot{q}/q - \dot{p}/p) + \frac{i - \tau\theta i - \dot{p}/p}{1-\tau}$

(A2.3)

$$\hat{C}R_E^p = \delta - (\dot{q}/q - \dot{p}/p) + \frac{R - \dot{p}/p + (\frac{(1-\tau\beta)(1-t)}{1-m_d} - 1)R}{1-\tau}$$

$$= \frac{\frac{(1-\beta\tau)(1-t)}{(1-m_d)} \cdot \frac{(1-m_i)i + (m_i - t)\dot{p}/p}{1-t} - \dot{p}/p}{1-\tau}$$

$$= \frac{(1-\beta\tau)(1-m_i)i + (1-\beta\tau)(m_i - t)\dot{p}/p - (1-m_d)\dot{p}/p}{(1-\tau)(1-m_d)}$$

$$= \frac{(1-\beta\tau)(1-m_i)(i - \dot{p}/p) + [(1-\beta\tau)(1-t) - (1-m_d)]\dot{p}/p}{(1-\tau)(1-m_d)}$$

Note that the value of z is derived in the following way

(A2.4) $z = \int_0^\infty \gamma e^{-\gamma t} e^{\dot{p}/pt} e^{-Rt} dt = \int_0^\infty \gamma e^{-(\gamma - \dot{p}/p + R)t} dt$

$= \frac{\gamma}{\gamma - \dot{p}/p + R}$.

This means that the depreciation charge (γ) is applied to the undepreciated value of the investment ($e^{-\gamma t}$), which is appreciated by the rate of inflation ($e^{\dot{p}/pt}$), however. By choosing

(A2.5) $\gamma = \delta - (\dot{q}/q - \dot{p}/p)$ = true economic depreciation we get

(A2.6) $z = \frac{\delta - (\dot{q}/q - \dot{p}/p)}{\delta - \dot{q}/q + R}$

Appendix 3

The King—Fullerton user cost formulas

The user cost formulas used by King & Fullerton (1984) are given by

(A3.1) $CR_j^p = \frac{1-\tau z}{1-\tau}(\delta + \rho_j - \dot{q}/q)$

$j = \{\text{internal, debt, equity}\}$

where

(A3.2) $z = \frac{\gamma}{\gamma + \rho j}$

and

(A3.3)

$$\rho_j = \begin{cases} \frac{1-m_i}{1-\tau} i & \text{if } j = \text{internal} \\ (1-\tau)i & \text{if } j = \text{debt} \\ \frac{(1-\tau\beta)(1-m_i)}{1-m_d} i & \text{if } j = \text{equity} \end{cases}$$

These formulas coincide with the ones presented in the text only in the case of internal finance. In table A3.1 we have compared the real required return derived using our approach (A—B) and the approach used by King & Fullerton (K—F).

Table A3.1 The real required return on investment in machinery (%), when the real rate of interest is 5 %: Comparison with King—Fullerton calculations ($\alpha = 1$).

Source of finance	Rate of inflation		
	0	5	10
Internal			
K—F	3.7	1.9	—0.4
A—B	3.7	1.9	—0.4
Borrowing			
K—F	3.3	1.1	—1.5
A—B	3.1	0.7	—2.0
Equity			
K—F	5.0	4.4	3.4
A—B	5.5	5.6	5.0

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