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By *Tobias Lindhe*, *Jan Södersten*, and *Ann Öberg*

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I. Introduction

Following the major tax reforms in the beginning of the 1990's, the Nordic countries abandoned the conventional global income tax in favor of a so-called dual income tax (Sörensen 1998). Under a global income tax, a single progressive tax schedule is applied to the sum of the taxpayer's income from all sources. A dual income tax system, as used in the Nordic countries today, instead combines progressive taxation of labor income with a flat rate of tax on capital income. There were several reasons for the introduction of the dual income tax system, including a desire to reduce the distortionary effects of progressive income taxation in an inflationary environment, to strengthen private savings incentives, and generally to limit the scope for tax arbitrage.[1]

Under the Nordic dual income tax, capital income is taxed at a lower rate than the top marginal tax rates on labor income, and the preferential tax treatment of capital income is reinforced because of the fact that social security taxes are levied only on labor income. Thus, the taxpayer's total tax bill depends not only

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[1] *Hagen* and *Sörensen* (1998, pp. 57) and *Agell*, *Englund*, and *Södersten* (1996, pp. 645).

on his total income, but also on his income division. This has created new room for tax avoidance, especially for owners of small business firms who are able to lower tax payments by transforming labor income subject to high marginal tax rates into capital income subject to low tax rates. Indeed, small business firms, where labor and capital income accrue jointly, have been judged to be the "Achilles heel" of the dual income tax (Sörensen 1994; cf. also Cnossen 1997).

To combat tax avoidance in small business firms, the Nordic governments have introduced alternative methods of income splitting, known in the taxation literature as the *fence model* and the *source model* (see Hagen and Sörensen 1998, pp.42, for a full discussion). The fence model attempts to separate (and tax differently) income retained within the business, from income withdrawn for private purposes, whereas the source model splits business earnings into income from capital and income from labor. The two methods have also been combined in various ways, depending on whether the business activity is legally organized as a *closely held* (or *closed*) *corporation*, as a *sole proprietorship* or as a *partnership.*

The purpose of this paper is to analyze the tax treatment of closely held corporations (CHC) in the Nordic countries. Though the partnership form and the sole proprietor form are close substitutes in organizing small firms, the tax rules of these forms of organization differ sufficiently to warrant a separate paper. In the tax treatment of CHC, the Nordic governments have mainly focused on the source model as a method of income splitting, though, depending on country, some elements of the fence model have been introduced as well. Moreover, the basic approach is that the capital income component is imputed, and the residual business income is categorized as labor income.

In Norway, where the source model is more consistently applied than in the other countries, the *pre-tax* income of the CHC is split independently of the dividend decision, into one part which is deemed to represent income from capital, and another (residual) part which is basically taxed as earned income. In Sweden, the imputed income from capital determines the tax treatment of cash dividends and capital gains. If actual dividends (and capital gains) exceed the imputed income, the difference is taxed as earned income of the shareholder. The Finnish CHC-rules determine only the tax treatment of cash dividends, which means that the system is somewhat closer to a fence model. In the following, we will call this a *graduated dividend tax scheme*. Another difference between the countries is how the imputed capital income is calculated. In Sweden, a presumptive rate of return is applied to the acquisition price of the shares (plus the presumptive return from past years not withdrawn as dividends), while in Finland and Norway, the return is applied to the net or gross business assets.

Tax-motivated shifting of income between different tax bases has attracted some interest in recent research. Gordon and MacKie-Mason (1995) have investigated two forms of payout from corporations to owners, as wages and dividends, and have found that individuals easily can lower tax payments by shifting their form of pay. In a related study, the authors examine tax distortions to the choice of organizational form (Gordon and MacKie-Mason 1994).

Nordic research within this area includes an exploratory empirical investigation of tax shifting behavior, based on data of single owners and their corporations in Norway, carried out by Fjaerli and Lund (2001). Earlier, Andersen (1994a; 1994b), has examined how taxes affect the way firms are organized and tax neutrality with respect to the legal form of organization. An important issue relating to the taxation of the CHC is the economic function of risk-bearing. The incentives for risk-taking have been studied by Sannarnes (1995) and by Hagen and Sörensen (1998). Both of these studies conclude *inter alia* that a dual income tax that treats residual business income as labor income may tend to encourage risk-taking, compared to a tax regime where all rewards to risk-taking are taxed as income from capital.

A recent study by Kari (1999), which is more directly related to the analysis in the present paper, focuses on the splitting of dividend income into capital and earned income parts. A dynamic deterministic model in continuous time is used, closely following the approach in Sinn (1991). Kari's study amounts to comparing the firm's behavior under a graduated dividend tax system to that under a linear system, and he finds that the long run neutrality of dividend taxation with respect to investment decisions, shown by Sinn, breaks down when a graduated tax scheme is introduced. However, by ignoring the owner's possibility to choose between wages and dividends as alternative forms of withdrawing earnings from the firm, Kari leaves out much of the complexity of the problem of taxing CHC.

To analyze the economic effects of the special rules introduced for CHC in the Nordic countries, we set up a dynamic model, which is related both to the standard neoclassical model of firm behavior, as used in the taxation literature, and to the static farm household model, see Hamermesh (1993). The owner of a CHC is assumed to maximize her utility, and determines the optimal trade-off between consumption and savings, between work and leisure, between how much labor effort to put into the own firm and how much to supply in the external market, and the optimal size and time path of the firm's capital stock. Though the model captures important aspects of the economic behavior of the CHC, it also ignores potentially interesting issues such as the impact on risk-taking and its interaction with the owner's occupational choice.

By examining the long run cost of capital we conclude that the Swedish scheme of taxing CHC is neutral in its impact on the allocation of resources between CHC and widely held corporations (WHC), and, moreover, that the cost of capital is invariant to the rate at which capital income is imputed to the owner. The Finnish system, where the net assets of the corporation (rather than the acquisition cost of the shares as in Sweden) form the basis for imputing income from capital, rather increases the attractiveness of investing in CHC, and thereby reallocates capital to this sector of the economy. The Norwegian scheme, finally, may or may not cause the cost of capital to be different from that of WHC. The exact outcome hinges on the relationship between the rate of imputing capital income and the owner's pre-tax rate of return requirement.

This paper is organized as follows. In chapter II, following this introduction, we describe the Nordic rules for taxation of CHC. Chapter III provides a derivation of the theoretical framework. In chapter IV, we proceed to examine the economic effects of taxation focusing on the CHC's long run and short run cost of capital. Using numerical simulation we explore a growth path for the firm of the type suggested by Sinn (1991). This chapter also contains a brief discussion of the effects of taxation on the owner's labor supply. Chapter V summarizes and concludes the study.

II. Tax Legislation in the Nordic Countries[2]

Table 1 gives a stylized picture of the tax treatment of income from labor and income from capital in the Nordic countries.

Though the total tax on income from capital – measured as the combined weight of the tax on corporate profits and the personal tax on dividends – differs considerably between the countries (dividends are only taxed once – at the corporate level – in both Norway and Finland), it is clear that there are strong tax incentives to transform labor income into capital income in all countries. We will describe how the Nordic governments have attempted to prevent such income shifting by enacting special rules for the CHC.

[2] Danish tax does not apply special tax rules for owners of CHC. These corporations are simply taxed according to the general tax rules applying to all other corporations (cf. *Sörensen* 1998).

Table 1

Summary of Nordic Tax Parameters in 2000 (in %)

Item	***Sweden***	***Norway***	***Finland***
Statutory rate of corporation tax (τ)	28	28	29
Tax rate on personal capital income (τ_{pi})	30	28	29
Personal tax on dividends (τ_{pd})	30	0[3]	0[4]
Total tax on income from corporate capital[5]	**49.6**	**28**[6]	**29**
Labor income tax (τ_{pw})[7]	57[8]	49.3[9]	50.13[10]
General payroll tax (p)	32.92	14.1[11]	18-29[12]
Total tax on labor income[13]	**67.6**	**55.6**	**61.3**

Source: Tax parameters in Sweden and Finland: Ministry of Finance, Sweden, Tax Commission 1999:12. Tax parameters in Norway: Ulf Pedersen, Ministry of Finance, Norway. The authors' own calculations.

1. Sweden

A CHC in Sweden is defined as a corporate business with one or a few active owners. People close to the owner count as one single person. The tax code allows dividends to be taxed as capital income only when equal to or less than an imputed return on the acquisition price of the shares.[14] The imputed return is

[3] In 2001, because of the imputation system the effective tax rate is zero for dividends up to the *personal income* (for definition see Norway below), and 11 percent for dividends above the limit.

[4] Finland uses an imputation system implying an effective tax rate of zero.

[5] Defined as: $\tau + (1-\tau)\tau_{pd}$, where τ is the corporate tax rate and τ_{pd} is the personal dividend tax rate.

[6] In 2001, we define the total tax as: $\tau = 0.28$, where $\tau + (1-\tau)\tau_{pd} = 35.9\%$ and $\tau_{pd} = 0.11$.

[7] The labor income tax consists of a national and local tax.

[8] For income exceeding 374 000 SEK.

[9] For income between 277 800 and 762 700 NOK.

[10] For income between 178 000 and 315 000 FIM.

[11] 26.6% for labor income exceeding 774 000 NOK.

[12] According to the corporation's size and type of industry.

[13] Defined as: $\frac{p+\tau_{pw}}{1+p}$, where p is the payroll tax rate and τ_{pw} is the labor income tax rate.

[14] For shares acquired before 1990, the acquisition cost may be adjusted to changes in the general price level. An alternative rule allows the owner of older shares to base the calculation of normal dividends on the difference between the corporation's assets and liabilities.

set equal to the interest rate on 10-year government bonds[15] plus a ”risk premium” of five percentage points. In the following we will denote dividends not exceeding this imputed return as *normal dividends*. If actual dividends exceed this level, the difference, called *excess dividends*, is taxed as labor income. When actual dividends are less than the imputed income, an amount equal to the difference may be taken out as a normal dividend (or realized capital gain) in a later year. Until distributed, the amount is added to the basis for calculating the imputed income. The rules for taxing capital gains on the shares of CHC state in principle that gains not exceeding whatever part of the imputed return that in the past has not been withdrawn as normal dividends be taxed as capital income. Half of the capital gains exceeding this limit are treated as labor income, and the other half as capital income. There is, however, also an upper limit to the amount of capital gain, which may be taxed as labor income.[16] Gains above the limit are taxed at the capital income tax rate.

