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TAX TREATMENT OF DIVIDENDS AND CAPITAL GAINS AND THE DIVIDEND DECISION UNDER DUAL INCOME TAX

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Abstract: The paper analyses efficiency aspects of a dual income tax system with a higher tax on capital gains than dividends. It argues that apart from the distortions to investments claimed in earlier literature, the system puts even more emphasis in creating incentives for entrepreneurs to participate in tax planning. The paper suggests that the owner of a closely held company can avoid all personal taxes on entrepreneurial income by two tax-planning strategies. The first is the avoidance of distributions, which would be taxed at the tax rate on labour income. These funds would instead be invested in the financial markets. The second strategy is a distribute-and-call-back policy, converting retained profits into new equity capital. Interestingly, the outcome is that investment in real capital is not distorted in the long-run equilibrium. Empirical evidence using micro data is also provided.

JEL code: H24 H25

Key words: Dual income tax, small business taxation, income shifting

Tiivistelmä: Artikkelissa analysoidaan eriytettyä tuloverojärjestelmää tehokkuusnäkökulmasta. Suomen järjestelmässä luovutusvoittojen verotus on ollut ankarampaa kuin osinkojen verotus. Aikaisemmissa tutkimuksissa on korostettu erityisesti eriytetyn tuloverotuksen investointeja vääristäviä vaikutuksia. Järjestelmä luo kuitenkin myös merkittäviä kannustimia verosuunnitteluun. Tutkimuksen mukaan yrittäjä voi pyrkiä välttämään yritystoiminnasta saamaansa tuloon kohdistuvia veroja kahdella verosuunnittelustrategialla. Ensimmäinen strategia on ansiotulona verotettavasta osingonjaosta pidättäytyminen ja rahavarojen sijoittaminen ansiotulo-osingon sijaan rahoitusmarkkinoille. Toinen strategia on niin kutsuttu ”distribute-and-call-back policy”: voittojen muuntaminen osakeannilla yrityksen uudeksi omaksi pääomaksi. Tutkimuksessa osoitetaan, että tarkasteltava verojärjestelmä ei vääristä reaali-investointeja pitkän aikavälin tasapainossa. Tuloksille tarjotaan myös empiiristä tukea.

Asiasanat: Eriytetty tulovero, pienyritysten verotus, verosuunnittelu

Contents

1. Introduction

The taxation of dividends has attracted renewed attention in public economics literature in recent years, partly because of the US 2003 tax reform which introduced considerable cuts to the tax rates on dividend income. Several studies have used the reform as a "natural" experiment to bring new understanding on the effects of dividend taxation on corporate behaviour. One of the issues is how the change in the relative tax burden between dividends and capital gains affected dividend pay-out behaviour (Poterba 2004, Chetty and Saez 2005, Gordon and Dietz 2006).

Another topical theme in public economics is income shifting between different tax bases. While the US literature has mainly focused on shifting between corporate and individual income tax bases (Gordon and Slemrod 2000), the European debate also pays attention to the incentives generated by the tax rate differentials between individual labour and capital income (Sørensen 2005b). On the background is the recent trend towards low nominal tax rates on capital income.

The Nordic dual income taxation (DIT), which combines progressive taxation of labour income with proportional tax on capital income, has received growing attention in the international debate.[1] As the literature explains, there are several theoretical and practical arguments in favour of DIT. However, since there is a large tax-rate gap between the proportional rates on capital income and the top marginal rates levied on labour income, the system is likely to provide incentives for tax-minimizing behaviour. Another problem, when implementing DIT, is how to deal with the fact that entrepreneurial income is a result of a combined contribution of capital and labour inputs. To tackle these issues, the Nordic countries have set up tax rules, among them the so-called splitting rules, for the taxation of owners of closely held corporations (CHC) and unincorporated firms. These splitting rules calculate the capital income part as an imputed return on the firm's assets and treat the residual as labour income.

The question of whether the tax rules of income-splitting have behavioural implications has attracted some attention among Nordic tax economists. Hagen and Sørensen (1998) provide a verbal analysis of the problem and Kari (1999), Lindhe et al. (2002, 2004) and Hietala and Kari (2006) report on the effects on investment decisions using standard corporate tax models. Kanniainen et al. (2007) discuss the effects on entrepreneurship. Some studies have also dealt with the issue of income-shifting. Alstadsæter (2003) examines the effects of the previous Norwegian DIT rules on tax-planning, especially the choice of the

[1] See Sørensen (2005b), Cnossen (2000), Keuschnigg and Dietz (2005) and the articles in the CESifo DICE Report 3/2004.

organizational form. Fjærli and Lund (2001) provide empirical evidence on income-shifting between labour income and capital income bases.

This paper analyses the taxation of closely held companies (CHC) under the variant of DIT applied in Finland since 1993. It centres on tax-planning, especially on how dividends and financial investments should be arranged to maximize after-tax income in the long run. Evidence using a large set of micro data is also provided.[2]

The Finnish DIT combines a broad-based flat tax on capital income with a progressive tax on labour income (Table 1). The tax rate difference between the top marginal tax rate (MTR) and the proportional capital income tax rate was close to 26 per cent in 2004 and even larger before the gradual MTR cuts implemented in the last decade. There is relief on owner-level taxation of dividends so that in practice owners receive normal dividends tax-free.[3] Realized capital gains from the sale of shares are taxed at the normal tax rate on capital income. Dividends received from a CHC are split into capital income and earned income by considering an imputed return on the firm's net assets as capital income (normal dividend) and categorizing the residual as earned income (excess dividend). The presumptive rate used to calculate the capital income portion of dividends was 9.6 per cent and the capital base was defined as the net assets in the firm's tax accounts.

Table 1. Summary data of the Finnish income tax system in 2004

Tax parameter	Symbol	%
Personal MTR on earned income[4]	τ_{ex}	20.92–54.92
Tax rate on corporate income	τ_f	29
Personal tax rate on capital income	τ_c	29
Rate of imputation	s	29
Presumptive rate of capital income	ρ	9.585

The Nordic countries have adopted differing definitions of the capital base (Hagen and Sørensen 1998, Lindhe et al. 2002). Under the Norwegian gross method the base is measured as the firm's non-financial gross assets. Sweden's approach is to define the base as the acquisition cost of the shares. Finland chose a third alternative and defines the base as the firm's net business assets. The

[2] The focus is on tax rules in force before a recent tax reform implemented as from 2005, which brought changes to tax rates and replaced the former full imputation system by a system of shareholder relief. The basic structure of the Finnish DIT was not changed, however. See Hietala and Kari (2006).

[3] From 1993 until 2004 this was implemented by a full imputation system. After the 2005 reform 'normal dividends' are tax-exempt up to 90,000 euros. Dividends exceeding this amount and also dividends from stock exchange-quoted corporations are subject to partial double taxation.

[4] Includes central government income tax of 0–34 %, municipal income tax of 18.12 % (average), church tax of 1.3 % (average) and sickness insurance contribution of 1.5 %.

Finnish base thus includes all types of business assets, including financial assets, and deducts liabilities. As is shown in this paper, this definition has interesting implications for firm behaviour and also for the efficiency of the tax system.

Besides the splitting system, another unconventional feature of the Finnish tax system is that it has combined single taxation of dividends with non-relieved taxation of capital gains, the latter implying double taxation of retained profits. Sweden and Norway took a different approach in their DIT reforms: both countries aimed at neutrality. While Norway's strategy was to implement single taxation of both distributed and retained profits, Sweden chose the other extreme: double taxation of both.

What are the effects of the non-neutrality of the Finnish system in this respect? Tax literature suggests that the relative tax burden on distributed and retained profits is important for dividend and financing decisions. A lower tax burden on dividends may induce higher dividend distributions (e.g. Poterba 2004, Gordon and Dietz 2006). Furthermore, Sinn (1987) shows it to establish incentives for what he calls a distribute-and-call-back policy, where profits are converted into new equity capital by distributing them and then collecting them back through new share issues.

This paper presents a formal analysis of the financial behaviour of a CHC under the Finnish dual income tax. It argues that the non-neutralities of the tax system encourage entrepreneurs to undertake two specific tax-planning strategies by which these agents may avoid personal taxation entirely. Capital gains taxation is shown to be important in understanding the observed dividend behaviour. In the theoretical part, a standard deterministic corporate tax model is used (Auerbach 1979, Sinn 1987) augmented here by financial capital. The modelling of the Finnish dual income tax closely follows Kari (1999) and Lindhe et al. (2002). The firm's optimal policy is analysed not only in the long-run equilibrium, but also in the adjustment stage. The empirical part provides evidence for the tax-planning strategies suggested by the theory using a large data set consisting of linked micro data for closely held firms and their owners.

The paper proceeds as follows. Section 2 sets up the model. Section 3 provides an analysis of the firm's optimal policy under the Finnish variant of DIT. Sections 4 and 5 present empirical support for the behaviour outlined in section 3. Section 6 concludes.

2. The model

2.1 Objective of the firm

Assume a closely held company that maximizes the wealth of its entrepreneur

(1) $$\max \int_{t_0}^{\infty} G\, e^{i'(t-t_0)} dt \quad ,$$

where G is the after-tax value of dividends received by the entrepreneur and i' is the after-tax discount rate of the owner.

There are two types of assets available in which the firm can invest: real capital, K, generating profits $f(K)$ with standard properties $f' > 0$, $f'' < 0$, and financial capital, F, with a constant rate of return i. Both assets are non-depreciable and develop as

(2) $$\dot{K} = I \quad , \qquad K(t_0) = K_0$$

$$\dot{F} = S \, , \qquad F \geq 0,\, F(t_0) = 0$$

where I is real investment and S is the net flow to financial assets. K_0 is the start-up value of the firm's stock of real capital financed by an initial equity input from the entrepreneur at time t_0 when the firm is established. The owner is assumed to be liquidity-constrained and also unwilling to accept outside equity to finance the firm. Because of this, the starting value of the firm K_0 is determined purely by these constraints, which are defined more explicitly below.

This assumption concerning K_0 is motivated here not only as a plausible feature of real life, but also by technical reasons. Without it we are not able to analyse the effects of the Finnish DIT on the firm's growth path in the presence of the incentive for the distribute-and-call-back policy mentioned in section 1. An endogenously determined initial stock of capital would eliminate the growth path and thus obscure many interesting aspects of the tax system. [5]

The firm's budget constraint is

(3) $$(1-\tau_f)[f(K)+iF] = D + I + S,$$

where τ_f depicts the rate of corporation tax and D depicts dividends distributed to owners. Observe that the only source of financing (after the initial equity input) is after-tax profits. Debt financing is ruled out to simplify the analysis, as

[5] As an example of a different approach, Sinn (1991) analyses dividend taxation as the only tax parameter in a model where the size of initial capital is optimized.

is new equity because of the liquidity constraints. In section 3.3 we extend the analysis by adding new share issues. The firm's uses of funds are dividends D and investments in real capital I and financial assets S.

Observe that the model excludes labour, both outside and the owner's own, as a factor of production. We do this to focus on the firm's tax planning using financial operations. The model further excludes the owner's wages as a form of remuneration from the firm. This may seem unconventional because one of the problems of DIT is alleged to be in the incentives to report labour income as more leniently taxed capital income. Instead of wage, however, our model includes excess dividends which face the high marginal tax rates of labour income.[6] Hence, in our model, the potential income-shifting from labour income to capital income occurs between excess dividends and normal dividends.

