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The Taxation of Closely Held Firms: The Achilles Heel of the Dual Income Tax System Reconsidered

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Abstract: This study presents an improvement of the King-Fullerton framework for calculating the marginal effective tax rate (METR) for active owners of closely held corporations in a dual income tax system with income splitting rules. The original King and Fullerton model was not modeled to incorporate this type of rule, making it difficult to fully calculate the METR in countries with a dual income tax. The model developed in this paper offers a more general method with less restrictive assumptions than earlier analyses of a dual income tax system. To illustrate the results, the model is applied to the Swedish dual income tax system and is contrasted with earlier works, revealing that the METR for new share issues may have been overestimated in earlier calculations. Our model provides a more comprehensive and flexible toolbox for calculating the METR in a dual income tax system with income splitting rules and improves the possibilities to evaluate how changes in the regulatory framework may affect the METR and the neutrality between investment opportunities. As such, the results are relevant not only for Sweden but also for other countries that have implemented a dual income tax system or are considering doing so.

JEL Codes: H24, H25, H26
Keywords: cost of capital, marginal effective tax rates, dual income tax, income splitting rules, income shifting

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1 Introduction

The general principles for how a well-functioning tax system should be designed are the topic of an intense policy debate and have garnered considerable attention in the tax literature (see, e.g., Mankiw et al., 2009). Concerning income taxation, researchers mainly contrast two principles. The first is a global (or comprehensive) income tax system, where all incomes are added together regardless of source and taxed according to the same tax schedule. The second is a dual income tax (DIT) system where the tax on labor income and capital income may differ, with a supposedly more lenient taxation of the latter. Whereas a global tax system may be credited for its alleged simplicity resting on a horizontal equity basis, a DIT system makes it possible to maintain a progressive and relatively high labor income tax while lowering the tax on capital income called for by an increasing international capital mobility in small open economies.[1]

DIT schemes have gained increasing attention in recent years (e.g., Mirrlees et al., 2011) and have gained supporters in many European countries, including the UK, Germany and Switzerland (Keuschnigg & Dietz, 2004; Spengel & Wiegard, 2004; Crawford & Freedman, 2010; Griffith et al., 2010). Until now, however, the Nordic countries are virtually alone in implementing such systems (Sweden 1991, Norway 1992, Finland 1993, Iceland 1997), and the discussion about its alleged benefits and costs is still a matter of contention (see, e.g., Cnossen, 2000; Genser & Reutter, 2007).

The DIT system has also received widespread attention in economic research, mostly among Nordic economists with detailed knowledge of national tax laws and the institutional background (see, e.g., Sørensen, 1994; Nielsen & Sørensen, 1997; Kanniainen et al., 2007; Pirttilä & Selin, 2011). A recurrent question concerns the neutrality of the tax system and how the tax rules will affect the effective tax rates and, in the end, the incentives for entrepreneurship and investment.

The theoretical advantages of a DIT system, with its possibility of taxing income types differently, must be weighed against the problems encountered in practice. Under a DIT system, a taxpayer's total tax bill depends not only on his or her total income but also on the division between types of income. In theory, it is implicitly assumed (or required) that the tax authority can easily distinguish between and assess the levels of capital and labor income alike. Even if this

[1] See, e.g., Sørensen (1994) for a more thorough discussion of the purported benefits, including both efficiency and equality arguments, of a dual income tax system.

is true for most taxpayers, such as regular employees with savings in bank accounts and listed shares, it is far from the case for everyone. The difficulty is particularly problematic for the tax authority when it comes to active owners of closely held corporations (CHCs), as it is up to the owners' discretion to determine how much wage income to report, which might have a vague – or no – direct connection with the actual effort put into the firm. As capital income is supposedly taxed at a lower rate, this possibility opens up for income shifting behavior and tax avoidance activities where de facto labor income is taxed as capital income. Sørensen (1994) refers to this problem as the "Achilles heel" of the DIT system—an analogy repeatedly used about the DIT system since then.