Sweden operates a classical system of corporate taxation. Since 1997, however, a partial mitigation of double taxation of dividends is offered for shares in unlisted corporations. For CHC, this rule implies that a certain part of normal dividends (see above) may be excluded from taxation.[17] This tax relief at the shareholder level can be saved and used in a later year. Furthermore, part of the firm’s wage bill may be added to the acquisition price of the shares when determining the amount allowed as normal dividends. We have excluded both this so-called *wage-addendum*[18] and the double tax relief in the calculations as an attempt to illustrate the economic effects in the simplest way possible.

2. Finland

A CHC in Finland is defined as a corporate firm not listed on the stock exchange. Finland has adopted a similar version of the income-splitting rule used in Sweden. However, the capital income part is calculated as an imputed return on the net assets of the business.[19] In 2000, this return was set to 13.5 percent. As in Sweden, if actual dividends exceed the imputed income, the difference is taxed as labor income. However, actual dividends less than the presumptive return cannot be used for tax purposes in a later year. Finland mitigates the double taxation of corporate income by using an imputation system. Double taxation is completely eliminated, since the “rate of imputation” equals the corporate tax rate for distributed income. Capital gains on shares in CHC are only subject to capital income tax at the time of realization.

The Finnish scheme for taxing owners in CHC is relatively simple, compared to the corresponding tax laws in Norway and Sweden. However, the system

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[15] The Swedish term is “Statslåneräntan”.

[16] In 1999, the amount was set to 3 640 000 SEK.

[17] The Swedish term is ”Lättnadsbelopp”, which is calculated according to a presumptive return (the interest rate on government bonds multiplied by seventy percent) on the acquisition price of the shares.

[18] The Swedish term is ”Lönesummetillägg”.

[19] Assets are valued at book value or at the tax assessed value.

seems to offer generous opportunities for tax-avoidance by transforming labor income into capital income. For instance, by underreporting labor income retained corporate profits will increase and inflate share values. Since capital gains on shares are only subject to capital income tax, considerably lower than the highest marginal income tax rates, less will be paid in tax.

3. Norway

A CHC in Norway is defined as a corporate business where at least two-thirds of the shares are owned by active shareholders. As in Sweden, people close to the owner count as one single person. The Norwegian tax rules are also based on a system that splits the income of CHC into two parts, denoted *personal income*[20] and capital income. However, this is done independently of how the owner withdraws the income. The residual business income in Norway is taxed as personal (labor) income even if the profits are not actually distributed. Norway has chosen a "gross" method of income-splitting. Thus, the presumptive rate of return – equal to the government's borrowing rate plus five percentage points – is applied to total assets of the corporation, with no deductions for financial liabilities (Hagen and Sörensen 1998, pp. 59). Also Norway operates an imputation system to mitigate corporate double taxation, but according to a recent change in the rules, the "rate of imputation" is less than the corporate tax rate for distributed income.[21]

Capital gains on shares in CHC are always regarded as capital income. There is also an upper limit to the amount declared as personal income, which may be taxed as labor income.[22] Personal income above this limit is taxed at the capital income tax rate. Another rule, similar to the Swedish wage-addendum scheme, is that owners in CHC are allowed to make a "wage deduction" amounting to 20 percent of their wage bill from taxable personal income. As in Sweden, the wage deduction is excluded in the analysis.

III. The Model

We examine the economic behavior of a CHC by setting up a dynamic model, where the owner is assumed to maximize the utility of her immortal extended family (Barro and Sala-i-Martin 1995, p. 60). We begin by explaining the various constraints faced by the firm and the owner, and we then derive the optimality conditions. To keep the analysis within manageable proportions, debt finance is ignored.

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[20] The Norwegian term is "Personinntekt".

[21] Described in table 1.

[22] In 2000, the amount was set to 774 032 NOK.

1. The Owner's Objective and Constraints on Behavior

The owner of the CHC maximizes the present discounted value of utility written as[23]

(1) $$V = \sum_{s=t}^{\infty} \frac{1}{(1+\beta)^{s-t}} \{U(C_s, Z_s)\},$$

where utility is derived from consumption C_t and leisure Z_t, and the discount rate β equals the owner's rate of time preference. We assume there is an external labor market for the owner, which means that the owner may choose between devoting all available non-leisure time to running her own business and working part-time in the own firm and become employed in another business. The amount of leisure time is determined as the residual

(2) $$Z_t = T - L_t^* - L_t^e,$$

where T is time endowment, L_t^* is work effort in the own firm and L_t^e is the amount of labor supplied in the external market.

To determine the owner's consumption C requires several steps that will be explained in equations (3) to (14) below. The CHC's budget constraint in period t is a cash flow identity, where, net of corporate tax τ, capital inflow equals capital outflow

(3) $$(1-\tau)\left(F\left(K_t, L_t, L_t^*\right) - (1+p)\left(wL_t + W_t^*\right)\right) + N_t = D_t + I_t .$$

The production function $F\left(K_t, L_t, L_t^*\right)$ depends on the stock of capital K_t, on the owner's labor effort L_t^* and on labor L_t, which is hired at the wage rate w per unit of time. The amount withdrawn as the owner's wage income W_t^* is not contingent on the amount of effort put into the firm by the owner, but is instead determined as a result of the owner's tax planning activity, which we analyze below. Further, p is the payroll tax that is levied both on the owner's and the employees' wage bills. D_t denotes dividends as defined in the firm's accounts. To keep the model simple, capital depreciation is ignored, which implies that investment I_t in (3) is given by the change in the capital stock

(4) $$K_{t+1} - K_t = I_t .$$

The amount of new share issues N_t in (3) is constrained to be greater than or equal to zero, ruling out repurchases of own shares, i.e.

(5) $$N_t \geq 0 .$$

[23] Equation (1) implicitly assumes that the shares of the corporation may be inherited by the succeeding generations of the dynasty without inheritance or capital gains taxes.

A CHC can use either dividends D or wages W^* as channels to transfer business income to its owner. There is no legal restriction on which channel to use, and the owner's choice is therefore solely dependent on the relative tax treatment[24], a matter we return to below.

Sweden, Finland and Norway make use of somewhat different approaches for dividing the business income of CHC into capital income and wage income. These approaches give rise to different personal tax functions that, in turn, affect the owner's cash flow and budget constraint. In the next three subsections we will derive these functions for each country and then proceed to solve the owner's optimization problem.

Sweden

In Sweden income withdrawn from the firm as owner's wages is taxed at the rate τ_{pw} at the personal level.[25] However, income distributed as dividends can be taxed at two different rates. In hands of the owner, *normal dividends*, denoted as R_t, are taxed at the personal dividend tax rate τ_{pd}, whereas *excess dividends* $(D_t - R_t)$ are taxed as labor income, at the rate τ_{pw}, where $\tau_{pw} > \tau_{pd}$. It must hold that

(6) $$D_t \geq R_t \ ,$$

and we also require

(7) $$R_t \geq 0 \ .$$

The amount taxed as normal dividends, i.e. at the rate τ_{pd}, is limited to

(8) $$R_t \leq \rho E_t + (1+\rho) B_{t-1} \ ,$$

where ρ is the rate of imputed return discussed in chapter II, and E_t equals the acquisition cost of the firm's shares. If the CHC does not distribute income any given year, or distributes less than the maximum amount allowed by the tax code as normal dividends, the excess may be saved (in a tax accounting sense) for later years, including interest compounded at the rate ρ. We let B_{t-1} denote the accumulated amount of such unused normal dividends, inherited from the past.

The firm adds to the acquisition cost of its shares by issuing new equity, according to

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[24] However, the owner may earn social security benefits by declaring wage income, see equation (17) below.

[25] We assume that ι_{pw} is constant even though wage income in practice is taxed according to a progressive rate schedule. This assumption may still be justified on the ground that the marginal tax rate actually stays constant over a fairly wide range, cf. the discussion in *Kari* (1999).

$$E_t - E_{t-1} = N_t \; . \tag{9}$$

The stock of unused normal dividends evolves over time as

$$B_t - B_{t-1} = \rho E_{t-1} + \rho B_{t-1} - R_t \; , \tag{10}$$

and we require that

$$B_t \geq 0 \; . \tag{11}$$

The personal taxes paid by the Swedish owner on business income withdrawn from the firm add up to

$$TAX_t^S = \tau_{pd} R_t + \tau_{pw}(D_t - R_t) + \tau_{pw} W_t^* \; , \tag{12}$$

and the owner's after-tax cash flow from the CHC is therefore obtained as

$$M_t^S \equiv D_t + W_t^* - TAX_t = (1-\tau_{pw})(D_t + W_t^*) + (\tau_{pw} - \tau_{pd})R_t \; . \tag{13}$$

The amount of consumption C_t , finally, then follows from the owner's budget constraint

$$\begin{aligned} C_t^S = {} & (1-\tau_{pw})(D_t + W_t^*) + (\tau_{pw} - \tau_{pd})R_t - N_t + \\ & (1-\tau_{pw})w_t^e L_t^e + b_t - (1 + i(1-\tau_{pi}))b_{t-1}. \end{aligned} \tag{14}$$

The first row on the right hand side of (14) is the cash flow from the corporation, net of the owner's investment in new shares. The term $(1-\tau_{pw})w_t^e L_t^e$ is the after-tax wage income from external work and the last two terms represent net personal borrowing, where *i* is the interest rate and τ_{pi} is the personal tax rate on interest income.