2.2 The tax system

Personal capital income is taxed at a flat rate τ_c, which equals the rate of corporation tax. Income categorized as earned income is taxed at rate τ_{ex}, which satisfies $\tau_{ex} > \tau_c$. To simplify the analysis, all tax rates are proportional (see Kari 1999 and Lindhe et al. 2002). Dividend taxation is mitigated by a full imputation system at a rate of $s = \tau_f = \tau_c$.

The splitting system is modelled by first dividing the cash dividend D into two parts

(4) $$D = D_n + D_{ex},$$

where D_n is 'normal dividend', subject to taxation as capital income, and D_{ex} is 'excess dividend', taxable as earned income in the hands of the owner.

The dividend variables are constrained as follows:

(5) $$0 \leq D_n \leq \rho N, D_{ex} \geq 0$$

The lower boundaries are necessary to exclude new financing through negative dividends. The upper boundary for (grossed-up) normal dividends brings the split rule into the model. It corresponds to the concept of 'imputed capital income' mentioned above and is calculated as a return at the rate ρ (presumptive rate of return) on the firm's net assets N. Since debt is excluded from the model, N is the sum of the firm's real and financial assets, $N=F+K$.

[6] This modelling choice has a good theoretical basis. In the Finnish tax system, excess dividends bear a small tax advantage compared to wage income due to social security contributions (Hietala and Kari 2006). This implies that excess dividends can be seen as the marginal form of labour income (Lindhe et al. 2002, Hietala and Kari 2006).

To simplify later analysis, it is useful to set the following profitability requirement for the firm's profit function

(6) $$\frac{(1-\tau_f)f(K^*)}{K^*} > \rho$$

where K^* depicts the size of the stock of real capital which satisfies $f'(K) = i$, where i is the interest rate. This assumption excludes firms, whose average return on capital is so low that their dividends remain below the threshold of the splitting system. By this we focus on high-profitability firms, where the predicted incentives are likely to occur (Lindhe et al. 2002).

The after-tax dividend income of the owner G is defined as

(7) $$G = \gamma_n D_n + \gamma_{ex} D_{ex},$$

where $$\gamma_n = \frac{1-\tau_c}{(1-s)(1-\tau_g)}, \quad \gamma_{ex} = \frac{1-\tau_{ex}}{(1-s)(1-\tau_g)}.$$

γ_n and γ_{ex} depict the opportunity cost of retaining after-tax profits distributable in the form of normal dividends or excess dividends, respectively, familiar from standard corporation tax theory (Auerbach 1979, Sinn 1987). τ_g is the accrual-effective tax rate on capital gains.[7]

Finally, we make the following assumptions

(8) $$\tau_g < \tau_c, \;\; \tau_g < (\tau_{ex}\text{-}\tau_c), \;\; \rho > \text{i}, \; i' = \frac{1-\tau_c}{1-\tau_g} i \text{ and } \lambda_1(K_0) = \lambda_1^0 > \gamma_n.$$

The first assumption states that the accrual-effective tax rate on capital gains is below the nominal tax rate on capital income. The second may be less obvious but focuses the analysis on cases where the tax rate gap between earned income and capital income is high compared to the effective capital gains tax rate. In the Finnish tax system this is easily satisfied in the case of a high-MTR entrepreneur. The third assumption states that the imputed rate of return of the splitting system, ρ, is higher than the interest rate, i. The next one specifies the tax adjusted interest rate, i'. The last assumption sets up the constraint for the start-up capital stock K, discussed above. It is defined in terms of the shadow price for real capital $\lambda_1(K)$.

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[7] Capital gains tax at the effective tax rate τ_g, creates an additional expected burden when profits are retained, and thus increases the opportunity cost of retained profits.

2.3 Optimality conditions

The model now consists of the objective function in (1), the equations of motion for the state variables in (2), the firm's budget constraint in (3), the definitions in (4), (7) and (8) and the constraints on the control and state variables in (2) and (5).

The current-value Lagrangean and the first order conditions for the basic model are:

(9) $$L = \gamma_n D_n + \gamma_{ex} D_{ex} + \lambda_1 \{(1-\tau_f)[f(K)+iF]-D_n-D_{ex}-S\}+\lambda_2 S + q_1 D_n + q_2[\rho(K+F)-D_n] + q_3 D_{ex} + q_4 F$$

(10a) $$\partial L/\partial D_n = \gamma_n - \lambda_1 + q_1 - q_2 = 0$$

(10b) $$\partial L/\partial D_{ex} = \gamma_{ex} - \lambda_1 + q_3 = 0$$

(10c) $$\partial L/\partial \mathrm{S} = -\lambda_1 + \lambda_2 = 0$$

(10d) $$\dot{\lambda}_1 = i'\lambda_1 - (1-\tau_f)f'(K)\lambda_1 - \rho q_2$$

(10e) $$\dot{\lambda}_2 = i'\lambda_2 - (1-\tau_f)i\lambda_1 - \rho q_2 - q_4$$

plus the constraints in (2) and (3) and the standard Kuhn-Tucker conditions, not presented here.

3. The firm's optimal policy[8]

3.1 Long-run equilibrium

This section presents a brief outline of the dynamic solution to the theoretical model. It begins by analysing policy in the long-run equilibrium assuming that investments in financial assets are not available. After this benchmark case, analysed also in earlier literature, the firm's opportunity set is broadened with financial investments.[9]

Financial investment excluded ($F = 0$)

To analyse the firm's steady-state policy in the absence of financial investments, assume that the firm, satisfying the profitability condition (6), distributes excess dividends $D_{ex}>0$. This together with (10b) implies that $\lambda_1 = \gamma_{ex}$, and further, using (10a), that $q_2=\gamma_n-\gamma_{ex}>0$. Thus the upper constraint for normal dividends is binding, $D_n=\rho N$. This means that the firm pays out excess dividends only if the maximum amount of normal dividends is distributed.

Using (10d) as well as (10a) and (10b), we obtain the following marginal condition to characterize the firm's investment policy:

$$f'(K^{**}) = \frac{1-\tau_c}{(1-\tau_f)(1-\tau_g)} i - \frac{\tau_{ex}-\tau_c}{(1-\tau_f)(1-\tau_{ex})}\rho . \tag{11}$$

This condition defines a steady-state stock of real capital denoted here as K^{**}. The rhs of the equation corresponds to the cost of capital for Finnish CHCs as derived in Lindhe et al. (2004) and Hietala and Kari (2006). Compared to the standard 'new' view cost of capital for investment financed by retained earnings, there is an additional term (second term on the rhs), which reflects the incentive effects created by the split of dividends into capital and earned income parts. Observe that the first term is independent of dividend taxation but the second term is not. The splitting system thus breaks with the 'new' view result, which states that dividend taxes do not distort investment financed from retained earnings.

The incentive effects reflected by the second term follow from the Finnish practice of splitting dividends using the firm's net assets as the capital base. By retaining profits the firm increases the capital base and thus reduces the share of dividends subject to earned income taxation. This leads, in the case of a positive

[8] We are grateful to one of the referees for very helpful comments on the exposition of this section.

[9] A more formal analysis of the model is given in Appendix 4.

tax rate differential (τ_{ex}-τ_c), to a tax saving which reduces the firm's cost of capital.

Equation (11) implies for an owner with tax rates as assumed in (8) (see Appendix 1):

(12) $$f'(K^{**}) < i\,.$$ [10]

Thus, as argued in the above cited studies, in this framework the Finnish splitting system may create strong investment incentives, leading to an inefficient outcome.

Allowing access to financial investment ($F \geq 0$)

Let us examine the case where the firm has the opportunity to invest in financial assets with a constant pre-tax rate of return equal to the market interest rate *i*. Now observe that the assumed tax system treats financial and real investments equally. The return on both investments is taxed at the rate τ_f (see eq. (3)) and both assets are included in the capital base of the splitting system, $N=K+F$. This allows us to state that the marginal returns on the two asset types must be equal in the long-run equilibrium:

(13) $$f'(K) = i\,.$$

This condition also defines the long-run cost of capital for real investments. This allows us to conclude that the steady-state stock of real capital K^* is lower than the capital stock K^{**}. Hence the inclusion of financial investments removes the distorting effect of the Finnish CHC tax rules indicated in earlier research.

To proceed in the analysis of the firm's long-run policy, let us insert condition (13) into (10d). Using this and conditions (10a) and (10c) we obtain the following formula for the firm's long-run equilibrium marginal valuation of capital:

(14) $$\lambda_1{}^* = \lambda_2{}^* = \frac{\rho}{\tau_g(1-\tau_c)i + (1-\tau_g)\rho_n}$$

This value can be shown to satisfy $1<\lambda_1{}^*=\lambda_2{}^*<\gamma_n$ (Appendix 1). Using this inequality and conditions (10a) and (10b) above, we obtain $q_1=0$, $q_2>0$, $q_3>0$, which imply $D_n=\rho N$, $D_{ex}=0$. Thus, in the long run equilibrium, the firm's dividend policy follows the rule that the maximum amount of normal dividends is distributed ($D=\rho N$), but no excess dividend ($D_{ex}=0$).

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[10] Hietala and Kari (2006) calculate that, using the Finnish tax rates effective in 2004, the cost of capital in the case of a top tax bracket owner, was 0.2 % when i=7 % is assumed.

Now, assuming the absence of financial assets, the profitability condition (6) implies:

(15) $(1-\tau_f)f(K^*) - D_n > 0.$

There are two alternative ways to use the positive residual cash flow: financial investments and excess dividends. While excess dividends trigger a high tax liability in the hands of the owner, financial investments have some favourable features under the assumed tax system. They increase the after-tax profits by an amount of $(1-\tau_f)i$ per unit of financial investment. However, since financial assets are included in the capital base N, they also increase normal dividends by an amount of ρ per one unit of investment. Since $\rho > (1-\tau_f)i$, this tax system not only leads to taxation of the returns on financial investments as normal dividends in the hands of the owner, but goes further and reduces the amount of excess dividends. Thus financial investments can be used as a tax planning vehicle by which excess dividends can be avoided.

Hence the firm will retain the part of the after-tax profits that exceeds D_n and invest this in financial assets. This continues until the following equality is satisfied:

(16) $(1-\tau_f)f(K^*) - \rho K^* = (\rho - (1-\tau_f)i)F^*$

where F^* is the long-run equilibrium value of the stock of financial capital. [11]

At this stage all of the firm's after-tax cash flow is used for normal dividends and nothing is left for the investment of excess dividends. Both of the firm's asset categories are stationary and therefore, as shown in Appendix 1, the standard transversality condition for the problem is satisfied. This means that the financial investment regime fulfils the requirements for the final stage of the optimal dynamic solution.

Consider finally the firm's financial investment policy when $K<K^*$. This can be studied by combining (10d) and (10e) and using $f'(K)>i$. We obtain $q_4>0$, which implies that F=0. Hence, as is fairly clear intuitively, the firm does not invest in financial assets unless $K=K^*$.