The problem is aggravated by the fact that the income from active owners of CHCs is a complex mixture consisting of both a (risk-adjusted) return on capital and compensation not only for labor but also for entrepreneurial effort and ability (Kanniainen et al., 2007). The latter is not distinguished and recognized as a distinct income category by the tax authority.[2]

To avoid or mitigate the income shifting problem, the introduction of a DIT system could be accompanied by special income splitting rules for CHCs that regulate the division between capital and labor income, as there is no objective way to determine whether a surplus in these corporations stems from an active owner's invested capital or work effort (and from a tax perspective, there is no additional third alternative). All Nordic countries with a DIT system have also introduced some kind of income splitting rules. Even if the reason for and basic idea behind this type of regulation is the same, the design and construction of the laws differ across countries. The rules have also changed repeatedly over time and have been cause for considerable dispute in the Nordic policy debate (see, e.g., Sorensen, 1998, 2005a; Bø et al., 2011).

A standard approach among economists (see OECD, 1991; EU, 2001) when analyzing and comparing capital income taxation over time and between countries is King and Fullerton's (1984) method to analyze capital income taxation on investments based on the cost of capital analysis in Hall and Jorgenson (1967). However, the King and Fullerton method was not modeled to incorporate the type of income splitting rules that are currently applied in DIT systems, nor did it include the possibility for an active owner to choose the optimal remuneration strategy given the restrictions detailed in the tax law. Expanding the original model to incorporate these income

[2] Remuneration of an active owner above a "normal" rate of return on capital must not necessarily be seen as covert wages (*förtäckt lön*) that should be taxed as such, or as a highly taxable rent, but as a compensation for entrepreneurship. It is beyond the scope of this article to discuss these conceptual issues further.

splitting rules is difficult and far from straightforward. Earlier studies, such as Öberg (2003), Lindhe et al. (2002, 2003, 2004) and Sørensen (2008), have extended the model in several ways to facilitate the analysis of the Swedish DIT system.[3] While these extensions are important contributions, they rest on assumptions that might veil important aspects of how the whole system works at present, although they may offer a good description of the differences and neutrality between investments and owner types. Notably, the distinction between the fixed acquisition costs of shares used to finance an investment with new share issues and the declining surplus that the investment generates due to depreciation might have tax consequences neglected in earlier works. The models can further incorporate the change of rules in 2006, when the owners' own wage bill matters for the amount of dividends and capital gains taxed with low capital income tax rates.

The purpose of this article is to develop a general model for analyzing the DIT system and its associated income splitting rules in a way that makes it possible to capture the general features of the DIT system and determine its impact on the cost of capital based on the King-Fullerton method. The article provides a framework for how the complex Swedish tax rules in a DIT system can be dealt with mathematically when calculating the effective marginal effective tax rate (METR) on capital income. To illustrate our results, we use our model to calculate the METR for a CHC based on Sweden's rules in 2018 and compare it with the results that earlier models would have generated. The model can be adjusted to incorporate how changes in the rules might influence the METR and how different regulations of DIT systems might affect the outcome. The article focuses on equity financed investments, as debt financed investments through the financial market are not affected by the income splitting rules.[4]

The extended model derived in this article has several advantages. First and foremost, it does not rely on assumptions on repurchases or nondepreciating real assets. Furthermore, it captures more aspects of the tax system than earlier models and gives greater degrees of freedom when analyzing different policy changes or evaluating the tax system. The model can be used to

[3] The Norwegian and Finnish dual income tax systems have also been modeled and discussed extensively in the literature; see, e.g., Sørensen (2005b), Lindhe & Södersten (2012), Södersten (2020) or Kari (1999). Lindhe et al. (2004) include a comparison among the Nordic systems.

[4] If an investment is financed through the financial market, the METR for debt will be the same. However, if an owner of a closely held corporation lends money to his or her own corporation, there are regulations in Sweden restricting compensation and taxation. See Wykman (2022) for how these rules can be incorporated into the King and Fullerton framework.

generate a consistent and comparable long-time series of how the METR on capital income has evolved across sources of finance and over time since the introduction of the DIT system. It also gives researchers and policy makers a flexible tool to evaluate how changes in the regulative framework may affect the METR and the neutrality between investment opportunities. One main finding based on the extended model presented in this article is that earlier models may have overestimated the METR for investment financed with new share issues.