Finland

Finland has adopted a graduated dividend tax scheme similar to that in Sweden, but the rules differ in two important ways. First, the amount taxed as income from capital ("normal dividends" in the terminology of the Swedish tax code), is determined on the basis of the firm's net assets. For the all-equity firm assumed here, the basis is thus the capital stock, *K*. If underutilized, normal dividends cannot be saved for reducing taxes in later years. This means that constraint (8) changes to

$$R_t \leq \rho K_t \; , \tag{8F}$$

while the restrictions (9), (10) and (11) used in the case of Sweden may be ignored. Second, Finland uses an imputation system for mitigating the double taxation of corporate income, both for CHC and WHC. If ϕ is the rate of imputation,

$\frac{D}{1-\phi}$ may be interpreted as the pre-tax earning behind the dividend. This amount is split into normal dividends R, taxed at the personal tax rate on capital income, τ_{pi}, and income from labor, $\frac{D}{1-\phi}-R$, taxed at the rate τ_{pw} (corresponding to "excess dividends" in the Swedish case). As an offset to this, the owner is offered an imputation credit of $\phi\frac{D}{1-\phi}$. The owner's tax liability is therefore

(12F) $$TAX_t^F = \tau_{pi}R_t + \tau_{pw}\left(\frac{D_t}{1-\phi_t} - R_t\right) - \phi\frac{D_t}{1-\phi} + \tau_{pw}W_t^*,$$

where the base of the labor income tax is required to be non-negative, i.e. restriction (6) is changed to

(6F) $$\frac{D_t}{1-\phi} \geq R_t.$$

We then derive the cash flow to the Finnish owner

(13F) $$M_t^F \equiv D_t + W_t^* - TAX_t = (1-\tau_{pw})\left(\frac{D_t}{1-\phi} + W_t^*\right) + (\tau_{pw} - \tau_{pd})R_t,$$

and her personal budget constraint (cf. equation (14)) is therefore

(14F) $$C_t^F = (1-\tau_{pw})\left(\frac{D_t}{1-\phi} + W_t^*\right) + (\tau_{pw} - \tau_{pi})R_t - N_t + (1-\tau_{pw})w_t^e L_t^e + b_t - (1+i(1-\tau_{pi}))b_{t-1}.$$

Norway

The Norwegian scheme differs from its counterparts in Finland and Sweden in that corporate income is split into capital income and so called *personal income*, independently of how much that is withdrawn from the corporation as dividends. As in Finland, the capital income part equals a presumptive rate of return times the capital stock. The amount of personal income, denoted as P, is obtained by subtracting total labor costs and capital income from the firm's gross earnings[26]

(15) $$P_t = F(K_t, L_t, L_t^*) - (1+p)(wL_t + W_t^*) - \rho K_t.$$

[26] We ignore here the wage-addendum deduction described in chapter II. This deduction may not be used to reduce P below a certain threshold and because of this, it will not affect the results of our analysis.

The personal income is taxed at the rate τ_{pp} [27], to be distinguished from the rate τ_{pw} which applies to the owner's wage income W^*. We require that

(16) $$P_t \geq 0 ,$$

as a simple way to capture the assumption that the declaration of negative personal income does not generate any refund of tax. Constraint (6) simplifies to

(6N) $$D_t \geq 0 ,$$

while constraints (7) – (11) are not applicable to Norway.

Also Norway makes use of an imputation system, and to simplify the exposition, we let τ_{pd} be the effective rate of personal tax on dividends.[28] In the case of CHC, however, the dividend tax applies only to dividends in excess of declared personal income. The personal tax liability on total cash withdrawals by the Norwegian owner is therefore

(12N) $$\begin{aligned} TAX_t^N &= \tau_{pw} W_t^* + \tau_{pp} P_t + \tau_{pd} (D_t - P_t) \\ &= \tau_{pw} W_t^* + \tau_{pd} D_t + (\tau_{pp} - \tau_{pd}) P_t . \end{aligned},$$

This implies a cash flow to the owner of

(13N) $$\begin{aligned} M_t^N &\equiv D_t + W_t^* - TAX_t \\ &= (1 - \tau_{pw}) W_t^* + (1 - \tau_{pd}) D_t - (\tau_{pp} - \tau_{pd}) P_t , \end{aligned}$$

and the Norwegian owner's personal budget constraint (cf. expression (14)), becomes

(14N) $$\begin{aligned} C_t^N &= (1 - \tau_{pw}) W_t^* + (1 - \tau_{pd}) D_t - (\tau_{pp} - \tau_{pd}) P_t - N_t \\ &+ (1 - \tau_{pw}) w_t^e L_t^e + b_t - (1 + i(1 - \tau_{pi})) b_{t-1} . \end{aligned}$$

In summing up, we have now derived the owner's personal budget constraint – equation (14) for Sweden, equation (14F) for Finland and equation (14N) for Norway – which will be used when solving the optimizing problem. However, before proceeding to derive the optimality conditions it will be helpful to examine the sources of equity funds available to the CHC.

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27 The tax rate on personal income is higher than the tax rate on labor income, 52.2 percent compared to 49.3 percent in 2000.

28 Following a recent modification of the system, shareholders are given credit for 17/28 of the 28 percent corporate tax against the personal capital income tax of 28 percent. The effect of this is to reduce the tax on shareholders' cash dividends to 11 percent.

2. Sources of Finance

Sweden

Since we ignore debt in the model, the firm has two possible ways of acquiring additional funds, namely by issuing new equity and by retaining earnings. For the CHC, there are in turn two ways of obtaining additional retained earnings, by reducing dividends or by cutting the owner's wages. However, we will assume that the owner chooses to withdraw wage income of no less than a minimum amount $\overline{W}$, i.e.

(17) $$W_t^* + w_t^e L_t^e \geq \overline{W} .$$

as a simple though arbitrary way of capturing the owner's desire to make maximum use of future social security benefits linked to current wage earnings.

The relative attractiveness of the two methods of internal funding obviously depends on the details of the tax code. In the following we will focus on the Swedish case, and only briefly discuss the pecking order of sources of finance for Finland and Norway at the end of this section. The tax system we analyze is characterized by the following inequalities.

(18) $$\tau + (1-\tau)\tau_{pd} < \frac{\tau_{pw} + p}{1+p} < \tau + (1-\tau)\tau_{pw} \quad \Leftrightarrow \quad (1-\tau)(1-\tau_{pd}) > \frac{1-\tau_{pw}}{1+p} > (1-\tau)(1-\tau_{pw}),$$

which means that (following the stylized description of the tax system in chapter II above) the total tax (corporate and personal) on normal dividends by assumption is less than the total tax on wage income (combined payroll tax and income tax), which in turn is less than the total tax on excess dividends (taxed at the income tax rate τ_{pw} at the personal level).

To explore the implications of (18) for the funding of the firm, rewrite the budget constraint (3) in terms of investment as

(19) $$I_t = RE_t + N_t ,$$

where the amount of retained earnings *RE* is defined as

(20) $$RE_t = (1-\tau)\left(F\left(K_t, L_t, L_t^*\right) - (1+p)\left(wL_t + W_t^*\right)\right) - D_t .$$

An increase in the amount of retained earnings can be accomplished by a reduction either in the owner's wage W^* (assuming that (17) does not bind) or in dividends *D*. Because of the asymmetric tax treatment, the choice between W^* and *D* affects the magnitude of the owner's after-tax cash flow *M*, as defined in (13). A simple way to demonstrate this is to increase W_t^* and decrease D_t in (20) such that the amount of retained earnings is unchanged

(21) $$\Delta RE_t = -(1-\tau)(1+p)\Delta W_t^* - \Delta D_t = 0\,.$$

For a given ΔW_t^*, expression (21) requires that $\Delta D_t = -(1-\tau)(1+p)\Delta W_t^*$. When $D > R^{max}$, that is when the firm pays excess dividends (R^{max} is when constraint (8) above binds), the effect on the owner's cash flow in (13) of this change in dividends is[29]

(22) $$\Delta M_t^S = (1+p)\left[\frac{1-\tau_{pw}}{1+p} - (1-\tau)(1-\tau_{pw})\right]\Delta W_t^*\,.$$

By (18) the sign of (22) is clearly positive. Hence, given the tax system as described by inequality (18) above, the "wage channel" dominates the "excess dividend channel".

Assuming instead that $D \le R^{max}$, which means that, in addition to wage income, W^*, the owner withdraws only normal dividends taxed at the rate τ_{pd} at the personal level, equation (22) is replaced by[30]

(23) $$\Delta M_t^S = (1+p)\left[\frac{1-\tau_{pw}}{1+p} - (1-\tau)(1-\tau_{pd})\right]\Delta W_t^*\,.$$

Expression (23) is negative when the inequality (18) holds, implying that payment of normal dividends dominates wages as a method of channeling earnings to the owner.

In summing up, we find that the Swedish tax code, as described in (18), implies a clear pecking order between the alternative ways of withdrawing earnings from the CHC. Normal dividends are tax-preferred, followed by wage income, which in turn dominates excess dividends. Since the tax code does not impose any limitation on the amount withdrawn as wage income, the corporation will never distribute earnings as dividends in excess of maximum normal dividends. For a firm that pays wage income to its owner, the marginal source of retained earnings is therefore a reduction in wages, W^*.

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[29] For a given $R(= R^{max})$, the change in the owner's cash flow is obtained from (13) as $\Delta M_t = (1-\tau_{pw})(\Delta D_t + \Delta W_t^*)$. Inserting $\Delta D_t = -(1-\tau)(1+p)\Delta W_t^*$, and a few manipulations give equation (22).

[30] In this case $\Delta M_t = (1-\tau_{pw})(\Delta D_t + \Delta W_t^*) + (\tau_{pw} - \tau_{pd})\Delta R_t$, and with $\Delta D_t = \Delta R_t = -(1-\tau)(1+p)\Delta W_t^*$, equation (23) follows after a few manipulations.