3.2 Growth path

In section 2 we assumed that the entrepreneur is credit-constrained and therefore is able to invest only a small amount of initial capital in the firm. This exogenous

[11] As repayment of debt closely corresponds to financial investments, the tax system analyzed in this paper is likely to produce incentives to retire debt as well. Observe that both operations increase the net assets of the firm.

Errata for “Tax treatment of dividends and capital gains and the dividend decision under dual income tax” by Seppo Kari and Hanna Karikallio published in International Tax and Public Finance 14, 427–456, and VATT-Discussion Papers 416.

Table 2 of the article includes several errors. The corrected version of the Table is as follows:

Table 2. Summary information on the solution

	K	$\dot{K}$	F	$\dot{F}$	D	λ_1
Start-up	$=K_0$		=0			$\lambda_1^0 > \gamma_n$
1. growth phase	>0	>0	=0	=0	=0	$\lambda_1 \geq \gamma_n$
2. growth phase	>0	≥0	=0	=0	$=D_n$	$\lambda_1 \leq \gamma_n$
Final phase	$=K^*$	=0	≥0	≥0	$=D_n$	$1 \leq \lambda_1^* \leq \gamma_n$

amount was defined in terms of the marginal valuation of capital $\lambda_1(K_0)=\lambda_1^0>\gamma_n$. Comparing this to the information of the previous section, we observe that the long run equilibrium value of this variable is below the start-up value $\lambda_1^*<\lambda_1^0$. In our framework with a concave profit function, this implies that the start-up size of the real capital stock is strictly lower than its long-run size, $K_0 < K^*$. Now, due to this gap, the dynamic solution to the firm's problem must include an adjustment phase during which the firm grows its capital stock to the long-run equilibrium level. In the following we outline features of the firm's growth path using intuitive reasoning.

The initial investment condition, $\lambda_1^0>\gamma_n$, says that the marginal valuation of capital exceeds the opportunity cost of retaining normal dividends (γ_n). Thus a value-increasing policy choice is to invest the accruing after-tax profits in real capital rather than to distribute them as dividends. So, after the firm has started up, it invests all after-tax profits $I = (1-\tau_f)f(K)$ and pays out no dividends $D=0$. This is an internal growth phase similar to the one of Sinn (1991). After the accumulation of real capital with decreasing returns has depressed the marginal valuation capital below the opportunity cost of retaining normal dividends, $\lambda_1 < \gamma_n$, the firm's policy changes. Now normal dividends are a better use for after-tax profits than investments. Hence the firm starts distributing the maximum amount of normal dividends, $D=\rho K$, and using the rest $I = (1-\tau_f)f(K) - \rho K > 0$ for investments in real capital.

Once the optimal size of the capital stock K^* is reached and the marginal valuation of capital has been depressed to its long-run equilibrium value, the firm continues paying normal dividends but starts investing its residual profits in financial assets, as explained in the previous section.

This process, with both normal dividends and financial investments, continues until

(17) $$(1-\tau_f)f(K^*) + (1-\tau_f)iF^* - \rho K^* - \rho F^* = 0,$$

i.e. when the firm is in the long-run equilibrium in respect of the stocks of both real and financial assets. Table 2 summarizes information on the firm's policies during the different phases of the optimal solution.

Table 2. Summary information on the solution

	K	$\dot{K}$	F	$\dot{F}$	D	λ_1
Start-up	$=K_0$		$=0$			$\lambda_1^0>\gamma_n$
1. growth phase	>0	>0	$=0$	$=0$	$=0$	$\lambda_1 \geq \gamma_n$
2. growth phase	$=K^*$	$=0$	≥ 0	>0	$=D_n$	$\lambda_1 \leq \gamma_n$
Final phase	$=K^*$	$=0$	≥ 0	≥ 0	$=D_n$	$1<\lambda_1^*<\gamma_n$

It may be worthwhile to take another look at the financial investment phase. Why, for example, does the firm not approach the steady-state value of financial assets F^* at a faster rate than in the solution above? To help understand this issue, let us compare the owner's costs and benefits from a one-unit increase in investment in financial assets financed by a one-unit reduction in normal dividends. The owner's cost of reducing dividends is given by γ_n, while the value of the discounted additional income stream is$(1-\tau_f)i\gamma_n /i'$.[12] Observe that with $i' = (1-\tau_c)i/(1-\tau_g)$ and $\tau_c=\tau_f$.

$$(18) \qquad \gamma_n > \frac{(1-\tau_f)i\gamma_n}{\frac{(1-\tau_c)i}{1-\tau_g}},$$

which tells us that the value of normal dividends is greater than the value of a one-unit investment. Thus any investment financed by a reduction in normal dividends is value-decreasing. One interpretation of this is that due to capital gains tax the total tax on the returns on financial assets held within the firm $\tau_f + \tau_g(1-\tau_f)$ is higher than the tax on the return on financial assets outside the firm τ_c. Thus the firm's optimal choice is to set normal dividends to their maximum value.

Observe the non-standard features of the entire dynamic solution to the firm's problem. Dividends are paid during the (second) real investment growth phase, and not only in the steady state. In this respect the outcome differs from Sinn (1991), who shows that under a linear dividend tax profits are only distributed in the steady state. We also observe an unambiguous incentive to invest excess profits in financial assets. The firm is not indifferent in respect of the use of funds, but strictly prefers investment in financial assets. Furthermore, no personal taxes are paid on distributed profits. This is because the imputation credit eliminates taxes on normal dividends and because excess dividends, subject to a high tax burden, are never paid out. Financial investments are in fact the tax-planning vehicle by which the distribution of excess dividends can be avoided.

3.3 Extension: new equity

The model in section 2 assumes that the firm does not collect new equity after the start-up stage. This assumption was imposed partly to simplify the analysis. Some features of the tax system, however, raise the question of whether the tax system creates special incentives to raise new equity. Attention is drawn to the unusual combination of a full imputation system with non-relieved taxation of

[12] To focus on the basic incentive to distribute normal dividends, we abstract here from the effect of investment on future normal dividends through the asset base N. Thus we assume a non-binding upper constraint on normal dividends.

capital gains. Under this combination, and taking into account the tax rates, dividends, and especially 'normal dividends', are in practice tax-free to shareholders. Capital gains are taxed at an effective rate τ_g, which is strictly positive. In literature such a system is seen to create incentives for tax-arbitrage, and is known as a distribute-and–call–back policy (Sinn 1987). Expected future capital gains tax prompts the firm to convert internally generated equity into share capital.

To examine this question, let us augment the model with new equity capital Q provided by the original owner. The variable is constrained as follows:

(19) $$0 \le Q \le \overline{Q},$$

where the ceiling $\overline{Q}$ is motivated by the financial constraints of the owner. We could think of the ceiling as being a function of income received by the owner from the firm. To simplify issues, however, let us assume $\overline{Q}$ to be exogenous.

We obtain the following first-order condition for the optimal use of equity issues

(20) $$\partial L/\partial Q = -1 + \lambda_1 + q_5 - q_6 = 0,$$

where q_5 and q_6 are the shadow prices related to the lower and upper constraints on Q respectively. Now the optimal value of Q depends on the co-state variables λ_1 and λ_2 as follows:

(21) $$Q\begin{cases} = 0 \\ \ge 0 \ \& \le \overline{Q} \\ = \overline{Q} \end{cases} \Leftrightarrow \ \lambda_1 = \lambda_2 \begin{Bmatrix} < \\ = \\ > \end{Bmatrix} 1$$

Condition (21) compares the value of a one-unit additional investment to the owner's opportunity cost on this investment, i.e. the cost of investing one unit of additional equity in the firm. Since λ_1=λ_2 >1 in all regimes of the optimal solution derived in section 3.2, we conclude that the firm faces an incentive to collect new equity from the owner throughout its life cycle.

To obtain additional insight into these incentives, compare the costs and benefits from a one-unit increase in normal dividends, γ_n, financed by new equity, the cost of which to the owner is one. Since $\gamma_n > 1$, this policy is value-increasing.

The role of capital gains taxation here can be understood by looking at the incentives under the case τ_g=0. Now $f'(K^*)=i$ implies, by conditions (10e), (10c) and (10a), that q_2=0 and λ_1=λ_2=1. Thus the upper constraint for normal dividends becomes non-binding and the incentive to collect new equity ceases. The firm is now indifferent in respect of both new equity and normal dividends. This demonstrates the crucial role of capital gains taxation in creating the incentive to finance dividend distributions by new equity.

3.4 Summary

Our theoretical model adds financial investments to the standard investment model for CHCs. The model predicts that under the Finnish DIT, which splits dividends from a CHC using the firm's net assets as the capital base, the owner avoids taxes on earned income using firm-level financial investments as the tax-planning vehicle. This is shown to eliminate the tax distortion to real investment decisions reported in earlier literature.

The firm's growth path contains several non-standard features. Unlike in the standard dividend-tax model by Sinn (1991), here the firm pays out dividends not only in the steady-state but also during its growth path. The CHCs dividend policy is determined by the rule that the maximum amount of normal dividends is distributed. This occurs both in the second real investment regime and the financial investment regime. Moreover, the CHC faces an incentive to collect new equity at the same time as it pays out dividends (distribute-and-call-back policy). This incentive is induced by the higher tax on retained profits (capital gains) than distributions in the Finnish tax system.

In the empirical part of this paper we address three aspects of the theoretical results. The first is the dividend rule: if the CHC distributes dividends, it should always distribute exactly the maximum amount of normal dividends ($D=\rho N$). The second question concerns the financial investment regime; there should be a connection between distribution of dividends and financial investments ($F>0$ & $D=\rho N$). The third issue deals with distribute-and-call-back policy. We examine whether firms simultaneously collect new equity and distribute dividends ($Q>0$ & $D=\rho N$).

4. Data and descriptive statistics

The panel data employed has been collected by the Finnish Tax Administration and is based on the firms' tax declarations. It contains information on financial statements and taxation of Finnish corporations for the period 1999–2003. The data set also includes information on the principal shareholders[13] of all dividend-distributing corporations; in some analyses we utilize linked data of the dividend-distributing CHCs and their owners.

An important quality of the data is that there is no restriction on the size of the firm or the sector it operates. It covers all Finnish firms that are subject to taxation and thus small firms make up the vast majority of the data. Table 3 gives basic information on the number of all corporations, listed companies, group companies and others (mainly CHCs) in the data. Table 3 also reports in absolute and proportional terms the number of corporations that paid dividends between 1999 and 2003 using the same categorization[14].