Being able to analyze how a DIT system and its associated income splitting rules affect behavior and effective tax rates is important for both research and policy development. Although the analysis in this article is based on tax laws taken from a Swedish context, the results are relevant for other countries already using or considering introducing some form of DIT system, thereby contributing to the debate on the specific design of DIT systems. The way Sweden has formalized and changed its DIT system over time can be contrasted with other systems.

The remainder of the paper is organized as follows. Section 2 briefly describes the taxation of owners of CHCs in Sweden. Section 3 presents our extended model and shows how earlier models can be improved. In section 4, the results from our augmented model are compared with the original and earlier models based on the tax rates in 2018. Section 5 concludes the paper. In Appendix A, the King-Fullerton model is briefly presented whereas an important tax savings relationship is derived in Appendix B. All parameters used for the calculations are presented in Appendix C. Further details on the calculations are presented in Appendices D and E.

2 The Swedish Dual Income Tax System and Income Splitting Rules[5]

Following a major tax reform in 1990–1991, Sweden abandoned its nearly century-old comprehensive income tax system and introduced a DIT system with a progressive tax schedule for labor income and a flat tax rate on capital income below the highest marginal tax rate for labor income. This change was accompanied by special income splitting rules for active owners of CHCs to prevent or reduce potential tax avoidance behavior.[6] Passive owners' income is always classified as capital income and is not subject to measures against income shifting.

[5] For an exhaustive description of the tax rules and tax rates, see Wykman (2022).
[6] The principal definition of a closely held corporation according to the tax law is that four or fewer owners control more than 50% of the ultimate voting rights. An owner is considered to be active if (s)he is (or during the past five years has been) active in the income generation of the corporation to a "considerable extent." Close family members are regarded as one owner in this context (see Bjuggren et al., 2011, for further details).

The basic idea behind the income splitting rule is to divide the remuneration from an active owner in a CHC into capital income taxed and labor income taxed part, or more formally, to restrict the amount that can be taxed as capital income. Even if the details of the rules and tax rate levels have changed over time, the general idea is the same determining a rate of return allowance (RRA) within which remuneration in the form of dividends or capital gains can be taxed as capital income.[7] Dividends within the RRA are often referred to as normal dividends, whereas dividends above the allowance are termed excess dividends.

Initially, the RRA was only based on the capital invested and equal to the owner's acquisition cost of the shares (denoted the capital or equity base) times an imputed normal rate of return consisting of a risk-free interest rate plus a risk premium.[8] Unused RRA can be saved and used in the future. Income above the RRA will be taxed as labor income. The idea behind this type of regulation is called a *normal return model*. It would be possible to have the opposite rule and instead specify an amount that must be taxed as labor income (a *normal wage model*). However, the capital or equity in a corporation can usually be observed and used as a basis for the calculation of a RRA, whereas the working hours and effort of an active owner cannot be observed in the same way and are more difficult for the tax authority to predict.[9] In Sweden, there was also a fear that a normal wage model would imply that active owners would be able to avoid the progressive labor income tax entirely and that the taxation would be too lenient. By only using the acquisition costs of the shares, investments financed with retained earnings will not increase the equity base and, as a result, will not increase the amount that is allowed to be taxed as capital income. An alternative would be to use the gross or net asset value of the corporation as the equity base.[10]

Since 1994, not only capital input but also labor input affects the size of the RRA – the higher the wage bill is, the higher the RRA. The importance of the wage bill for the size of the

[7] Occasionally, it is termed the *dividend allowance*, but because it also might be used for capital gains, this term may be somewhat misleading.

[8] The Swedish government borrowing rate (*statslåneräntan*) was used as the risk-free interest rate. The risk premium was initially set to 5% but has increased over time to 9% in 2021. Other forms of owner capital injections were also part of the equity base.