Finland

The Finnish imputation system effectively reduces the personal taxes on both normal and excess dividends. Assume first that the constraint (6F) binds, with the amount declared as normal dividends being less than the maximum allowed, $R < R^{max}$. No labor income tax is then paid, but the owner pays capital income tax on the imputed dividends, $\tau_{pi} \frac{D}{1-\phi}$, and receives an imputation credit of $\phi \frac{D}{1-\phi}$, implying an effective personal tax rate on normal dividends of $\frac{\tau_{pi} - \phi}{1-\phi}$. When (6F) does not bind, and $R = R^{max}$, the imputation system likewise reduces the effective personal tax rate on an extra unit of excess dividends to $\frac{\tau_{pw} - \phi}{1-\phi}$.

Given the parameter values shown in Table 1, and $\phi = 0.29\ (= \tau)$, the Finnish tax system is characterized by the following inequalities[31]

$$\tau + (1-\tau)\left(\frac{\tau_{pi} - \phi}{1-\phi}\right) < \tau + (1-\tau)\left(\frac{\tau_{pw} - \phi}{1-\phi}\right) < \frac{\tau_{pw} + p}{1+p}$$

(18F)

$$\Leftrightarrow$$

$$\frac{(1-\tau)(1-\tau_{pi})}{1-\phi} > \frac{(1-\tau)(1-\tau_{pw})}{1-\phi} > \frac{1-\tau_{pw}}{1+p},$$

that is, the total tax on normal dividends is less than the total tax on excess dividends, which in turn is less than the total tax on earnings withdrawn as labor income. Since there are no limitations of how much income that can be distributed as excess dividends, (18F) implies that the firm will only withdraw earnings as wage income up to the threshold given in (17), to obtain full benefits from the social security system. Remaining earnings will be distributed as normal and excess dividends. Hence, we find that the Finnish tax code, as described in (18F), implies a clear pecking order between the alternative ways of obtaining equity funds. A firm that pays excess dividends will finance the marginal investment by reducing such dividends.

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[31] With $\phi = \tau$ the inequalities are effectively reduced to $\tau_{pi} < \tau_{pw} < \frac{\tau_{pw} + p}{1+p}$ or $1-\tau_{pi} > 1-\tau_{pw} > \frac{1-\tau_{pw}}{1+p}$.

Norway

Illustrating the pecking order in Norway is more complicated. The taxation of personal income P defined by equation (15) above, affects the owner's choice between wages W^* and dividends D as alternative forms of withdrawing earnings from the corporation. To explore the incentives involved, assume that the firm is in a steady-state equilibrium where the owner attempts to withdraw the earnings of her corporation in a tax-minimizing way. For the sake of the argument, assume first that $P > 0$. Raising wages and reducing dividends according to $\Delta D_t = -(1-\tau)(1+p)\Delta W_t^*$ (see the Swedish case above) would then change the owner's after-tax cash flow from the firm according to

$$\Delta M_t^N = (1+p)\left[\frac{1-\tau_{pw}}{1+p} + \left(\tau_{pp} - \tau_{pd}\right) - (1-\tau)\left(1-\tau_{pd}\right)\right]\Delta W_t^* . \tag{24}$$

The first term within brackets captures the after-tax value of an additional unit of wage income, while the second term is due to the reduced tax on *personal income* tax (note that higher W^* reduces P). The third term is the after-tax dividend foregone by the substitution. Our assumptions about the Norwegian tax parameters[32] imply that $\Delta M^N > 0$, which means that the owner does have an incentive to undertake this substitution of wage income for dividends. This incentive remains until P is reduced to zero. Provided that reporting a negative P does not give rise to any refund of tax, a further substitution of W^* for D is, however, clearly not in the interest of the owner. We derive (with $P \le 0$)

$$\Delta M_t^N = (1+p)\left[\frac{1-\tau_{pw}}{1+p} - (1-\tau)\left(1-\tau_{pd}\right)\right]\Delta W_t^* \tag{25}$$

and for the parameter values given in footnote 33, ΔM_t^N is negative.

The conclusion from equations (24) and (25) is thus that the owner will withdraw wages from the corporation sufficient to put $P = 0$, leaving remaining after-tax corporate earnings, equal to $\rho K(1-\tau)$, to be paid as dividends.[33]

Though the role of the owner's wages W^* as a form of withdrawing corporate earnings is similar in all Nordic countries, the implications for financing a marginal investment differ. In Sweden, the marginal source of retained earnings is a reduction in wages, W^*. Given that the owner in Norway has an incentive to adjust wage withdrawals to eliminate the tax on personal income, that is setting $P = 0$, a reduction in W^* to finance additional investment will raise P above zero and hence trigger payment of tax. This mechanism is captured by the first two terms within brackets of (24), and can be further clarified by directly computing the im-

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[32] Following the description of the Norwegian tax rules in chapter II, we assume that $\tau_{pw} = 0.493$, $\tau_{pd} = 0.11$, $\tau = 0.28$ and $p = 0.141$.

[33] With $P = 0$, the amount of dividends follows from (15) and the firm's budget constraint (3), with $I = N = 0$ in steady-state.

pact on the owner's after tax cash flow M of an increase in investment I financed by a reduction in W^*. Using the firm's budget constraint (3), the personal income (15) and the tax function (12N) we get

(26) $$\Delta M_t^N = \Delta W_t^* - \Delta TAX_t = -\left[\frac{1-\tau_{pw}}{(1+p)(1-\tau)} + \frac{\tau_{pp}-\tau_{pd}}{1-\tau}\right]\Delta I_t \ .$$

With the parameter values given in footnote 33, (see also table 1, chapter II), we find that the bracketed term of (26) takes the value of 1.19, that is an investment of one *krona* makes the owner forego an after-tax income of 1.19 kronor. Reducing wages W^* to finance additional investment hence makes no sense, since the owner always has the less expensive option to inject additional funds into the firm by issuing new shares. We conclude, therefore, that the marginal source of retained earning for the CHC in Norway is a reduction in dividends, $\Delta D_t = -\Delta I_t$. In this case we then derive

(27) $$\Delta M_t^N = \Delta D_t - \Delta TAX_t = -(1-\tau_{pd})\Delta I_t$$

which means that the owner foregoes less than one *krona* per *krona* of corporate investment.

3. The Optimality Conditions

We present the optimization procedure for Sweden, and refer to appendices for the corresponding calculations and first order conditions for Finland (appendix B) and Norway (appendix C). Given the owner's objective and the constraints on behavior as defined above, her problem may be re-written as

$$\max \sum_{s=t}^{\infty} \frac{1}{(1+\beta)^{s-t}} \Big\{ U(C_s, Z_s) + \lambda_s^D \left[(1-\tau)\left(F\left(K_s, L_s, L_s^*\right) - (1+p)\left(wL_s + W_s^*\right)\right) - I_s + N_s - D_s \right] +$$
$$\lambda_s^C \left[(1-\tau_{pw})\left(D_s + W_s^*\right) + (\tau_{pw} - \tau_{pd})R_s - N_s + (1-\tau_{pw})w^e L_s^e + b_s - \left(1+(1-\tau_{pi})i\right)b_{s-1} - C_s \right] +$$
$$\lambda_s^B \left[B_{s-1} + \rho E_{s-1} + \rho B_{s-1} - R_s - B_s\right] + \lambda_s^E \left[E_{s-1} + N_s - E_s\right] + \lambda_s^K \left[K_s + I_s - K_{s+1}\right] +$$
$$\lambda_s^Z \left[T_s - L_s^* - L_s^e - Z_s\right] + \eta_s^D \left[D_s - R_s\right] + \eta_s^N N_s + \eta_s^B B_s + \eta_s^R R_s + \eta_s^{W^*}\left[W_s^* + w^e L_s^e - \overline{W}\right] \Big\}.$$

Technically, the model defines a discrete-time control problem with controls C, Z, L, L^*, L^e, b W^*, I, N, D and R and state variables K, E and B. The Lagrange shadow values are λ_t^i for $i = D, C, B, E, K, Z$ and the Kuhn-Tucker shadow values are η_t^j for $j = D, N, B, R, W^*$, . We get the following first-order conditions

(28) $C_t :$ $$U_{C_t} - \lambda_t^C = 0 \ ,$$

(29) $Z_t :$ $$U_{Z_t} - \lambda_t^Z = 0 \ ,$$

(30) D_t : $\lambda_t^C \left(1-\tau_{pw}\right) - \lambda_t^D + \eta_t^D = 0$,

(31) L_t^* : $\lambda_t^D \left(1-\tau\right) F_{L_t^*} - \lambda_t^Z = 0$,

(32) L_t^e : $\lambda_t^C \left(1-\tau_{pw}\right) w^e - \lambda_t^Z + \eta_t^{W^*} w^e = 0$,

(33) L_t : $\left(1-\tau\right)\lambda_t^D \left(F_{L_t} - \left(1+p\right)w\right) = 0$,

(34) N_t : $-\lambda_t^C + \eta_t^N + \lambda_t^D + \lambda_t^E = 0$,

(35) R_t : $\lambda_t^C \left(\tau_{pw} - \tau_{pd}\right) - \eta_t^D + \eta_t^R - \lambda_t^B = 0$,

(36) W_t^* : $\lambda_t^C \left(1-\tau_{pw}\right) - \lambda_t^D \left(1-\tau\right)\left(1+p\right) + \eta_t^{W^*} = 0$,

(37) I_t : $-\lambda_t^D + \lambda_t^K = 0$,

(38) b_t : $\lambda_t^C - \left(1+\beta\right)^{-1} \lambda_{t+1}^C \left(1 + \left(1-\tau_{pi}\right) i\right) = 0$,

(39) E_t : $-\lambda_t^E + \left(1+\beta\right)^{-1} \left(\rho \lambda_{t+1}^B + \lambda_{t+1}^E\right) = 0$,

(40) K_{t+1}: $-\lambda_t^K + \left(1+\beta\right)^{-1} \left(\lambda_{t+1}^D \left(1-\tau\right) F_{K_{t+1}} + \lambda_{t+1}^K\right) = 0$,

(41) B_t : $-\lambda_t^B + \eta_t^B + \left(1+\beta\right)^{-1} \left(1+\rho\right) \lambda_{t+1}^B = 0$.

In the next chapter we will examine the economic effects of taxing CHC by using and providing economic interpretations to these first-order conditions.