Table 3. The number of corporations in the data

	1999	2000	2001	2002	2003
Corporations (total)	**113926**	**115709**	**117899**	**130186**	**143180**
Listed corporations	136	150	151	146	142
Group companies	9814	10826	11614	14468	14023
Others	103976	104733	106134	115572	129015
Corporations that have paid dividends (total)	**37114**	**40028**	**42575**	**45880**	**48788**
Listed corporations	105	100	106	102	101
Group companies	2470	2899	3190	3602	3765
Others	34539	37029	39279	42176	44922
Corporations that have paid dividends per all corporations (total)	**33 %**	**35 %**	**36 %**	**35 %**	**34 %**
Listed corporations	77 %	67 %	70 %	70 %	71 %
Group companies	25 %	27 %	27 %	25 %	27 %
Others	33 %	35 %	37 %	36 %	35 %

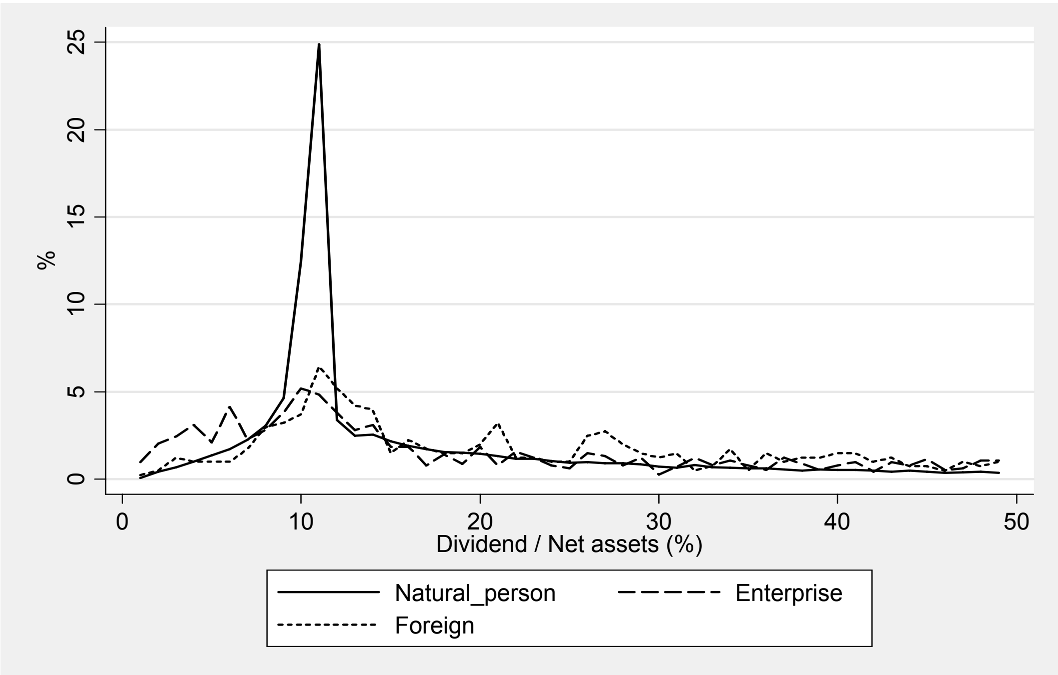
In this article the focus is on the group "others"; this includes closely held corporations and other small corporations owned by another domestic enterprise or a foreign natural person or enterprise. Listed companies and group companies are excluded from the analysis.

[13] The principal shareholder is defined as the one who owns the largest number of shares in the firm.

[14] Appendix 2 illustrates the construction and descriptive statistics of the variables utilized in the analysis.

The income-splitting system analysed concerns dividends from CHCs received by domestic natural persons. Thus, if we hypothesize that the system affects dividend distributions, we expect to see a difference in dividend policies between corporations owned by natural persons and those owned by other owner groups[15]. Figure 1 illustrates the distribution of corporations according to the dividend return (share of dividends relative to the firm's net assets) for three groups of corporations which differ in their ownership structures. Figure 1 gives the intuition that dividend distribution is indeed very much influenced by the splitting system. Distribution by corporations whose principal shareholder is a natural person peaks at around a 10 percent return on the firm's net assets. This corresponds broadly to the upper boundary of normal dividends; 9.585 percent of the firm's net assets.[16]

Figure 1. Dividend return according to owner status, 2003



[15] In 2003 the principal shareholder was the type "natural person" in 41854 dividend-paying corporations. In the same year there were 2857 dividend-paying corporations where the principal shareholder was another enterprise (including all the legal organizational forms) and 578 corporations where the principal shareholder was a foreign natural person or enterprise.

[16] The maximum amount of normal dividend is determined as follows: Grossed up dividends (cash dividend plus imputation credit) are categorized as capital income up to a 13,5 percent return on the firm's net assets (gross assets minus debt). In terms of cash dividends the equivalent rate is 9,585 percent on net assets (see Lindhe et al. 2004).

Figure 2. Dividend return according to share of ownership, 2003

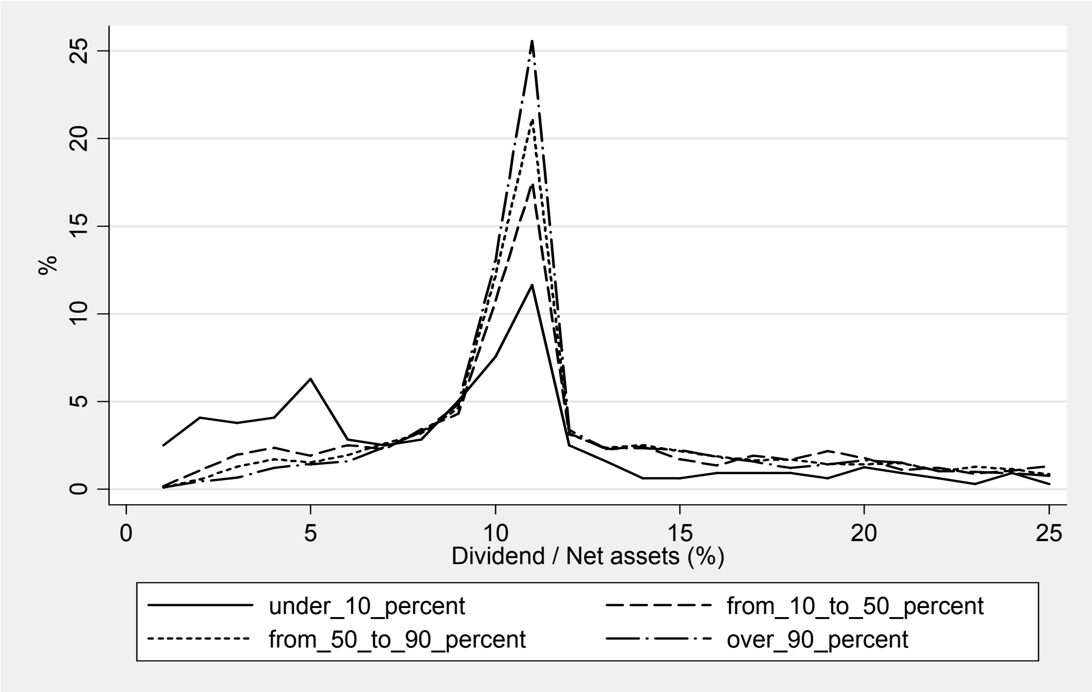
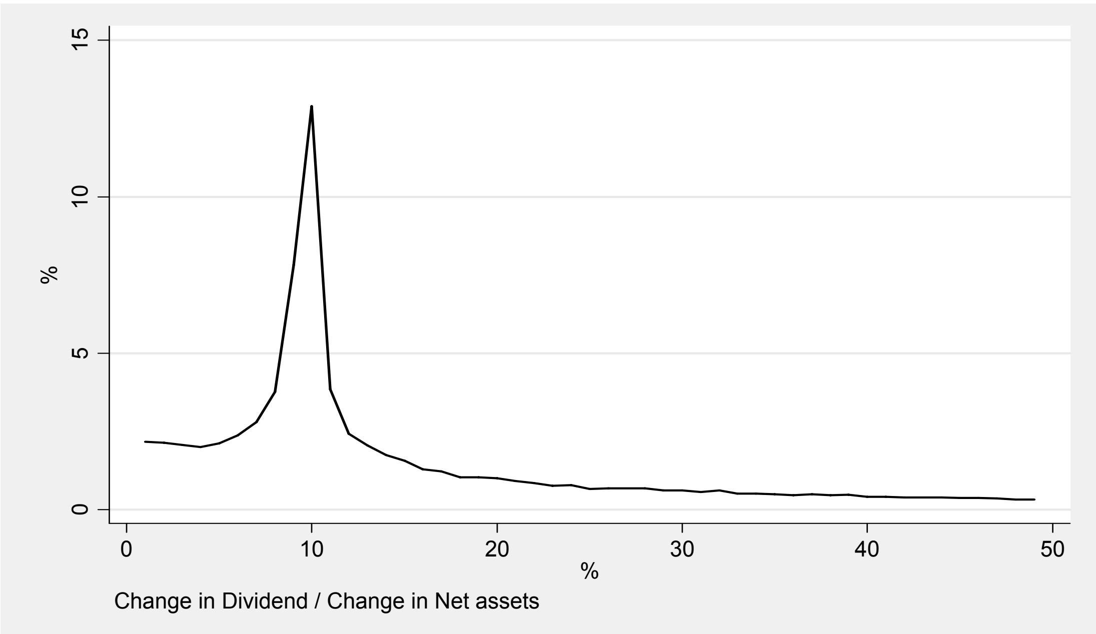


Figure 3. Response of dividends to change in net assets, 1999–2003



On the right hand side of the peak in Figure 1 are corporations that paid dividends taxed partly as earned income. Table 4 shows how dividends distributed by the non-listed corporations for the financial year 2003 were divided between capital and earned income. As can be seen, 80 per cent of distributed dividends were taxed as capital income and only 20 per cent as earned income. In the following we focus on corporations distributing only normal dividends, and leave the questions related to excess dividends for later research.

Table 4. Capital income and earned income as shares of dividends in 2003

	Dividends taxed as capital income	Dividends taxed as earned income
Number of corporations	48677	30073
Mean (€)	194582	78177
Median (€)	8498	9635
Sum (€)	9470 million	2351 million
Average share of distributed dividends	80.2	19.8

In Figure 2 the distribution of cash dividends as a return on the firm's net assets is presented according to the principal shareholder's share of ownership. We observe that also the share of ownership affects the significance of taxation for dividend distribution; the higher the principal shareholder's share of ownership is, the higher is the peak at around 10 percent return and the more dividend distribution is influenced by income taxation. It appears that high share of ownership gives better opportunities for tax planning.

The figure 3 illustrates how dividends respond to changes in net assets among CHCs. The peak is still at around 10 percent return on firm's net assets; a significant proportion of firms have increased (decreased) dividend distribution by exactly the amount that corresponds to the change of the maximum amount of normal dividends.

The graphs presented support our theoretical findings. Firms distribute dividends corresponding to the maximum amount of normal dividends.

5. Estimation methods and results

Our theory predicts that the policy whereby the firm invests in fixed assets continues until the condition $f'=i$ is satisfied. At this point the firm switches to financial investments. The firm saves in financial assets until it reaches a sufficient size of the capital base. However, all the time the firm distributes to dividends amounting $D=\rho N$. In this section we investigate whether there are differences in investment policies of firms as suggested by our theoretical approach. We also test the significance of distribute-and-call-back policy. This analysis includes two steps: first we lay out a binary response model for the case where the dividend distribution exactly corresponds to the maximum amount of normal dividends. We study whether the probability to distribute maximum normal dividends is dependent on financial factors and ownership characteristics of the corporation. The purpose of the second step is to determine the financial factors being primarily associated with the maximum normal dividends. In this analysis we use gradually narrower samples based on dividend distribution and tax rules.

5.1 Discrete model of maximum normal dividends

Method

In our first analysis we investigate the probability that the firm distributes dividends exactly to the maximum amount of normal dividends.