[9] Nevertheless, Iceland uses a normal wage model, and the Icelandic Ministry of Finance decides and publishes minimum imputed wages for different sectors and sizes of companies on an annual basis (Matheson et al., 2012; Fjóla & Rakel, 2014). The IMF recommended that Iceland change to a normal return model (Escolano et al., 2010).

[10] This alternative has been used in other countries, and a variant of this idea was also discussed in Sweden (the so-called *BEK-model*) but was rejected (see, e.g., SOU, 2002:52; Edin et al., 2005). Using the historical acquisition costs only could be considered a modified version of the net asset value.

RRA has increased substantially over time, making labor-intensive firms more tax favored. From 2006, the owner's own wage was also included in the wage bill, making the choice of renumeration strategy and calculation of effective taxes more complex. A formal minimum wage requirement for the owner that had to be fulfilled if the owner wanted to expand the RRA with these wage rules was also added in 1994.[11]

There have been several reasons for the introduction and expansion of these wage favoring rules. The wage bill may give an admittedly crude, but not improper, estimation of the risk of the corporation. The higher the wage bill is, the higher the risk, the higher the risk premium and the higher the amount that could and should be taxed as capital income. Exploiting these rules (increasing the wage bill) for tax avoidance was, further, not advantageous and difficult to abuse. A generous wage rule also meant that the income splitting rule in practice was not binding for closely held medium-sized firms with many employees where the opportunities for income shifting were slim. Instead of having a very sharp exception rule (e.g., for firms above 10 employees), leading to an uncertain tax situation for firms fluctuating just around the size threshold, these rules offered a more flexible exception regulation. Finally, these rules could encourage closely held firms to expand and employ more people.

Since 2006, there has also been an alternative rule that can be used (mainly by self-employed individuals with few or no employees), where the RRA is set to a fixed amount by the legislator, independent of equity invested and wage bill paid (*förenklingsregeln*). This fixed amount has increased over time and become more generous.

Additional rules have been added and abolished over time. There is a labor income tax ceiling that limits the total amount of capital income that can be taxed as labor income and above which all capital income will be taxed as capital. This rule was in place from the beginning in 1991 for capital gains but was first introduced for dividends in 2012. Between 1997 and 2005, a part (approximately two-thirds) of the remuneration within the RRA was tax exempt, and before 2006 and between 2007 and 2009, half of the capital gains were taxed as labor and half as labor above the RRA.

[11] With a minimum wage requirement and a very generous RRA, the system can be seen as moving toward a more normal wage type of system.

3 The METR Model and the Income Splitting Rules

3.1 The Basic Framework

The aim of the original well-known King and Fullerton (1984) method is to calculate the METR on investments, described in greater detail in Appendix A. To briefly summarize the model, it formally defines the METR as

$$METR = \frac{p-s}{p} \tag{1}$$

where p is the pretax real rate of return on a marginal investment and s the posttax real rate of return to the saver. Based on the idea behind the King-Fullerton model that an investment must yield (at least) the same return after taxes as if it the saver/investor lent his or her capital on the capital market receiving the nominal interest rate, s can be further detailed as

$$s = (1-m)i - \pi - w_p, \tag{2}$$

where m is the tax on interest income, π is the rate of inflation, and w_p is the wealth tax rate.[12]

The original King-Fullerton model examines the effective marginal tax rates on investments from different sources of finance (new share issues, retained earnings and debt), from different groups of savers (households, tax-exempt institutions and insurance companies), in different assets (machinery, buildings and inventories) and in different industries (manufacturing, commerce and "other"). This study analyzes the METR for CHCs, and hence only household savings, and focuses on equity financed investments in machinery. Since there are no differences in taxation between industries, the results hold for any equity-financed investments in machinery. As King and Fullerton (1984) primarily use a fixed-p model, we conform to that standard.[13]

Although the original King and Fullerton model is an often used and established approach for analyzing capital taxation, it unfortunately does not allow for any division of income for the owner, which is at the core of the tax rules for CHCs. In the model, the investor receives all surplus as capital income (dividends, capital gains and interest). However, in a CHC, it is up to the active owners' own discretion to choose how to receive personal income out of the potential surplus generated in the corporation and, as a consequence, how the remuneration will be taxed.