IV. Economic Effects of Taxation

The steps for solving for the cost of capital in the long run are shown for the case of Sweden, and we present the results of corresponding calculations for Finland and Norway. To determine the short run cost of capital we confine the analysis to the Swedish rules and we make use of numerical simulations to illustrate the growth path of the firm following a new share issue. The discussion of tax effects on the owner's labor supply that ends this chapter is also focused on the Swedish tax rules.

1. The Long Run Cost of Capital

From expression (40) we may solve for F_K, which is the required pre-tax rate of return on new investment, or the cost of capital

$$F_{K_{t+1}} = \frac{1}{1-\tau}\left((1+\beta)\frac{\lambda_t^K}{\lambda_{t+1}^K} - 1 \right). \tag{42}$$

The crucial factor in determining the cost of capital will be the shadow value of capital, λ^K, or, more specifically, the change in the shadow value between two subsequent periods. Note that $\lambda_t^K = \lambda_t^D$ from (37) and $\lambda_t^C / \lambda_{t+1}^C = 1$ from (38) when we impose the restriction that the rate of time preference equals the after-tax interest rate, i.e. $\beta = (1-\tau_{pi})i$, for all *t*. When the marginal investment is financed with a wage reduction, we assume that the total wage income is larger than the floor, $W_t^* + w^e L_t^e > \overline{W}$, and that new share issues are set to zero, $N_t = 0$. This implies that (36) can be rewritten as $\lambda_t^D / \lambda_{t+1}^D = \lambda_t^C / \lambda_{t+1}^C$ and, hence, $\lambda_t^K / \lambda_{t+1}^K = 1$. The cost of capital then simplifies to

$$F_{K_{t+1}}^{LR}(Sweden) = \frac{\beta}{1-\tau}, \tag{43}$$

which is the long run cost of capital for the CHC. The corresponding expressions for Finland and Norway, see appendices B and C for the technical details, are

$$\begin{aligned} F_{K_{t+1}}^{LR}(Finland) &= \frac{\beta}{1-\tau} - \frac{\rho(1-\phi)}{1-\tau}\left(\frac{\frac{\tau_{pw}-\phi}{1-\phi} - \frac{\tau_{pi}-\phi}{1-\phi}}{1-\frac{\tau_{pw}-\phi}{1-\phi}} \right) \\ &= \frac{\beta}{1-\tau} - \rho\left(\frac{1-\phi}{1-\tau}\right)\left(\frac{\tau_{pw}-\tau_{pi}}{1-\tau_{pw}}\right), \end{aligned} \tag{43F}$$

and

$$\begin{aligned} F_{K_{t+1}}^{LR}(Norway) &= \frac{\beta(1-\tau_{pd})}{1-\frac{\tau_{pw}+p}{1+p}} - \rho\left(\frac{\frac{\tau_{pw}+p}{1+p} - (\tau + (1-\tau)\tau_{pd})}{1-\frac{\tau_{pw}+p}{1+p}} \right) \\ &= \frac{\beta}{1-\tau} + \left(\frac{\beta}{1-\tau} - \rho\right)\left(\frac{\frac{\tau_{pw}+p}{1+p} - (\tau + (1-\tau)\tau_{pd})}{1-\frac{\tau_{pw}+p}{1+p}} \right). \end{aligned} \tag{43N}$$

We note that expression (43) for Sweden only depends on the owner's rate of time preference and the statutory corporate tax rate, that is, the long run cost of capital is the same as for WHC (assuming, as we do here, that there is no tax on capital gains). Neither the personal taxes on dividends and wage income, nor the special rules for determining the size of normal dividends (e.g. the presumptive return parameter ρ) matter. Though this result may seem surprising, it is an exact parallel to the familiar finding of the *new view of equity*, that the long run cost of capital for a (widely held) corporate firm with retained earnings as the marginal source of funds is independent of the tax on dividends (cf. Auerbach 1979 and Sinn 1987). Expression (43) implies that the CHC is in a "trapped equity" regime, where a (possible) high rate of tax on the marginal source of income (owner's wages) not only means that the after-tax amount remaining from one *krona* of pre-tax business income is small, but also that the opportunity cost of retaining funds for new investment in the firm is equally low.

The fact that Sweden and Finland make use of different bases when determining normal dividends has important long run effects. The Finnish scheme, where the base is the firm's net assets, implies that the long run cost of capital is lower for CHC than for WHC, as seen from (43F) (the bracketed term in (43F) is positive). This preferential tax treatment of the CHC is stronger the higher is the presumptive rate of return, ρ. Quantitatively, this distorting effect is far from trivial. With $\rho = 0.135$, tax parameters (see table 1) $\tau_{pw} = 0.5013$, $\tau_{pi} = 0.29$ and full corporate tax integration (implying $\phi = \tau$), the cost of capital is reduced by as much as 5.7 percentage points, or by 40 percent of the cost of capital of a WHC with $\beta = 0.1$ and $\tau = 0.29$.

The complicated Norwegian scheme of splitting the pre-tax earnings of the corporate firm into income from labor and income from capital affects the cost of capital through several interrelated mechanisms. The cost of capital is lowered because the dividend tax lowers the after-tax cost to the owner of retaining funds for investment, $1-\tau_{pd}$, and increased because the return on investment is taxed as labor income, that is at the rate $\frac{\tau_{pw}+p}{1+p}$. Moreover, the higher is the return parameter ρ, the lower is the cost of capital. The second line of (43N) shows that the net effect of these offsetting mechanisms may or may not cause the cost of capital to be different from that of a WHC, i.e. $\frac{\beta}{1-\tau}$. Neutrality requires that $\rho = \frac{\beta}{1-\tau}$, i.e. that the rate of return parameter equals the owner's pre-tax rate of return requirement.

From the first order condition with respect to the labor input, expression (33), we find that the marginal product of labor on the optimal path equals the total wage rate, i.e. payroll tax included, $F_L = (1+p)w$. The factors determining the owner's labor effort L^* are somewhat more complicated to analyze. As shown by expressions (31) and (32), optimal L_t^* also depends on e.g. the marginal valuations of consumption λ_t^C and capital $\lambda_t^K \left(= \lambda_t^D\right)$. However, since in long run equilibrium $\eta_t^{W^*} = 0$ and $\lambda_t^D = \lambda_t^K = \lambda_t^C \frac{1-\tau_{pw}}{(1-\tau)(1+p)}$, we find that $F_{L_t^*} = (1+p)w^e$.

Hence, neither the amount of managerial effort optimally used by the firm, nor the optimal input of hired labor will be affected by the special rules governing the taxation of CHC. Performing exactly the same operations for Finland and Norway shows that the same result holds for those countries as well.

2. The Short Run Cost of Capital – the Swedish Case

The cost of raising new equity by issuing new shares is more difficult to analyze. As is usual, we will assume that new shares are issued only occasionally as a response to an exogenous disturbance to the productivity of capital, and when retained earnings are insufficient to finance the required addition to the capital stock. However, and following the approach used by Sinn (1991), we also assume that the owner will choose to inject less than the total amount of funds needed to reach a new long run equilibrium. The reason for this is that once a "nucleus" of new equity has been injected, the firm can start on a "growth path" by using less expensive retained earnings. The firm then continues to grow by internal funds until the marginal productivity of capital has been brought down to its long run value.

Sinn's "growth path" or "nucleus" theory of equity is developed within a highly stylized model, with a dividend tax as the only policy parameter. When the firm is hit by an exogenous shock that raises the marginal productivity of capital, or Tobin's marginal *q*, the firm obtains new equity sufficient to depress *q* to unity. The growth path financed by retained earnings then follows, and continues until within finite time marginal *q* is reduced to its long run value of unity minus the dividend tax rate.

In our model of the CHC Tobin's marginal *q* is given by the shadow value λ^K, and its long run value is directly obtained from (36) as

(44) $$q^{LR} \equiv \lambda^K = \lambda^C \frac{1-\tau_{pw}}{(1-\tau)(1+p)}$$

When (44) holds, the owner is indifferent between retaining business earnings (taxed at the rate τ with the firm) and withdrawing earnings as wage income (deductible against the corporate income tax, but subject to payroll tax *p* and income tax τ_{pw}).

The starting condition[34] – determining the size of the initial equity issue – takes a rather complicated form for the CHC. If the CHC issues shares in period *t*, i.e. $N_t > 0$, the associated shadow value is $\eta_t^N = 0$ and the marginal valuation of capital in the short run then follows from expression (34) as

[34] The starting condition is simply $q^{SR} = 1$ for *Sinn*'s firm, or $q^{SR} = \lambda^C$ if *Sinn*'s firm were to maximize the owner's utility.

(45) $$q^{SR} \equiv \lambda_t^K = \lambda_t^C - \lambda_t^E ,$$

which, besides the owner's marginal valuation of consumption λ_t^C, also depends on λ_t^E, i.e. the marginal valuation of the acquisition cost of the firm's shares. The derivation of λ_t^E is explained in Appendix A and we obtain

(46) $$q^{SR} \equiv \lambda_t^K = \lambda_{t+1}^C \left\{ 1 - \frac{1}{1-\tau} \left(\left(\frac{1+\rho}{1+\beta} \right)^{\chi} - \frac{1-\rho/\beta}{(1+\beta)^{\chi}} \right) \left((1-\tau)(1-\tau_{pd}) - \frac{1-\tau_{pw}}{1+p} \right) \right\}.$$

The starting condition depends on the special tax treatment of the CHC. The term $(1-\tau)(1-\tau_{pd})$ in the last parenthesis shows the after-tax value of one unit of business income distributed as a normal dividend to the owner, while the term $(1-\tau_{pw})/(1+p)$ shows the after-tax value of one unit of business income withdrawn as owner's wage income. Note that in the absence of tax discrimination between normal dividends and wage income, the last bracketed term in (46) would equal zero. The short run marginal valuation of capital would then simplify to $q^{SR} \equiv \lambda^K = \lambda^C$, which is the same starting condition as for a (utility maximizing) WHC. However, given the tax treatment assumed here (see expression (18) above), the first term of the last parenthesis is larger than the second, and the effect of this tax asymmetry is strengthened the higher is the imputed return parameter ρ. Moreover, since normal dividends are paid neither the year of the new issue nor on the subsequent growth path and since, in addition, they may be saved for later use, also the relationship between the interest earned on the stock of unused normal dividends, ρ, and the owner's discount rate β matters. An effect of this is that the time required (denoted as χ in equation (46)) for the firm to reach its new long run equilibrium enters the short run marginal valuation of capital. For $\rho = \beta$ equation (46) simplifies to

(47) $$q^{SR} \equiv \lambda_t^K = \lambda_{t+1}^C \left\{ 1 - \frac{1}{1-\tau} \left((1-\tau)(1-\tau_{pd}) - \frac{1-\tau_{pw}}{1+p} \right) \right\}.$$

which is independent of the duration of the growth path. Moreover, q^{SR} is clearly lower than λ^C, provided that dividends are tax favored compared to wage income.