The estimation method is a random effects probit model, which involves an auxiliary distributional assumption on the unobserved heterogeneity. The binary outcome, y_{it}, signifies whether firm i has distributed dividends to the maximum amount taxable as capital income in year t $(y_{it} = 1)$ or not $(y_{it} = 0)$. This is represented by the following:

(22) $$y_{it} = y_{it-1}'\delta + \boldsymbol{x}_{it}'\boldsymbol{\beta} + \upsilon_{it}$$

(23) $$\upsilon_{it} = u_i + \varepsilon_{it},$$

where i indexes corporations and t indexes years. u_i denotes the unobserved firm-specific component that is assumed to be random across firms with $u_i \sim N(0, \sigma^2_\alpha)$. The term $\varepsilon_{it} \sim N(0, \sigma^2_\varepsilon)$ represents random error and is assumed to be independent of u_i. The terms u_i and ε_{it} are also assumed to be orthogonal to the set of covariates, $\boldsymbol{x}$, with an associated parameter vector $\boldsymbol{\beta}$. The model is estimated by maximum likelihood, using unbalanced panel data.

We assume that the probability of distributing dividends amounting to $D=\rho N$ is related to financial factors and the ownership of the corporation. In addition, the firm's growth rate, size and industry are included as additional explanatory variables in the econometric model. The growth rate dummies are included to control for deviations in firms' financial policies[17]. There might be economies of scale in financing, and therefore we control also the size of the firm measured by the logarithm of its employment. Since we do not have access to any other variables needed to control for the industry-level heterogeneity, we only test the significance of industry-level dummies.

The inclusion of the lagged dependent variable, y_{it-1} captures the tendency that may exist for corporations that have paid the maximum normal dividend in one year to continue to do so. We expect that y_{it-1} is positive and statistically significant.

Estimation of the model with lagged dependent variable requires an assumption concerning the first observations, y_{i1}, in particular regarding their relation with the unobserved heterogeneity u_i. We assume that this is exogenous, although we know that this is a very strong assumption. When the initial condition y_{i1} is correlated with the unobservables u_i, this will lead to an upward bias in the extent of persistence in dividend policies. In our case this is very likely, because our examining period is relatively short.

The estimation results from the random effects probit model are presented in Table 6 and Table 7 (Appendix 3). The second specifications include the lagged dependent variable. The third and fourth estimation results include additional control variables. Apart from the last estimation case we use an interval 9 to 10 per cent return on net asset to define the corporations that have paid dividends maximum amount taxable as capital income and therefore get $y_{it} = 1$. In the last estimation the interval in question is 7 to 12 per cent. If the results of the two last estimations differ, we can make some conclusions concerning the sensitivity of the financial factors affecting maximum normal dividend policy.

Table 6 includes the results of estimations where we used the panel data covering all corporations. The results in Table 7 based on data that only includes dividend-paying corporations. We only have information on the ownership of a corporation if the corporation has paid dividends. For that reason no ownership information is used in Table 6.

Combining non-linear models used in microeconometric applications with typical panel data features like an error component structure yields complex models which are difficult to estimate by maximum likelihood. In such cases the GMM approach is a good alternative. The assumed absence of any correlation

[17] Growth is a difference in turnover between two consecutive years. We use three growth rate dummies: negative, 5–10 per cent and over 10 per cent. The reference category is that growth in turnover is 0–5 percent.

between the unobserved heterogeneity and both the regressors and the error term are strong assumptions. These assumptions and the initial conditions problem referred to above can be relaxed by estimating a linear probability fixed effects model for binary response by GMM. The estimation results from the linear probability model are presented in Table 8[18].

Results

A high level of after-tax profit increases the probability of maximum normal dividend distribution. According to our theory, liquidity-constrained immature firms finance investment out of retained profits and neither pay dividends nor issue new shares. The after-tax profit is a statistical significant explanatory variable also when we are considering only dividend-paying corporations (Table 7). That can be interpreted to mean that the maximum normal dividend policy is mostly undertaken by the most profitable firms.

Investments in fixed assets are negatively related to the propensity to distribute dividends amounting to $D=\rho N$. As can be seen from dividend-paying corporations, the level of fixed investments has a statistically insignificant effect on the probability. Immature firms invest in fixed assets and do not distribute dividends, whereas there are no significant differences in investment behaviour between corporations that have paid maximum normal dividends and other dividend-paying corporations.

The opposite holds when considering financial holdings; the probability of distributing maximum normal dividends increases when the corporation's financial holdings increase. This is evident also when we are considering only dividend-paying corporations. This finding gives strong support to our theoretical result of the investment behaviour in CHCs. We argued that firms have an incentive to increase net assets by investing in financial assets and simultaneously pay dividend the maximum amount taxable as capital income.

These conclusions provide support for the findings of investment behaviour and dividend policy of the firm presented in the theoretical part of the article.

It is also interesting to note that the coefficient of the share issues is significant at the 5 percent level in the third estimation in Table 7. This indicates that among dividend-paying firms a new share issue increases the probability of distributing

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[18] Note that now we do not estimate the model including the lagged dependent variable. In that case, due to the correlation between Δy_{t-1} and Δw_{it}, instrumentation becomes necessary to avoid a downward bias on the coefficient of the lagged dependent variable. A popular technique for this is the method developed by Arellano and Bond (1991), who derive a GMM estimator involving an increasing number of instruments beginning at $t-2$ as t increases. However, the time dimension of our data is short so this is not a good approach in our case.

maximum normal dividends. This is consistent with our findings concerning distribute-and-call-back policy in the previous chapters.

The owner dummies are contained in the two last estimations. Because of the data restrictions we are now only considering dividend-paying corporations. When the owner of the corporation is another firm or foreign, the probability of dividends being distributed to the maximum amount of normal dividends decreases. This is exactly what can be expected for tax reasons. The results are consistent with the intuitive presentation in Figure 2.

The lagged dependent variable is highly significant, indicating that, controlling for financial characteristics and unobservable factors, there is a significant degree of persistence in the dividend policies of Finnish corporations.

The results of the linear probability fixed effects model (Table 8) are consistent with the results of the random effects probit model (Table 6 and Table 7). The findings seem to be quite robust to different model specifications[19].

5.2 Models for the factors with the most impact on dividend distribution

Method

In the followings we are interested in the significance of the financial factors being primarily associated with the maximum normal dividends. Generally there are three alternative ways to increase net assets and therefore normal dividends: investments in fixed assets, investments in financial assets and debt repayment. However, now we use debt variables only as controls, because our theory doesn't say anything about debt in corporate finance structure[20]. We have classified the corporations into gradually narrower groups based on dividend distribution and taxation. As a dependent variable we use the firm's dividends/total assets.

Random effects and fixed effects models are the most popular approaches estimating unobserved effects panel data models under a strict assumption of exogeneity of the explanatory variables. The estimated models are in the forms

(24) $$y_{it} = x_{it}'\beta + \alpha_i + \varepsilon_{it} \quad \text{(FE)}$$

(25) $$y_{it} = x_{it}'\beta + \alpha + u_i + \varepsilon_{it} \quad \text{(RE)}$$

[19] It can also be noticed that the results are quite sensitive to the interval of the return on net assets which specifies the corporations that get $y_{it} = 1$.

[20] Intuitively the same incentives apply: debt repayment is actually negative financial investment.

with the same explanations as in the previous binary response models. The fixed effects approach (FE) takes α_i to be a firm-specific constant term in the regression model. Fixed effect model allows for α_i to be arbitrarily correlated with the x_{it}. The random effects model (RE) assumes that unobserved heterogeneity is uncorrelated with the explanatory variables used. The random effects approach specifies that u_i is a firm-specific random element with normal distribution.

We control again the firm's growth rate, size and industry and these variables are included as additional explanatory variables in the model. The question of whether the effects are random or fixed is tested using a Hausman specification test. The estimation results are given in Table 9.

Results

In the first estimations the entire data set is considered. As can be expected, profit has a very significant influence on dividend distribution. It can also be seen that the more the firm invests in real assets, the less it pays dividends; real investments and dividends are more or less alternative uses of funds. They also take in all likelihood places in different growth stages. The influence of financial investments on dividends is positive and significant. This is very much in line with expectations.

In the second estimations we consider corporations that have distributed dividends the maximum amount of normal dividends. In this case we require that dividends correspond 7–12 per cent return on the firm's net assets. There are few differences comparing to the results in the previous case; the significance of financial holdings variable increases, whilst the significance of profit and real investments decreases. Compared to the previous case, this reflects that there are also other factors than profitability aspects behind the dividend decision of these corporations.

The results of the third estimation are in line with previous findings. In this estimation we consider corporations that have distributed dividends the maximum amount of normal dividends and require that dividends correspond to the 9–10 per cent return on the firm's net assets. It can be noticed that the significance of financial holdings increases further and, at the same time, the significance of real investments continues to decrease. This means that of the firms that have paid dividends amounting to $D=\rho N$, much of the increase in net assets is generated by new financial investments and therefore financial investments are important factors explaining distributed maximum normal dividends. This is consistent with the optimal behaviour of the firm under the DIT described in the theoretical part. From our theoretical point of view, when the firm shifts from the first real investments regime to the second real investments regime and to the financial investments regime the empirical observed changes in the firm's investments and financial structure are expected.

In the case of corporations that have distributed dividends up to the maximum amount taxable as capital income, new share issue does not affect dividend distribution. The effect of new share issue falls short of significance. According to these results the distribute-and-call-back policy does not get empirical support.

All in all, the results indicate that in part there are differences in the significance of the variables that are associated with the dividend distribution of different types of firms. In particular, those differences can be approached by classifying corporations according to dividend distribution and tax rules. It is very noticeable that financial investments have most typically associated with dividends in the case of corporations that have distributed dividends to the maximum amount of normal dividends. This suggests that firms increase the amount of normal dividends by investing in financial holdings in a particular stage of the growth path.

We conclude by noticing that the fixed-effects model seems to fit the data well: the results of the Hausman specification tests reject the null hypothesis of random effects. This is consistent with our expectation of the importance of effects that vary across corporations but are constant over time.

6. Conclusion

This paper introduces financial investments into a standard investment model and uses it to analyse the financial and investment policies of a CHC under the Finnish dual income tax. Main aspects of the tax system are high taxation of capital gains on shares compared to dividends, and the dual income tax. The latter element splits dividends using the firm's net assets as the capital base into capital income taxed at a low proportional tax rate and earned income subject to a progressive schedule with high top marginal tax rates.

The results suggest that the potential distortions of the Finnish variant of dual income tax do not necessarily affect real investments, as claimed in earlier literature, but rather financial behaviour. Taxation induces the firm to postpone distributions because of the high tax rate on earned income and instead invest these funds in the financial markets. Through these financial investments the firm increases its net assets and transforms excess dividends into more leniently taxed future normal dividends. As a result the entrepreneur never pays personal taxes on dividends. The CHC is also shown to face an incentive to raise new equity capital to finance additional dividends. This activity, called in literature as distribute-and-call-back policy may lead to a similar outcome. The firm's retained profits are transformed into new equity capital and thus capital gains tax is not paid on the increase in the firm's value of equity.