[12] In the original model, risk is not included in the analysis, and we follow that approach because our purpose is to improve the original model to incorporate a DIT system with income splitting rules. For a discussion on how to extend the model with risk, see Lindhe et al. (2003) and Sørensen (2004).
[13] As also stated in Appendix A, the METR can be calculated either given a fixed pretax real rate of return, p, or given a fixed real interest rate, r.

Based on a so-called pecking order of the retention rate (i.e., the proportion of income left after taxation), earlier works, such as Lindhe et al. (2002, 2003, 2004) and Öberg (2003), conclude that the optimal tax strategy for an owner of a CHC, everything else equal, reduces to paying dividends until the whole RRA is used and thereafter withdrawing any surplus as wages. Based on this pecking order, the original King-Fullerton model can be extended, allowing the owner to be remunerated in a more general and comprehensive way.[14]

3.2 Extended METR Model

The pecking order used in earlier studies remains valid when examining the Swedish DIT system until today, although the reasons are less straightforward after 2006.[15] From that year, the owner's own wage expands the RRA, effectively transforming wage remuneration into a system where part will be taxed as labor income and part can be taxed as capital income in the form of increased dividends.[16] Situations in which wage payments are preferred to dividends within the RRA or when dividends outside the RRA are preferred to wage payments can occur and can be incorporated into the model derived below by simply changing the tax rates and/or payment flows.

In section 3.2.1, the METR for new share issues is discussed and contrasted with earlier models in section 3.2.2. Section 3.2.3 analyzes the less complicated case using retained earnings as a source of finance.

3.2.1 New Share Issues

Based on Sørensen (2004) and Öberg (2003), but using our own notation, the non-arbitrage condition that a potential investor faces would be

[14] Formally, the pecking order can be depicted as $(1-\tau)(1-\tau_d) > \frac{1-\tau_w}{(1+\sigma)} > (1-\tau)(1-\tau_w)$, where τ is the corporate income tax rate, τ_d is the capital income tax rate on dividends within the RRA, τ_w is the labor income tax rate and σ is the social security contribution rate. The insurance value of the social security contributions has a ceiling, and for simplicity, the social security contributions are considered a pure tax. In contrast to ordinary wages, the labor-taxed capital income is not subject to any deductions/credits or social security contributions.

[15] Cf. analysis of the Norwegian system in Fjaerli and Lund (2001) and Finnish system in Hietala and Kari (2006) and Kari and Karikallio (2007).

[16] Beginning in 2014, the RRA includes, e.g., half of the wage bill (including the owner's own wage). If the RRA is used up and the owner wants to withdraw *1* additional Swedish krona from the corporation, it is enough to increase the wage by approximately *2/3,* allowing him or her to also increase the capital taxed dividends by approximately *1/3,* which would be the tax-minimizing choice.

$$i(1-m)V(t) = \left(1-m_{cf}\right)CF(t) + (1-\tau_c)\frac{d}{dt}V(t), \tag{3}$$

where *V(t)* is the corporation's value at time *t*. The right-hand side of the equation shows how a surplus generated by a potential investment could be received (after tax) for the investor. The investor can be remunerated through cash flow *CF* and as an increase in corporation value $\frac{d}{dt}V(t)$. m_{cf} is the tax on the cash flow from the corporation to the investor, and τ_c is the capital gains tax.[17] The surplus from the investment should equal the return generated on the financial market if the investor instead had invested the same amount in bonds generating interest *i* taxed with capital income tax *m* (left-hand side of the equation).