Following the new issue, and for the next $\chi - 1$ periods (the symbol χ denotes the duration of the growth path), the firm will neither issue more shares nor distribute dividends or owner's wages (above the floor $\overline{W}$). It will instead retain all internally generated income and grow towards the new long run equilibrium. When reaching the new long run equilibrium capital stock in period $t+\chi$ the CHC starts to pay both normal dividends $\left(R_{t+\chi}^{max}\right)$ and owner's wages exceeding the floor, implying that $\eta_{t+\chi}^{W^*=0}$. The long run marginal valuation of capital is then given by (44) above.

Unfortunately, neither Sinn's nor our model can be used to derive an explicit expression for the short run cost of capital. Though λ_t^K in (42) is given by equation (47), $\lambda_{t+1}^K (t+1$ is the first year on the growth path following the new issue) cannot be determined without further assumptions. However, because the present model is written in discrete time, we will be able to make considerable progress in examining the firm's growth path by resorting to numerical simulation. This is the topic of next section.

3. The Growth Path[35]

The short and long run marginal valuations of capital will play a crucial role in determining the firm's growth path following a new share issue. As long as the marginal valuation of capital is larger than q^{SR} it is profitable to put additional new equity into the firm. This pushes the valuation of capital down to q^{SR}, where the firm stops issuing more shares and instead uses all available internally generated profits, that is $I=(1-\tau)F(K)$, for growing until q^{LR} is reached. This is the mechanism we will make use of when simulating the growth path.

Starting in the new long run equilibrium, where q^{LR} is given by (44) and the marginal productivity of capital by (43), we solve the model backwards by using (42). From the long run capital stock, implicitly given by (43), we subtract annual investment to obtain the capital stock and the marginal productivity of capital for the previous year. This step-wise procedure, which is repeated until the marginal valuation of capital λ^K reaches q^{SR}, allows us to derive numerically the marginal productivity of capital, or the cost of capital, for each year on the growth path. The duration of this adjustment path, denoted as χ in equation (46), is then determined endogenously.

The simulation procedure requires a specification of the firm's production function. To keep the model as simple as possible we neglect labor and let the production function be

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[35] One of the Editors of this volume, *Alfons J. Weichenrieder*, has kindly pointed out that simulations of the firm's growth path has been carried out also by *McGee* (1998) and *Weichenrieder* (1995). While *McGee* examines capital gains taxation and *Weichenrieder* the taxation of a foreign subsidiary of a multinational firm, their simulation approaches are similar to ours. *Weichenrieder* finds, as we do (see below), that immediately following a new issue, the marginal cost of capital is considerably higher than the long run cost of capital, and also much higher than suggested by the standard King-Fullerton formula (see footnote 26 below). Though a closer comparison of the results is less meaningful because the tax policy problems are different, *Weichenrieder's* model suggests that the growth-path of the subsidiary is longer than that we have found for both WHC and CHC.

(48) $$F(K) = aK^{a},$$

where $a > 0$ determines the level of the technology, and α is the share of capital. Further, the marginal product of capital in long run is given by $F_{K_{LK}} = \alpha a K^{a-1}$. Equating the long run cost of capital given in (43) and the marginal product of capital from the production function, we can solve for *a* in the long run as

(49) $$a = \frac{\beta}{\alpha(1-\tau)K_{LR}^{a-1}}.$$

With $\alpha = 0.4, \beta = \rho = 0.1, K_{LR} = 1$ and *a* as given by (49) we obtain a growth path of $\chi = 5.25$ years, assuming that the tax parameters take values representative for Sweden in 2001 (see note to table 1). The marginal productivity of capital, expressed as a proportion of the long run cost of capital, is shown in table 2 for each year of the adjustment period.[36] With $\beta = 0.1$ and $\tau = 0.28$, the long run cost of capital, $F_{K_{LK}}$, given in (43) is 0.1389.

Table 2

The Cost of Capital (COC) during the Growth Path

Period	$t+\chi-525$	$t+\chi-5$	$t+\chi-4$	$t+\chi-3$	$t+\chi-2$	$t+\chi-1$	$t+\chi$
COC	$4.77F_K^{LR}$	$4.04F_K^{LR}$	$2.51F_K^{LR}$	$1.82F_K^{LR}$	$1.43F_K^{LR}$	$1.18F_K^{LR}$	F_K^{LR}

Note: The simulations assume that $\tau = 0.28, \tau_{pd} = 0.3, \tau_{pw} = 0.57$ and $\chi = 5.25$ is the duration of the growth path.

Immediately following the new issue, the marginal product of capital – which, following Sinn, may be viewed as the cost of new issues of shares – is almost 4.8 times the long run cost of capital (with retained earnings as the marginal source of funds).[37] For comparison we also note that a WHC – were the long run cost of capital is the same as for the CHC (see equation (43)) – according to our simulations, will have a marginal productivity of capital immediately after the new issue, which is 3.51 times its long run cost of capital. The special rules for the CHC hence raise the short run rate of return requirement on new investment

[36] The magnitudes of α and $\beta (= \rho)$ only affect the length of the growth path. An increase in β reduces the length, while an increase in the capital share α increases the length of the growth path.

[37] Simplifying our model to make it replicate *Sinn's* stylized tax system (with the dividend tax as the only tax parameter), we find that the short run cost of capital (following the new issue) is in the order of 3.5 times the long run cost of capital. The standard King-Fullerton formula (*King-Fullerton* 1984, pp. 18) by comparison then gives a cost of new equity that is 1.43 times the long run capital cost.

financed by an issue of new shares by more than one third (4.77/3.51 = 1.359). As a result of this, the growth path for the CHC is longer, or 5.25 years compared to 4.75 years for the WHC.

Table 3 below gives some further information on the sensitivity of the results to alternative assumptions about the after-tax discount rate β and the imputed rate of return, ρ.

Table 3

The Cost of Capital when Varying β and ρ

Percent

	F_K^{LR}	F_K^{SR}	
β		$\rho = .05$	$\rho = .10$
.05	6.94	33.78[38]	–
.10	13.89	90.61[39]	66.19[40]

Note: F_K^{LR} is the long run cost of capital, and F_K^{SR} is the short run cost of capital. The model requires $\beta \geq \rho$. The simulations assume that $\tau = 0.28$, $\tau_{pd} = 0.3$, $\tau_{pw} = 0.57$ and $p = 0.3292$.

4. Owner's Labor Supply

We next turn to the owner's labor supply. Our intention is to examine how the rules for withdrawing earnings from the CHC affect the owner's trade off between work and leisure, and between working inside and outside of the own firm. We will focus on the tax treatment of normal dividends, *R*, depending, *inter alia*, on the imputed return parameter, ρ. To simplify, we will treat *R* as a parameter of the tax system, and examine the effect on L^* of a change in *R*. We are only interested in the long run effect, and we therefore ignore possible labor input changes during the growth path. Furthermore, we will assume that the CHC faces a separable production function of the form.

$$F(K_t) = aK_t^{\alpha} + cL_t^{y} + e\left(L_t^*\right)^{\varepsilon}, \tag{50}$$

[38] The cost of new share issues is 4.87 times the long run cost of capital (33.78/6.94 = 4.87).

[39] The cost of new share issues is 6.52 times the long run cost of capital (90.61/13.89 = 6.52).

[40] The cost of new share issues is 4.77 times the long run cost of capital (66.19/13.89 = 4.77).

implying that any change in the owner's labor input L^* will not change the long run optimal capital stock.[41]

The existence of an external labor market enables the owner to separate the decision on how much to work in the own business and how much to work outside the firm at the going market wage, w^e. The amount of effort put into the own firm then follows from the first order condition $F_{L_t^*} = (1+p)w^e$, i.e. independent of the preferences of the owner. In the absence of an external labor market for the owner, the outcome will instead depend on the owner's preferences over consumption and leisure. Combining the first order conditions (28), (29), (31) and (36) gives the owner's labor input into the firm as

$$F_{L_t^*} = \left(\frac{1+p}{1-\tau_{pw}}\right)\frac{U_{Z_t}}{U_{C_t}}. \tag{51}$$

We once more emphasize that we are comparing two different long run states with the same capital stock but different amount of owner's labor input, and thereby ignoring any indirect effects during the growth path. This means that we can isolate the consumption function as $C_t = C(L_t^*, R_t)$, where leisure now becomes the residual $Z_t = T - L_t^*$. Differentiating (51) with respect to R and L^* gives the effect on the owners' labor input into the firm of an increase in the amount of business income treated as normal dividends (i.e. an increase in the imputed return parameter ρ)

$$\frac{dL^*}{dR} = \frac{-(1-\tau_{pw})U_{CC}F_{L^*} + (1+p)U_{ZC}}{(1-\tau_{pw})U_{CC}F_{L^*}^2 + (1-\tau_{pw})U_C F_{L^*L^*} + (1+p)U_{ZZ} - (1-\tau_{pw})U_{CZ}F_{L^*} - (1+p)U_{ZC}F_{L^*}} < 0. \tag{52}$$

We will follow the standard assumptions that the utility function is concave in consumption, $U_{CC} < 0$, and that consumption and leisure are complementary, $U_{CZ} > 0$. These assumptions and the fact that we are maximizing utility, i.e. the second order condition is negative, guarantees a negative partial derivative.[42] Thus, the owner's effort decreases in the CHC if a larger amount of business income may be withdrawn as tax favored normal dividends. The intuition for this result can be understood from a Slutsky decomposition of the effects. The substitution effect is zero because the increase in R does not change any relative prices at the margin. Hence, owners have no incentive to increase the labor

[41] The picture to have in mind is that the stocks of capital and labor in the CHC exceed some minimum level. This is to prevent the unrealistic scenario of positive output with zero input in some of the factors.