Empirical evidence based on tax return data supports the hypothesis concerning the effects on dividend policy as well as the effect on financial investment. In particular, the data gives strong support to the hypothesis that it is optimal for the firm to distribute the maximum amount taxable as capital income. A significant proportion of dividend-paying corporations pursue exactly this type of policy. The empirical part also provides evidence that firms increase capital base by investing in financial assets and simultaneously distribute dividends to an amount corresponding to maximum normal dividends. However, the data only lightly supports the hypothesis concerning the tax-induced distribute-and-call-back policy.

The particular incentives to tax planning discussed in this paper may well be a special feature of the Finnish DIT. Other Nordic countries do not include financial assets into the capital base of split. Thus the observed financial investment incentive is probably not faced there. Similarly, Norway and Sweden have taxed retained and distributed profits fairly equally, while Finland has favored dividends. Albeit a Finnish peculiarity, we yet believe that our results provide a useful contribution to the debate on design issues in a dual income tax. The policy conclusion remains ambiguous, however. There seems to be a trade-off between efficiency aspects and adverse effects on tax revenue raised by income shifting.

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Appendix 1

The result *K***<*K**

The inequality $f'(K^{**}) = \frac{1-\tau_c}{(1-\tau_g)(1-\tau_f)} i - \frac{\tau_{ex}-\tau_c}{(1-\tau_f)(1-\tau_{ex})}\rho < i$ holds if

$\tau_g < (\tau_{ex}-\tau_c)\frac{1-\tau_g}{(1-\tau_f)(1-\tau_{ex})}\frac{\rho}{i}$.

Using condition (8) we observe that $\rho/i > 1$, $(1-\tau_g)/[(1-\tau_f)(1-\tau_{ex})] > 1$ and $\tau_g < (\tau_{ex}-\tau_c)$, which allows us to conclude that the tax-rate condition is satisfied.

Long-run value of λ_1 and λ_2

In financial investment phase $\lambda_1 = \lambda_2 = \frac{\rho}{\tau_g(1-\tau_c)i + (1-\tau_g)\rho}$. This value satisfies $1<\lambda_1=\lambda_2<\gamma_n$. The first inequality requires that $\rho>(1-\tau_c)i$, which holds by (9). The second inequality requires that $\tau_g(1-\tau_c)i>0$ which also holds.

Convergence of *F*(*t*)

In the financial investment phase, where $D=D_n=\rho N$ the firm's budget equation is:

(A1) $$(1-\tau_f)[f(K^*)+iF] = \rho N + S.$$

Inserting (A1) to (3) we obtain:

(A2) $$\dot{F} = [(1-\tau_f)i - \rho]F + (1-\tau_f)f(K^*) - \rho K^*,$$

This differential equation is convergent since $\rho > r$ (see (9)), approaching the following equilibrium value

(A3) $$F^* = \frac{(1-\tau_f)f(K^*) - \rho K^*}{\rho - (1-\tau_f)i}$$

Transversality condition

The final regime of the solution must satisfy the following transversality condition[21]:

(A4) $$\lim_{t\to\infty} \lambda_1(t)K(t)e^{-i't} = \lim_{t\to\infty} \lambda_2(t)F(t)e^{-i't} = 0$$

[21] Leonard and Long (1993), Theorem 9.3.1 and Corollary 9.3.2.

This is satisfied in the financial investment phase due to convergence of F and the constancy of K^* as well as the co-state variables. Hence the financial investment regime qualifies for the final regime of the optimal solution.

Appendix 2

Table 5. Financial characteristics of corporations in 1999–2003 (€)

	all corporations					
	N	mean	median	std. deviation	min	max
dividend	119830	287573	16819	5578317	0,01	1438887738
profit	253225	190106	6762	19617684	-2231302403	3070208097
Δ(short-term debt)	167983	201100	248	28289791	-467395212	557828090
Δ(long-term debt)	73108	346539	-3702	33862756	-277754160	364625817
real investments	141162	388483	13596	32260974	0,17	3043126118
Δ(financial holdings)	78949	692264	1265	23987000	-514159360	953702604
share issue	3242	346990	6557	66265140	250	272345657
	dividend distribution					
	N	mean	median	std. deviation	min	max
dividend	119830	287573	16819	5578317	0,01	1438887738
profit	117875	297994	23178	12007009	-70621856	3070208097
Δ(short-term debt)	86085	145743	444	21476422	-241623968	472749926
Δ(long-term debt)	35139	263840	-5046	29901359	-173647232	364625817
real investments	71928	296232	17623	18850614	0,17	1955293696
Δ(financial holdings)	47584	312318	1359	19177160	-514159360	953702604
share issue	1049	389692	5887	8466524	1982	272345657
	maximum dividend taxable as capital income (maximum normal dividend); 7%-12%					
	N	mean	median	std. deviation	min	max
dividend	54641	74331	11480	862801	100	109996008
profit	54390	117494	20417	749448	-6376940	86680600
Δ(short-term debt)	41580	42211	216	10138677	-204163960	93772400
Δ(long-term debt)	16907	78018	-5081	2517389	-107665392	129497136
real investments	32923	113376	18236	1550526	0,17	219706272
Δ(financial holdings)	16037	49477	3856	2926014	-102376856	91633960
share issue	442	23802	5482	2225029	1098	82221185
	maximum dividend taxable as capital income (maximum normal dividend); 9%-10%					
	N	mean	median	std. deviation	min	max
dividend	37006	65626	11353	567571	108	54492888
profit	36840	112597	19975	803566	-6376940	86680600
Δ(short-term debt)	28800	17318	133	1509950	-132717816	85026448
Δ(long-term debt)	11704	14788	-4916	2378493	-107665392	50844284
real investments	21718	93568	17518	748510	0,17	63465120
Δ(financial holdings)	16464	54533	5958	2070595	-102376856	91633960
share issue	378	41490	6482	2122004	2469	82221185

dividend = distributed dividend from year t, (*balance sheet*)
profit = after tax profit in year t (*income statement*)
Δ(short-term debt) = current liabilities in year t minus current liabilities in year t-1 (omitted amounts: advanced paid, accounts payable and deferred income and accrued expenses), (*balance sheet*)
Δ(long-term debt) = long term debts in year t long term debts in year t-1 (omitted amounts: advanced paid, accounts payable and deferred income and accrued expenses), (*balance sheet*)
real investments = gross fixed investments in year t, measured as an increase in net expenditures (*depreciation account*)
Δ(financial holdings) = current financial assets in year t minus current financial assets in year t-1, (*balance sheet*)
share issue = share issue in year t, (*balance sheet*)

Appendix 3

Table 6. Coefficient estimates from random-effects probit model / All corporations

	RE probit (9-10)	Marg. effect	RE probit (9-10)	Marg. effect	RE probit (9-10)	Marg. effect	RE probit (7-12)	Marg. effect
PROFIT								
profit/total assets	3,721 (0,109)**	0,262	2,429 (0,112)**	0,190	3,258 (0,117)**	0,231	2,532 (0,109)**	0,309
FINANCE								
Linked with theory								
real investments/total assets	-1,467 (0,114)**	-0,107	-1,243 (0,095)**	-0,103	-1,126 (0,087)**	-0,095	-1,037 (0,096)**	-0,087
Δfinancial holdings/total assets	2,043 (0,098)**	0,127	1,614 (0,073)**	0,115	1,884 (0,075)**	0,130	1,114 (0,085)**	0,055
share issue/total assets	0,486 (0,294)	0,005	0,341 (0,202)	0,005	0,251 (0,186)	0,003	0,185 (0,126)	0,001
Others								
Δlong-term debt/total assets	-0,931 (0,145)**	-0,081	-0,619 (0,132)**	-0,053	-0,743 (0,082)**	-0,062	-0,969 (0,178)**	-0,074
Δshort-term debt/total assets	-1,217 (0,121)**	-0,096	-1,017 (0,117)**	-0,079	-0,826 (0,103)**	-0,065	-0,837 (0,113)**	-0,082
y_{t-1} (dep. var, t-1)			3,512 (0,091)**	0,327				
OTHER CONTROLS								
growth negative					-0,359 (0,227)	-0,006	-0,274 (0,213)	-0,004
growth 5-10%					0,416 (0,264)	0,011	0,362 (0,221)	0,009
growth >10%					-0,124 (0,072)	-0,010	-0,075 (0,046)	-0,070
ln(employment)					-1,235 (0,271)**	-0,159	-1,139 (0,249)**	-0,151
ln(employment)^2					-0,779 (0,198)**	-0,072	-0,752 (0,181)**	-0,068
industry dummies					yes		yes	
year dummies	yes		yes		yes		yes	
log-likelihood	-55387,443		-52143,287		-62371,229		-60121,887	
ρ (Rho)	0,402 (0,00085)		0,355 (0,0012)		0,429 (0,00068)		0,421 (0,00076)	
pseudo R^2	0,12		0,18		0,21		0,20	
number of obseravations	401258		351544		374378		374378	
number of firms	90251		79145		82899		82899	

The marginal effects are calculated as $d[prob(y=1|\mathbf{x})]/dx_i = \Phi(\mathbf{x}_i'\boldsymbol{\beta})\beta$, where $\Phi(\cdot)$ is a standard normal density function.
A robust estimator as per White is used to estimate standard errors.
** and * denote significance at 0.01 and 0.05 respectively.
The within-firm correlation ρ indicates the proportion of the total variance that is accounted for by the panel variance component. Under a restriction $\rho=0$, the model collapses to the pooled cross-sectional probit model.

Table 7. Coefficient estimates from random-effects probit model / Dividend-paying corporations

	RE probit (9-10)	Marg. effect	RE probit (9-10)	Marg. effect	RE probit (9-10)	Marg. effect	RE probit (7-12)	Marg. effect
PROFIT								
profit/total assets	1,385 (0,086)**	0,182	1,302 (0,087)**	0,180	1,247 (0,077)**	0,171	1,918 (0,117)**	0,225
FINANCE								
Linked with theory								
real investments/total assets	-0,168 (0,090)	-0,009	-0,125 (0,085)	-0,009	-0,156 (0,087)	-0,007	-0,126 (0,088)	-0,006
Δfinancial holdings/total assets	0,788 (0,059)**	0,068	0,664 (0,058)**	0,061	0,784 (0,055)**	0,087	0,639 (0,048)**	0,075
share issue/total assets	0,883 (0,394)*	0,027	0,467 (0,258)	0,010	0,511 (0,226)*	0,023	0,471 (0,246)	0,014
Others								
Δlong-term debt/total assets	-0,197 (0,118)	-0,010	-0,188 (0,122)	-0,009	-0,183 (0,096)*	-0,019	-0,191 (0,112)	-0,010
Δshort-term debt/total assets	0,472 (0,218)*	0,015	0,264 (0,185)	0,007	0,326 (0,203)	-0,005	0,419 (0,213)	-0,005
y_{t-1} (dep. var, t-1)			2,877 (0,077)**	0,386				
OWNERSHIP								
dummy for foreigens	-0,837 (0,079)**	-0,131	-0,447 (0,055)**	-0,117	-0,816 (0,067)**	-0,128	-0,525 (0,064)**	-0,093
dummy for enterprises	-1,241 (0,147)**	-0,175	-1,115 (0,132)**	-0,169	-1,124 (0,173)**	-0,182	-1,011 (0,122)**	-0,138
OTHER CONTROLS								
growth negative					-0,135 (0,071)	-0,003	-0,127 (0,070)	-0,003
growth 5-10%					-0,279 (0,158)	-0,006	-0,254 (0,155)	-0,005
growth >10%					-0,381 (0,222)	-0,009	-0,331 (0,205)	-0,010
ln(employment)					-0,755 (0,171)**	-0,029	-0,759 (0,189)**	-0,025
ln(employment)^2					-0,348 (0,187)	-0,007	-0,327 (0,169)	-0,007
industry dummies					yes		yes	
year dummies	yes		yes		yes		yes	
log-likelihood	-32485,783		-30158,741		-36672,344		-33192,75	
ρ (Rho)	0,296 (0,0031)		0,508 (0,0058)		0,220 (0,0019)		0,288 (0,0028)	
pseudo R^2	0,09		0,11		0,15		0,13	
number of obseravations	81048		64755		76176		76176	
number of firms	22064		16123		20432		20432	

The marginal effects are calculated as $d[prob(y=1|\mathbf{x})]/dx_i = \Phi(\mathbf{x}_i'\boldsymbol{\beta})\beta$, where $\Phi(\cdot)$ is a standard normal density function.
A robust estimator as per White is used to estimate standard errors.
** and * denote significance at 0.01 and 0.05 respectively.