Solving differential Equation (3) for time zero yields the maximum present value *V(0)*

$$V(0) = \int_0^\infty \left(\frac{(1-m_{cf})}{(1-\tau_c)}CF(t)\right)e^{-\frac{i(1-m)t}{(1-\tau_c)}}dt.^{18} \tag{4}$$

The general cash-flow term, *CF*, could be wages, dividends or repurchases of shares, each associated with a tax rate, or no tax at all. Repurchases of shares are likely an uncommon method to distribute surplus but are nevertheless used in many other models (see the discussion below). As discussed further below and shown in Appendix E, it is a suboptimal tax strategy for CHC under normal conditions, even when the tax rate is set to zero. Hence, the income division will be between wage, *W*, and dividends, *D*, and the maximum present value of a marginal investment can be described as

$$V(0) = \int_0^\infty \left(\frac{(1-\tau_w)}{(1-\tau_c)}W(t) + \frac{(1-\tau_d)}{(1-\tau_c)}D(t)\right)e^{-\frac{i(1-m)t}{(1-\tau_c)}}dt. \tag{5}$$

The next step is to derive the explicit functions for *W(t)* and *D(t)*. Given that the RRA is not large enough to include the whole surplus that the investment generates, a profit-maximizing owner will split the surplus between wages and dividends so that the after-tax sum is as large as possible.[19] Based on the rules from 2006 together with the standard assumption in the King-Fullerton framework that the whole surplus is distributed, the division following a unit investment will be

$$D(t) = \beta + \varphi W(t), \text{ and} \tag{6}$$

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[17] As the capital gains tax is deferred until the gains are realized, an effective capital gains tax rate on accrued capital gains, which is lower than the statutory tax rate, should be used to take this effect into account (see Appendix C for further details).

[18] See Appendix D for a proof that (4) is the maximum value of *V(0)* from solving Equation (3).

[19] If wage payments are tax preferable to dividend payments, the whole surplus will be distributed as wages.

$$W(t) = \frac{(1-\tau)MRRe^{-(\delta-\pi)t} - \beta + \tau a e^{-at}}{\varphi + (1-\tau)(1+\sigma)}, \quad (7)$$

where β is the imputed normal rate of return on the RRA, φ is the coefficient representing the size of the share of the wage bill that is added to the RRA, and MRR refers to the marginal rate of return on the investment (equal to $p + \delta$, where δ is the depreciation rate of the asset invested in).[20] The last term in the numerator in Equation (7) refers to taxation depreciation allowances associated with real asset investment (machinery), which is integrated directly into the wage remuneration function.[21]

In equilibrium, the present value of the investment project, V, must equal the cost of the project, and assuming that the marginal investment cost is unity, the equilibrium condition for new share issues will be

$V(0) = 1$.[22] (8)

Equations (5, 6 and 7) can then finally be combined with the equilibrium condition (Equation 8), and a relationship for the interest rate, i, can be derived (either by calculus or by simulations). For a given i, Equation (2) can be used to solve for s, and then, given a fixed p, the METR can be determined (Equation 1). The above general analysis is in line with earlier work.

Further examination of the model reveals, however, that this cannot be the complete solution due to the construction of the equity base. The definition of the equity base in the tax law is crucial since it governs the size of the RRA, which in turn determines how much of the surplus that can be taxed as capital income. The equity base is based on the acquisition cost of the shares that the owner invested in, as described in section 2. The equity base will increase with new share issues and decrease with the repurchase of shares, but will, besides of that, be constant over time. The real assets, such as machinery, that the corporation invests in will, however, depreciate, and

[20] The wage renumeration function can be derived by solving
$Max\ (1-\tau_w)W + (1-\tau_d)D,\ s.t.\ (1+\sigma)W + \frac{1}{1-\tau}D = MRR,$
taking the dividend renumeration function (Equation 6) into account.
Since β is a function of the interest rate (government borrowing rate or risk-free interest rate), it could partly be calculated within the model presented below. Earlier work, however, takes this rate as exogenously given, and this paper conforms to that standard.

[21] In line with Öberg's analysis (see Öberg, 2003, for further details). For machinery, a standard assumption is that the rate of the tax depreciation allowance is a continuous exponential function decreasing at rate a.

[22] Formally, it should be the after-tax value of the investment project that equals the cost, $V(0) - \tau_c(V(0) - 1) = 1$, implying Equation (8).
As shown in Appendix A, the present value of the taxation depreciation allowances, denoted as A, is included in the equilibrium condition in the original model, implying an equilibrium condition of $V = 1 - A$. This difference will not alter the results.

the generated surplus for a given investment will diminish over time. At the start of an investment project financed with new share issues, the equity base and the real assets will be the same (or increase by the same amount), but over time, the real assets will depreciate, while the equity base will not.