[42] Taking the derivatives of (51) with respect to L^* gives the second order condition as $(1-\tau_{pw})U_{CC}F_{L^*}^2 + (1-\tau_{pw})U_C F_{L^*L^*} + (1+p)U_{ZZ} < 0$, which is postulated negative in a maximization problem.

supply. However, an increase in R has a direct income effect that will affect the amount of consumption positively. Assuming that leisure is a normal good, the income effect will reduce labor supply. The bottom line is hence that a more lenient tax treatment of the CHC, by way of allowing an increased share of business income to be treated as normal dividends, will cause the sole owner to reduce his work effort.

V. Summary and Conclusions

Drawing on the standard neoclassical model of firm behavior, as used in the taxation literature, and the static farm household model, we have examined the economic effects of the Nordic systems of taxing CHC. The special tax rules were introduced in the beginning of the 1990's in order to mitigate the incentives for tax shifting offered by the introduction of the dual income tax system. Though all three countries adhere to the basic idea of splitting earnings into income from capital and income from labor by imputing capital income, the chosen techniques differ in important ways.

The Swedish scheme, where the amount of tax favored *normal dividends* are determined by multiplying the presumptive rate of return by the acquisition cost of the shares of the corporation, gives the same long run cost of capital for CHC as for WHC. We show that in long run equilibrium, the firm is in a "trapped equity" regime, where a high rate of tax on the marginal source of income (owner's wages) not only means that the after-tax amount remaining from one *krona* of pre-tax business income is small, but also that the opportunity cost of retaining funds for new investment in the firm is equally low. Since the marginal source of funds is retained earnings, the marginal investment leaves the acquisition cost of the corporate shares unchanged, and the effect of this is to make the long run cost of capital invariant to the rate at which capital income is imputed to the owner.

Finland's approach to taxing CHC is similar to that of Sweden. An important difference, however, is that income from capital is determined by applying the presumptive rate of return to the net assets of the corporation. As this base increases when the firm invests, the long run cost of capital turns out to be a negative function of the rate used for imputing capital income. In terms of the long run cost of capital, Finnish CHC are therefore favored by the tax system, compared to WHC.

The taxation of CHC in Norway is particularly complicated, and aside from the regular corporate tax, the owner faces a possibility to pay tax on three accounts, for dividends, for wage income and for *personal income* ("personinntekt"). The income splitting - which determines the amount of personal income - applies to the pre-tax income of the corporation, and is independent of the extent to which the firm pays dividends. The Norwegian scheme is shown to have a neutral impact of the long run cost of capital (compared to the treatment of WHC), provided that the rate of return used for imputing capital income is set equal to the owner's pre-tax rate of return requirement.

Focusing on the Swedish tax rules, we examined the CHC's short run adjustment to a productivity shock. We have computed the pre-tax marginal return to capital needed to justify an issue of new equity, and we simulated the firm's internally financed "growth path" following the new issue. Though the growth path idea was suggested by Sinn (1991) some time ago, and has been used in later research (see for example Kari 1999), we extend earlier work by offering a quantitative characterization of the growth path and a measure of the duration of the adjustment phase. We find that the special rules for the CHC raise the short run rate of return requirement on new investment financed by new share issues by more than one third, compared to the case of WHC. As a result of this, the growth path for the CHC is longer.

The owner's choice between withdrawing earnings from her firm as wages and as dividends is in general a matter of tax planning, unrelated to the owner's actual labor effort put into the firm. However, in a final section of the paper, we have tentatively examined also the owner's choice between working inside and outside of the firm, and between work and leisure. We have found that a more lenient tax treatment, by way of allowing an increased share of business income to be treated as tax favored normal dividends, will cause the owner to reduce her work effort in the CHC. This result presumes that no external labor market for managerial services is available to the owner.

In this paper we have examined the Nordic schemes for taxing CHC in terms of their impact on the cost of capital. The cost of capital is a key variable for evaluating the effects of tax policy on long run resource allocation, and in terms of neutrality, the Swedish tax rules rank above those of Norway, which in turn are much less likely to distort resource allocation than is the Finnish CHC-scheme. However, there are clearly also other aspects that deserve attention when comparing and evaluating the design of tax rules. One such aspect, which has been ignored in this paper because of its focus, is the cost to the taxpayers of complying with the tax rules. Though there is little reliable and systematic information on this, there is a widespread view in the public debate that the CHC-rules are excessively complicated and time-consuming to comply with. Complication gives rise to unintentional mistakes but it also opens up for avoidance and evasion. In particular, the provision in the Norwegian and Swedish tax code that the CHC-rules pertain to active but not to passive owners, has given rise to various *pro forma* schemes where the owners effectively retain operating control of the company even though they appear to be passive investors. As pointed out by Schjelderup (2002), it has proven costly and difficult to prevent these illegal constructions. The incentive for tax evasion, and hence the pressure on the CHC rules, should also be greater in Norway and Finland than in Sweden, since Sweden has limited the tax differential between earned income and income from capital by retaining a classical system of dividend taxation (see Table 1 for data) within the dual income tax.

Summary

Under the Nordic dual income tax system, the taxpayer's total tax bill depends not only on his total income but also on the division of that income between capital income and labor income. This has created new room for tax avoidance, especially for active owners of (closed) corporations. For that reason the Nordic governments have enacted special income-splitting rules and this paper examines the economic effects of these rules. The Swedish scheme of taxing closed corporations is shown to be neutral in its impact on the allocation of resources between closely and widely held corporations, and the cost of capital is invariant to the rate at which capital income is imputed to the owner. The Finnish system rather increases the attractiveness of investing in closed corporations, while the Norwegian scheme may or may not cause the cost of capital to be different from that of widely held corporations. Finally, for Swedish tax rules, we show that the owner's labor supply may decrease as a response to a more lenient tax treatment.

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Appendix A

This appendix derives the expression for λ_t^E used in the definition of the short run marginal *q*. For a CHC issuing shares in period *t* and returning to long run equilibrium in period $t+\chi$ the constraints looks as table A.1, with obvious signs of the shadow values.

Table A.1

Period	Total wage	New share issue	Dividends	Unused normal dividends	Investment
t	$W^* + w^e L^e = \overline{W}$	$N > 0$	$D = R = 0$	$B > 0$	$I = N + RE$
$t+1,\ldots,t+\chi-1$	$W^* + w^e L^e = \overline{W}$	$N = 0$	$D = R = 0$	$B > 0$	$I = RE$
$t+\chi, t+\chi+1$	$W^* + w^e L^e > \overline{W}$	$N = 0$	$D = R > 0$	$B = 0$	$I = RE$

That is, for the next $\chi-1$ periods following a new share issue the firm will neither issue more shares nor distribute dividends or owner's wages above the floor, $\overline{W}$. It will instead retain all earnings and grow towards the new long run equilibrium. When reaching the new capital stock in period $t+\chi$ the CHC starts to pay both dividends and owner's wages (over the floor). Solving the difference equation in (39) gives

(A1) $$\lambda_t^E = \rho \sum_{s=t}^{\infty} \frac{\lambda_{s+1}^B}{(1+\beta)^{s-t+1}},$$

where λ_{t+1}^B follows from (41) as

(A2) $$\lambda_{t+1}^B = \frac{1+\rho}{1+\beta} \lambda_{t+2}^B,$$

since $\eta_{t+1}^B = 0$ because of unused normal dividends, $B > 0$, during the growth path. When the new long run equilibrium is reached in period $t+\chi$ we know that $\lambda_{t+\chi}^B = \lambda_{t+\chi+1}^B = \lambda_{LR}^B$. Taking this into account we can solve for λ_t^E as

(A3) $$\lambda_t^E = \lambda_{LR}^B \left(\left(\frac{1+\rho}{1+\beta} \right)^{\chi} - \frac{1-\rho/\beta}{(1+\beta)^{\chi}} \right).$$

Hence, next step is to find an expression for λ^B in the long run. From (30) we have a relation for $\eta_{t+\chi}^D$, and by using (36) we derive

(A4) $$\eta_{t+\chi}^D = \lambda_{t+\chi}^C (1-\tau_{pw}) \left(\frac{1}{(1-\tau)(1+p)} - 1 \right).$$

When the firm issues more shares at time *t* it does not distribute any income to the owner, i.e. $R_t = 0$, and the stock of unused normal dividends therefore amounts to $B_t = \rho E_{t-1}$. However, as long as the firm is in long run equilibrium we have $R_{t+\chi} > 0$ and, hence, $\eta_{t+\chi}^R = 0$ implying that (35) can be rewritten, by using (A4), as

(A5) $$\lambda_{t+\chi}^B = \lambda_{t+\chi}^C \left((1-\tau_{pd}) - \frac{1-\tau_{pw}}{(1-\tau)(1+p)} \right).$$

But since (A5) is the long run value, we have found an expression for λ_t^E by substituting (A5) into (A3)

(A6) $$\lambda_t^E = \lambda_{t+\chi}^C \left(\left(\frac{1+\rho}{1+\beta} \right)^{\chi} - \frac{1-\rho/\beta}{(1+\beta)^{\chi}} \right) \left((1-\tau_{pd}) - \frac{1-\tau_{pw}}{(1-\tau)(1+p)} \right).$$