Table 8. *Coefficient estimates from linear probability fixed effects model*

	all corporations 10	9- all corporations 10	9- all corporations 12	7- dividend-paying corporations 9-10	dividend-paying corporations 9-10	dividend-paying corporations 7-12
PROFIT						
profit/total assets	0,442 (0,023)**	0,435 (0,019)**	0,461 (0,031)**	0,149 (0,011)**	0,146 (0,013)**	0,461 (0,031)**
FINANCE						
Linked with theory						
real investments/total assets	-0,293 (0,028)**	-0,251 (0,021)**	-0,193 (0,014)**	-0,020 (0,012)	-0,020 (0,011)**	-0,193 (0,014)**
Δfinancial holdings/total assets	0,315 (0,024)**	0,209 (0,017)**	0,114 (0,025)**	0,097 (0,017)**	0,087 (0,017)**	0,114 (0,025)**
share issue/total assets	0,025 (0,015)	0,014 (0,010)	0,009 (0,007)	0,025 (0,013)	0,011 (0,008)	0,009 (0,007)
Others						
Δlong-term debt/total assets	-0,093 (0,019)**	-0,065 (0,015)**	-0,074 (0,021)**	-0,031 (0,017)	-0,032 (0,015)**	-0,074 (0,021)**
Δshort-term debt/total assets	-0,171 (0,022)**	-0,93 (0,018)**	-0,81 (0,023)**	-0,048 (0,026)	-0,43 (0,021)**	-0,81 (0,023)**
OWNERSHIP						
dummy for foreigens				-0,107 (0,018)**	-0,110 (0,016)**	-0,097 (0,018)**
dummy for enterprises				-0,089 (0,014)**	-0,093 (0,015)**	-0,090 (0,017)**
OTHER CONTROLS						
growth negative		0,009 (0,006)	0,008 (0,005)		0,007 (0,005)	0,007 (0,005)
growth 0-5%		0,024 (0,015)	0,020 (0,013)		0,028 (0,013)*	0,031 (0,014)**
growth >10%		-0,115 (0,073)	-0,097 (0,051)		-0,111 (0,030)**	-0,085 (0,027)**
ln(employment)		-0,089 (0,028)**	-0,096 (0,038)**		-0,089 (0,028)**	-0,090 (0,036)**
ln(employment)^2		-0,053 (0,027)	-0,057 (0,032)		-0,057 (0,029)	-0,054 (0,027)
industry dummies		yes	yes		yes	yes
year dummies	yes	yes	yes	yes	yes	yes
Wald-test (p-value)	2321,49 (0,000)	2985,54 (0,000)	2562,91 (0,000)	1311,28 (0,000)	1589,45 (0,000)	1506,71 (0,000)
Sargan (p-value)	14,14 (0,000)	12,63 (0,001)	12,11 (0,001)	9,50 (0,002)	7,36 (0,006)	8,09 (0,005)
number of obseravations	287454	287454	287454	52742	52742	52742
number of firms	75269	75269	75269	15826	15826	15826

1 Wald test of the joint significance of reported coefficient estimates
2 Sargan test of overidentifying restrictions
3 Dividends correspond 9-10 per cent return on the firm's net assets.
4 Dividends correspond 7-12 per cent return on the firm's net assets
Robust standard errors are reported
** and * denote significance at 0.01 and 0.05 respectively

Table 9. *Coefficient estimates from random-effects and fixed-effects regression models of dividend distribution*

dependent variable: dividends/total assets

	all corporations		**maximum dividend taxable as capital income (maximum normal dividend); 7-12%**		**maximum dividend taxable as capital income (maximum normal dividend); 9-10%**	
	RE	**FE**	**RE**	**FE**	**RE**	**FE**
Linked with theory						
profit / total assets	1,175 (0,361)**	0,922 (0,275)**	0,955 (0,251)**	0,724 (0,155)**	0,713 (0,204)**	0,548 (0,106)**
real investments / total assets	-0,798 (0,226)**	-0,611 (0,223)**	-0,278 (0,071)**	-0,197 (0,078)**	-0,296 (0,083)**	-0,171 (0,074)**
Δfinancial holdings / total assets	0,551 (0,127)**	0,763 (0,171)**	0,337 (0,075)**	0,481 (0,114)**	0,317 (0,052)**	0,533 (0,151)**
share issue / total assets	0,066 (0,042)	0,067 (0,034)*	0,085 (0,062)	0,094 (0,057)	0,091 (0,051)	0,118 (0,070)
Others						
Δshort-term debt / total assets	0,162 (0,083)*	0,094 (0,047)*	0,137 (0,066)*	-0,051 (0,033)	-0,026 (0,012)*	-0,047 (0,023)*
Δlong-term debt / total assets	-0,087 (0,056)	-0,061 (0,045)	-0,034 (0,021)	-0,039 (0,023)	-0,057 (0,035)	-0,019 (0,012)
growth negative	-0,259 (0,186)	-0,174 (0,091)	0,013 (0,010)	0,029 (0,020)	0,028 (0,016)	0,040 (0,027)
growth 5-10%	0,084 (0,039)**	0,087 (0,037)**	0,035 (0,018)	0,022 (0,016)	0,032 (0,020)	0,025 (0,021)**
growth >10%	0,097 (0,042)**	0,116 (0,051)**	0,025 (0,019)	0,023 (0,018)	0,017 (0,010)	0,009 (0,005)
ln(employment)	0,249 (0,091)**	0,191 (0,042)**	-0,088 (0,035)**	-0,092 (0,030)**	-0,133 (0,062)**	-0,151 (0,062)**
ln(employment)^2	-0,171 (0,126)	-0,065 (0,039)	-0,089 (0,049)	-0,071 (0,041)	-0,122 (0,078)	-0,086 (0,051)
constant	-0,252 (0,189)	—	-0,184 (0,129)	—	-0,137 (0,093)	—
industry dummies	yes	yes	yes	yes	yes	yes
year dummies	yes	yes	yes	yes	yes	yes
R^2	0,194	0,392	0,197	0,348	0,211	0,419
Hausman (p-value)	51,25 (0,000)		42,89 (0,000)		36,22 (0,000)	
Wald (p-value)	11532,47 (0,000)	9913,12 (0,000)	8741,95 (0,000)	7619,13 (0,000)	8987,31 (0,000)	8214,43 (0,000)
number of obseravations	299495	299495	66234	66234	57006	57006
number of firms	59899	59899	22689	22689	17051	17051

1 Wald test of the joint significance of reported coefficient estimates
Robust standard errors are reported
3 Dividends correspond 7-12 per cent return on the firm's net assets.
4 Dividends correspond 9-10 per cent return on the firm's net assets
** and * denote significance at 0.01 and 0.05 respectively

Appendix 4

Tax treatment of dividends and capital gains and the dividend decision under dual income tax: Mathematical appendix

A.1 Introduction

In this Appendix we present the mathematical derivation of the main analytical results of the paper. The optimal dynamic solution is derived using the Maximum Principle and a step-wise solution procedure presented in van Hilten et al. (1993). Section A2 introduces the model. Section A3 discusses on how the firm's feasible policy regimes are sorted out from a larger set of potential regimes defined by the model's inequality constraints on control and state variables. Section A4 derives and discusses the optimal dynamic solution.

A.2 The model

The continuous-time model (B1a)-(B1e) below analyses the behaviour of a closely held company (CHC) that maximizes the present value of the flow of after-tax dividends, G, discounted by the after-tax discount rate i', equation (B1a). There are two types of assets in which the firm can invest: real capital, K, generating profits, $f(K)$, with standard properties $f' > 0$, $f'' < 0$, and financial capital, F, with a constant rate of return i, equation (B1b). The start-up value of real capital K_0, financed by an initial equity input, is exogenously given. The firm's only source of financing (after start-up) is profits after corporate income taxes, tax rate being τ_f. These funds are used to dividend distributions, D, and investments in real, I, and financial assets, S , condition (B1c).

To model the dual income tax, dividends D are split into two parts, normal dividends, D_n, subject to taxation as capital income and excess dividends, D_{ex}, taxed as earned income, equation (B1e). Both types of dividends are non-negative (B1d). Normal dividends satisfy $D_n \leq \rho N$ where ρ is the presumptive rate of return and N is the firm's total assets, (B1d) and (B1e).[22]

(B1a) $$\max_{\{D_n, D_{ex}, S\}} \int_{t_0}^{\infty} G\, e^{i'(t-t_0)} dt$$

(B1b) $$\dot{K} = I \quad , \qquad K(t_0) = K_0 > 0$$
$$\dot{F} = S \, ,$$

(B1c) $$(1-\tau_f)[f(K)+iF] = D + I + S,$$

[22] For more on these concepts, see the main text.

(B1d) $D_n \geq 0,\ \rho N\text{-}D_n \geq 0,\ D_{ex} \geq 0,\ F \geq 0$

(B1e) $D = D_n + D_{ex},\ N = K+F$

After-tax dividend income of the owner, G, is defined as

(B2) $$G = \gamma_n D_n + \gamma_{ex} D_{ex},$$

$$\text{with } \gamma_n = \frac{1-\tau_c}{(1-s)(1-\tau_g)}, \quad \gamma_{ex} = \frac{1-\tau_{ex}}{(1-s)(1-\tau_g)},$$

where γ_n and γ_{ex} are valuation factors for normal dividends and excess dividends, respectively. τ_c depicts the tax rate on capital income and τ_{ex} the tax rate on earned income. τ_g is the accrual-effective tax rate on capital gains and s is the rate of imputation credit.

The tax parameters are constants and satisfy the following properties under the assumed dual income tax system:

(B3) $$0 < \tau_g < \tau_c = \tau_f = s < \tau_{ex},\ \ \tau_g < (\tau_{ex} - \tau_c),\ \ \rho > i,$$

where i is the rate of interest, assumed as exogenously given. We further set up the following profitability condition

(B4) $$\frac{(1-\tau_f)f(K^*)}{K^*} > \rho$$

where K^* is given by $f'(K^*)=i$.