In practice, this implies that our model must be modified because the RRA might be higher than the generated surplus, allowing the owner to avoid paying (high-taxed) wages over time. An owner that wants to minimize tax payment will only remunerate him or herself with wages up to a time, t_d, where

$$(1-\tau)MRRe^{-(\delta-\pi)t_d} + \tau a e^{-at_d} = \beta. \tag{9}$$

With this definition of t_d, the present value function in (5) must be reformulated as

$$V(0) = \int_0^{t_d} \left(\frac{(1-\tau_w)}{(1-\tau_c)} W(t) + \frac{(1-\tau_d)}{(1-\tau_c)} D(t)\right) e^{-\frac{i(1-m)t}{(1-\tau_c)}} dt + \int_{t_d}^{\infty} \frac{(1-\tau_d)}{(1-\tau_c)} D^*(t) e^{-\frac{i(1-m)t}{(1-\tau_c)}} dt \tag{10}$$

where

$$D^*(t) = (1-\tau)MRRe^{-(\delta-\pi)t} + \tau a e^{-at}. \tag{11}$$

A marginal investment will, further, give rise to tax savings that can be used to transform additional income from labor to capital from time t_d and onward. Higher taxed labor income, *W*, could be shifted to lower taxed dividend income, *D*. The tax savings (*TS*) will be equal to

$$TS = \left(\frac{(1-\tau)(1+\sigma)}{(1-\tau)(1+\sigma)+\varphi}\right)\left(\left(\frac{\sigma+\tau_w}{1+\sigma}\right) - (\tau + \tau_d - \tau\tau_d) \int_{t_d}^{\infty} \frac{(\beta - D^*(t))}{1-\tau}\right) e^{-\frac{i(1-m)t}{(1-\tau_c)}} dt. \tag{12}$$

The tax savings in Equation (12) have similarities with how Sørensen (2008) incorporates the effect of an increase in the equity base.[23] The idea also parallels Södersten's (2020) notion about tax savings following new share issues in the Norwegian system due to an increased equity base. Hence, the increase in the equity base following investments financed with new share issues has two effects: an increase in dividend payments and the opportunity to shift additional income from wages to dividend payments.