Appendix B – Finland

The Finnish owner's problem is to maximize

$$max \sum_{s=t}^{\infty} \frac{1}{(1+\beta)^{s-t}} \Big\{ U(C_s, Z_s) + \lambda_s^D \Big[(1-\tau)\big(F(K_s, L_s, L_s^*) - (1+p)(wL_s + W_s^*)\big) - I_s + N_s - D_s \Big] +$$

$$\lambda_s^C \left[(1-\tau_{pw})\left(\frac{D_s}{1-\phi} + W_s^*\right) + (\tau_{pw} - \tau_{pi})R_s - N_s + (1-\tau_{pw})w^e L_s^e + b_s - \big(1 + (1-\tau_{pi})i\big)b_{s-1} - C_s \right] +$$

$$\lambda_s^K [K_s + I_s - K_{s+1}] + \lambda_s^Z [T_s - L_s^* - L_s^e - Z_s] + \eta_s^K [\rho K_s - R_s] + \eta_s^D \left[\frac{D_s}{1-\phi} - R_s\right] + \eta_s^N N_s + \eta_s^R R_s +$$

$$\eta_s^{W^*} \left[W_s^* + w^e L_s^e - \overline{W}\right] \Big\},$$

with the following first order conditions

(B1) $C_t:$ $U_{C_t} - \lambda_t^C = 0$,

(B2) $Z_t:$ $U_{Z_t} - \lambda_t^Z = 0$,

(B3) $D_t:$ $\lambda_t^C \left(\frac{1-\tau_{pw}}{1-\phi}\right) - \lambda_t^D + \eta_t^D \frac{1}{1-\phi} = 0$,

(B4) $L_t^*:$ $\lambda_t^D (1-\tau) F_{L_t^*} - \lambda_t^Z = 0$,

(B5) $L_t^e:$ $\lambda_t^C (1-\tau_{pw}) w^e - \lambda_t^Z + \eta_t^{W^*} w^e = 0$,

(B6) $L_t:$ $(1-\tau)\lambda_t^D \left(F_{L_t} - (1+p)w\right) = 0$,

(B7) $N_t:$ $-\lambda_t^C + \eta_t^N + \lambda_t^D = 0$,

(B8) $R_t:$ $\lambda_t^C (\tau_{pw} - \tau_{pi}) - \eta_t^D + \eta_t^R - \lambda_t^K = 0$,

(B9) $W_t^*:$ $\lambda_t^C (1-\tau_{pw}) - \lambda_t^D (1-\tau)(1+p) + \eta_t^{W^*} = 0$,

(B10) $I_t:$ $-\lambda_t^D + \lambda_t^K = 0$,

(B11) $b_t:$ $\lambda_t^C - (1+\beta)^{-1} \lambda_{t+1}^C \big(1 + (1-\tau_{pi})i\big) = 0$,

(B12) $K_{t+1}:$ $-\lambda_t^K + (1+\beta)^{-1}\left(\lambda_{t+1}^D (1-\tau) F_{K_{t+1}} + \lambda_{t+1}^K + \rho\eta_{t+1}^K\right) = 0$.

The general expression for the cost of capital is

(B13)
$$F_{K_{t+1}} = \frac{1}{(1-\tau)}\left((1+\beta)\frac{\lambda_t^K}{\lambda_{t+1}^K} - 1 - \rho\,\frac{\eta_{t+1}^K}{\lambda_{t+1}^K} \right),$$

and we see from (B10) that $\lambda_t^D = \lambda_t^K$ still holds. Solving for the cost of capital in long run we note that $\lambda_t^K = \lambda_{t+1}^K$, so only need to focus on the ratio $\eta_{t+1}^K / \lambda_{t+1}^K$ in (B13). From (B8) we have $\eta_{t+1}^K = \lambda_{t+1}^C(\tau_{pw} - \tau_{pi})$, where $\eta_{t+1}^R = 0$ since $R_{t+1} > 0$ in long run equilibrium. Further, $\eta_{t+1}^D = 0$ since $\frac{D_{t+1}}{1-\phi} > R_{t+1}$ implying that (B3) equals $\lambda_{t+1}^C = \lambda_{t+1}^D \frac{1-\phi}{1-\tau_{pw}}$. These algebraic exercises give

(B14)
$$\frac{\eta_{t+1}^K}{\lambda_{t+1}^K} = \frac{1-\phi}{1-\tau_{pw}}(\tau_{pw} - \tau_{pi})$$

Substituting the ratio in (B14) into (B13) gives the long run cost of capital as

(B15)
$$F_{K_{t+1}}^{LR}(Finland) = \frac{\beta}{1-\tau} - \frac{\rho(1-\phi)}{1-\tau}\left(\frac{\frac{\tau_{pw}-\phi}{1-\phi} - \frac{\tau_{pi}-\phi}{1-\phi}}{1 - \frac{\tau_{pw}-\phi}{1-\phi}} \right)$$
$$= \frac{\beta}{1-\tau} - \rho\left(\frac{1-\phi}{1-\tau}\right)\left(\frac{\tau_{pw}-\tau_{pi}}{1-\tau_{pw}}\right).$$

Appendix C – Norway

The Norwegian owner's problem is to maximize

$$max \sum_{s=t}^{\infty} \frac{1}{(1+\beta)^{s-t}} \Big\{ U(C_s, Z_s) + \lambda_s^D \Big[(1-\tau)\big(F(K_s, L_s, L_s^*) - (1+p)(wL_s + W_s^*)\big) - I_s + N_s - D_s \Big] +$$
$$\lambda_s^C \Big[(1-\tau_{pw})W_s^* + (1-\tau_{pd})D_s - (\tau_{pp} - \tau_{pd})P_s - N_s + (1-\tau_{pw})w_s^e L_s^e + b_s - \big(1 + i\,(1-\tau_{pi})\big)b_{s-1} - C_s \Big] +$$
$$\lambda_s^P \Big[F(K_s, L_s, L_s^*) - (1+p)(wL_s + W_s^*) - \rho K_s - P_s \Big] + \lambda_s^K [K_s + I_s - K_{s+1}] + \lambda_s^Z \Big[T_s - L_s^* - L_s^e - Z_s \Big] +$$
$$\eta_s^D D_s + \eta_s^P P_s + \eta_s^N N_s + \eta_s^{W^*} \Big[W_s^* + w^e L_s^e - \overline{W} \Big] \Big\},$$

with the following first order conditions

(C1) C_t : $U_{C_t} - \lambda_t^C = 0$,

(C2) Z_t : $U_{Z_t} - \lambda_t^Z = 0$,

(C3) D_t : $\lambda_t^C (1-\tau_{pd}) - \lambda_t^D + \eta_t^D = 0$,

(C4) L_t^* : $\lambda_t^D (1-\tau) F_{L_t^*} + \lambda_t^P F_{L_t^*} - \lambda_t^Z = 0$,

(C5) L_t^e : $\lambda_t^C (1-\tau_{pw}) w^e - \lambda_t^Z + \eta_t^{W^*} w^e = 0$,

(C6) L_t : $\left((1-\tau)\lambda_t^D + \lambda_t^P\right)\left(F_{L_t} - (1+p)w\right) = 0$,

(C7) N_t : $-\lambda_t^C + \eta_t^N + \lambda_t^D = 0$,

(C8) W_t^* : $\lambda_t^C (1-\tau_{pw}) - \left((1-\tau)\lambda_t^D + \lambda_t^P\right)(1+p) + \eta_t^{W^*} = 0$,

(C9) I_t : $-\lambda_t^D + \lambda_t^K = 0$,

(C10) b_t : $\lambda_t^C - (1+\beta)^{-1}\lambda_{t+1}^C \left(1 + (1-\tau_{pi})i\right) = 0$,

(C11) K_{t+1}: $-\lambda_t^K + (1+\beta)^{-1}\left(\lambda_{t+1}^D (1-\tau) F_{K_{t+1}} + \lambda_{t+1}^P \left(F_{K_{t+1}} - \rho\right) + \lambda_{t+1}^K\right) = 0$,

(C12) P_t : $-\lambda_t^P - \lambda_t^C \left(\tau_{pp} - \tau_{pd}\right) + \eta_t^P = 0$.

The general expression for the cost of capital is

(C13)
$$F_{K_{t+1}} = \frac{(1+\beta)\lambda_t^K - \lambda_{t+1}^K + \rho\lambda_{t+1}^P}{(1-\tau)\lambda_{t+1}^K + \lambda_{t+1}^P} ,$$

since $\lambda_t^D = \lambda_t^K$ from (C9). In solving the cost of capital in the long run the assumption of steady state considerably simplifies expression (C13). As explained above, the firm will pay both dividends and withdraw owner's wage income, i.e. $D_t > 0$ and $W_t^* > 0$, which implies that $\eta_t^D = \eta_t^{W^*} = 0$. From (C3) and (C9) we derive $\lambda_t^D = \lambda_t^K = \lambda_t^C (1-\tau_{pd})$ for all *t*. Using (C8), this implies that $\lambda_t^P = -\lambda_t^C \left[(1-\tau)(1-\tau_{pd}) - \frac{1-\tau_{pw}}{1+p} \right]$, which is negative, for all *t*. For the denominator in (C13), this yields $(1-\tau)\lambda_{t+1}^K + \lambda_{t+1}^P = \frac{1-\tau_{pw}}{1+p}\lambda_{t+1}^C$, and we finally get the long run, or steady state, marginal product of capital

$$
\text{(C14)} \quad
\begin{aligned}
F_{K_{t+1}}^{LR}(Norway) &= \frac{\beta(1-\tau_{pd})}{1-\frac{\tau_{pw}+p}{1+p}} - \rho\left(\frac{\frac{\tau_{pw}+p}{1+p}-(\tau+(1-\tau)\tau_{pd})}{1-\frac{\tau_{pw}+p}{1+p}}\right) \\
&= \frac{\beta}{1-\tau} + \left(\frac{\beta}{1-\tau}-\rho\right)\left(\frac{\frac{\tau_{pw}+p}{1+p}-(\tau+(1-\tau)\tau_{pd})}{1-\frac{\tau_{pw}+p}{1+p}}\right).
\end{aligned}
$$