Finally, we define

(B5) $$i' = \frac{1-\tau_c}{1-\tau_g} i,\ \lambda_1(K_0) = \lambda_1^0 > \gamma_n.$$

The first element in (B5) defines the standard form discount rate i'. The second element sets up a constraint for K_0 in terms of the shadow price for real capital, λ_1.

The current-value Lagrangean for the basic model becomes:

(B6) $$L = \gamma_n D_n + \gamma_{ex} D_{ex} + \lambda_1 \{(1-\tau_f)[f(K)+iF] - D_n - D_{ex} - S\} + \lambda_2 S + q_1 D_n$$
$$+ q_2[\rho(K+F) - D_n] + q_3 D_{ex} + q_4 F,$$

where λ_1 and λ_2 are co-state variables associated with real and financial capital, respectively, and q_1-q_4 are Kuhn-Tucker multipliers associated with the inequality conditions in (B1d).

The first-order necessary conditions are:

(B7a) $\partial L/\partial D_n = \gamma_n - \lambda_1 + q_1 - q_2 = 0$

(B7b) $\partial L/\partial D_{ex} = \gamma_{ex} - \lambda_1 + q_3 = 0$

(B7c) $\partial L/\partial S = -\lambda_1 + \lambda_2 = 0$

(B7d) $\dot{\lambda}_1 = i'\lambda_1 - (1-\tau_f)f'(K)\lambda_1 - \rho q_2$

(B7e) $\dot{\lambda}_2 = i'\lambda_2 - (1-\tau_f)i\lambda_1 - \rho q_2 - q_4$

(B7f) $D_n \geq 0,\ q_1 \geq 0,\ q_1 D_n = 0;\quad \rho(K+F) - D_n \geq 0,\ q_2 \geq 0,\ q_2[\rho(K+F) - D_n] = 0$

$D_{ex} \geq 0,\ q_3 \geq 0,\ q_3 D_{ex} = 0;\quad F \geq 0,\ q_4 \geq 0,\ q_4 F = 0$

plus the constraints in (B1b) and (B1c).

The transversality condition for the problem is:

(B8) $\lim_{t\to\infty} \lambda_1(t)K(t)e^{-i't} = \lim_{t\to\infty} \lambda_2(t)F(t)e^{-i't} = 0.$

A.3 Selecting the feasible police alternatives

The Kuhn-Tucker conditions in (B7f) generate 16 combinations of binding or non-binding constraints each constituting one policy alternative (regimes) of the firm (see Table A1). In the following we sort out the feasible regimes that satisfy the first-order conditions and other restrictions of our model. We start this procedure by first identifying the infeasible regimes. After that we analyse the feasible regimes and attempt to construct a sequence of regimes that satisfies the transversality condition and the general requirement that there are no jumps in the co-state variables, λ_1 and λ_2. A combination of regimes satisfying all these requirements is the optimal dynamic solution to the problem.

Infeasible regimes

First we focus on a group of regimes (R1-R4 & R9-R12) where the upper and lower constraints for D_n are simultaneously binding. This implies $D_n=\rho N=0$ and clearly requires $N=K+F=0$. The properties of our model, (B1b), (B4) and the concavity of $f(K)$, do not allow this to happen. Hence these regimes can be dropped.

Next we take up those regimes where the firm distributes excess dividends, $D_{ex}>0$. This condition implies using (B7f) that $q_3=0$, and further, by condition (B7b), that $\lambda_1 = \gamma_{ex}$. Using (B7a) and recalling that $\gamma_n > \gamma_{ex}$ we have now $q_2 = \gamma_n - \gamma_{ex} > 0$. This implies, by the Kuhn-Tucker conditions (B7f), that $D_n=\rho N$. Hence, if the firm distributes excess dividends, the upper constraint for D_n is necessarily binding. This enables us to drop regimes R15 and R16, where the firm distributes excess dividends but fails to use up the maximum amount of normal dividends.

Next we exploit the tax-parameter condition (B3). From Table A1 we observe that, in regime R14, the firm's dividend policy satisfies $0\leq D_n\leq \rho N$ implying $q_1=q_2=0$ and further $\lambda_1 = \gamma_n$. From (B7e) we may derive that the regime is feasible on condition $i' = (1-\tau_c)i$. This is only satisfied with $\tau_g=0$, which contradicts our assumptions in (B3). Similarly, R12 is only feasible on condition $i =[(\tau_{ex}-\tau_c)/\tau_g]\rho$, which requires $i > \rho$, assuming $\tau_g<\tau_{ex}-\tau_c$ as in (B3). This is against the restrictions of the tax system, set up in (B3). Regime R11 is dropped using the same argument.

Table A1. The firm's policy alternatives

Name	$\underline{D}_n$	$\overline{D}_n$	$\underline{D}_{ex}$	$\underline{F}$	q_1	q_2	q_3	q_4	Feasible?
R1	b	b	b	b	+	+	+	+	no
R2	b	b	b	n	+	+	+	0	no
R3	b	b	n	b	+	+	0	+	no
R4	b	b	n	n	+	+	0	0	no
R5	**b**	**n**	**b**	**b**	+	**0**	+	+	**yes**
R6	**b**	**n**	**b**	**n**	+	**0**	+	**0**	**yes**
R7	b	n	n	b	+	0	0	+	no
R8	b	n	n	n	+	0	0	0	no
R9	**n**	**b**	**b**	**b**	**0**	+	+	+	**yes**
R10	**n**	**b**	**b**	**n**	**0**	+	+	**0**	**yes**
R11	n	b	n	b	0	+	0	+	no
R12	n	b	n	n	0	+	0	0	no
R13	n	n	b	b	0	0	+	+	no
R14	n	n	b	n	0	0	+	0	no
R15	n	n	n	b	0	0	0	+	no
R16	n	n	n	n	0	0	0	0	no

*) 'b'~ binding constraint, 'n'~non-binding constraint, '+'~ $q_i>0$, '0'~ $q_i=0$

Finally, regime R13 is a steady state regime with $D\leq\rho N$, $F=0$ and K^+ as the stationary stock of real capital satisfying $f'(K^+)=i'/(1-\tau_f)$. When comparing this to the corresponding condition for K^*, we observe that $K^+<K^*$. Using the firm's budget equation (B3) we observe that the firms after-tax average return on capital

satisfies $(1-\tau_f)f(K^+)/K^+<\rho$. Due to concavity of $f(K)$ this contradicts with the assumption (B4). Hence we drop regime R13.

Feasible regimes

We are now left with regimes R5, R6, R9 and R10, which all pass the feasibility test. Regimes R5 and R9 both satisfy F=0. Dividend policies differ however. While no dividends are distributed, D=0, in R5, the upper constraint for normal dividends is binding, $D=\rho N$, in regime R9. Using (B2), (B3) and the profitability condition (B4) we now observe that both satisfy

(B9) $$\dot{K} = (1-\tau_f)f(K) - D > 0$$

with D=0 in regime R5 and $D=\rho N$ in regime R9. Both regimes are thus internal growth regimes in the sense that the firm uses internal financing to grow its stock of real capital K.

These regimes also satisfy

(B10) $$f'(K) > i\,,$$

which makes it easy to understand why the firm prefers investments in real capital to investments in financial assets (with a fixed rate i).

Regimes R6 and R10 both allow $F\geq 0$. Similarly, using (B7c), (B7d) and (B7e), they both satisfy

(B11) $$f'(K) = i\,.$$

This implies a stationary value of $K=K^*$. The equation of motion for F is from (B1b) and (B1c)

(B12) $$\dot{F} = (1-\tau_f)(f(K^*) + iF) - D$$

with D=0 in regime R6 and $D=\rho N$ in regime R10. Equation (B12) implies that F converges in regime R10 to a stationary value

(B13) $$F^* = \frac{(1-\tau_f)f(K^*) - \rho K^*}{\rho - (1-\tau_f)i}$$

In regime R6, however, F diverges growing at the constant rate $(1-\tau_c)i$.

Let us next look at the values of the co-state variables λ_1 and λ_2 in regimes R6 and R10. Using conditions (B7a) and (B7e), the definitions for γ_n and i' we obtain for regime R10:

(B14) $$\lambda_1 = \lambda_2 = \frac{\rho}{\tau_g(1-\tau_c)i + (1-\tau_g)\rho}$$

Thus, the co-states are constant and can be shown to satisfy $1 < \lambda_1 = \lambda_2 < \gamma_n$. The former inequality holds if $\rho > (1-\tau_c)i$ and the latter if $\tau_g(1-\tau_c)i > 0$, which both conform to our assumptions in (B3).

For regime R6, equations (B7a) and (B7c) and the values of the shadow prices imply $\lambda_1 = \lambda_2 = \gamma_n + q_1 \geq \gamma_n$. Further, from (B7e) we conclude that the co-states grow constantly at rate $\tau_g(1-\tau_c)i/(1-\tau_g)$.

The transversality condition (B8) is satisfied for regime R10 due to convergence of F, constancy of K and constancy of the co-state variables. Regime R6, however, does not satisfy the condition due to divergence. This means that R10 is the only feasible candidate for the final regime of the optimal solution.

A4 Optimal solution

The solution can be found by constructing a sequence of feasible regimes under which the state and co-state variables develop continuously from their initial values to their steady state values. Based on information given in table A2 it is obvious that the optimal solution includes a phase where the firm grows its stock of real capital from the start-up value K_0 to the final value K^*. Comparing the values of co-state variables in different regimes it is similarly clear that the internal growth phase occurs in the two regimes R5 and R9.

Table A2. Summary of feasible regimes

	K	$\dot{K}$	F	$\dot{F}$	D	λ_1, λ_2
Start-up	$=K_0$	$=0$	$=0$	$=0$	$=0$	$\lambda_1=\lambda_2 > \gamma_n$
Regime R5	>0	>0	$=0$	$=0$	$=0$	$\lambda_1=\lambda_2 \geq \gamma_n$
Regime R6	$=K^*$	$=0$	≥ 0	>0	$=0$	$\lambda_1=\lambda_2 \geq \gamma_n$
Regime R9	>0	>0	$=0$	$=0$	$=D_n$	$\lambda_1=\lambda_2 \leq \gamma_n$
Regime R10	$=K^*$	$=0$	≥ 0	≥ 0	$=D_n$	$1< \lambda_1=\lambda_2 < \gamma_n$

Regime R6 cannot be a part of the solution. It does not qualify for the final regime nor can it be connected continuously to other feasible regimes in the role of an intermediate regime. The string of regimes describing the solution to the problem is thus:

Initial investment => Regime R5 => Regime R9 => Regime R10.

The solution includes a two-step internal growth phase where the firm grows its stock of real capital from the start-up value K_0 to its steady state level K^*. While in the first phase of internal growth, R5, the firm uses all its internal financing to investments, in the second phase the firm distributes $D=\rho N$ and invests the rest of after tax profits. Intuition to the firm's policy is given in the main text. After the firm's capital stock has reached the value which satisfies $f'=i$, the firm switches to the final regime where it continues to distribute $D=\rho N$, but uses the remaining funds to financial investments. This policy continues until condition (B13) is satisfied. At this stage all of the firm's after-tax cash flow is used to normal dividends $D_n = (1-\tau_f)[f(K)+iF]$. Excess dividends are never paid out.

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