The present value function of the investment will now be

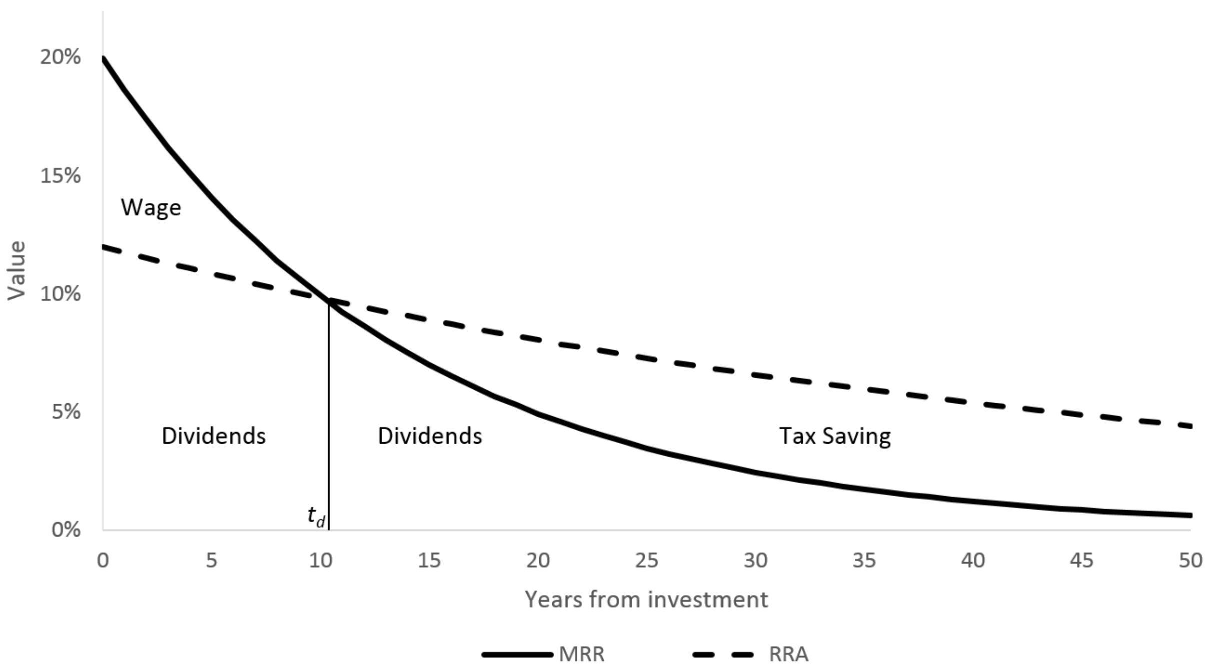
$$V(0) - \frac{TS}{(1-\tau_c)} =$$

[23] It has also similarities with earlier techniques when incorporating different credits and allowances, such as the additional investment allowance in the 1970s and 1980s. The constant term in equation (12) is the tax difference between paying wages and dividends. The first part corrects for the change in the RRA due to the reduction in wage payments. The first term under the integral is the sum subject to income shifting at the corporate level and the second term is the same discount factor as above. See Appendix B for a formal derivation of equation (12).

$$=\int_0^{t_d}\left(\frac{(1-\tau_{pw})}{(1-\tau_c)}W(t)+\frac{(1-\tau_d)}{(1-\tau_c)}D(t)\right)e^{-\frac{i(1-m)t}{(1-\tau_c)}}dt+\int_{t_d}^{\infty}\frac{(1-\tau_d)}{(1-\tau_c)}D^*(t)e^{-\frac{i(1-m)t}{(1-\tau_c)}}dt. \quad (13)$$

The equilibrium condition (Equation 8) must still hold. Based on simulations, an *i* can be found that fulfills this condition and Equation (13). Excluding taxes, the division of income and the extent of tax savings over time can also be described graphically as in Figure 1. The solid line represents the marginal rate of return, and the dashed line represents the RRA. The present pretax value (of the first 50 years) of the return on the investment is the area under the solid line. The present value of the pretax wage payments is the area under the solid line and above the dashed line until time t_d. The present pretax value of the dividend payments will be the area under the dashed line until time t_d and under the bold line thereafter. The present value of unused RRA that can be used for tax savings is, in the same manner, the area above the bold line but below the dashed line after time t_d.

Figure 1. The division of income after an investment (*MRR=20%*) financed by new share issues.



Note: MRR is the (discounted) marginal rate of return on an investment. RRA is the (discounted) rate of return allowance
Source: Own figure.

3.2.2 Earlier Models

Lindhe et al. (2002, 2003, 2004) and Sørensen (2008) circumvent the problems that the difference between the equity base and real assets will cause by abstracting from depreciations.[24] The main purpose of their analyses is to examine the neutrality of investments by different types and legal forms and ignores depreciation, as it arguably affects all investments and owners in the same way. However, this approach will overlook important aspects of the METR (as seen in the section above).

Öberg (2003) includes depreciation but also assumes that the investor is remunerated through the repurchase of shares at the same pace as the capital (assets) depreciates. Öberg's repurchase assumption avoids mathematical difficulties but restricts the analysis to a highly stylized situation in which repurchases exactly match the (real) depreciation rate. However, the repurchase of shares is not common among closely held firms in Sweden, and repurchasing shares at the same rate as real assets depreciate in the corporation seems, further, very unlikely.

In models with repurchases of shares at the same pace as assets depreciate, the wage and dividend remuneration functions (Equations 6 and 7) take the form

$$W(t) = \frac{(1-\tau)MRRe^{-(\delta-\pi)t} - \beta e^{-(\delta-\pi)t} - (\delta-\pi)e^{-(\delta-\pi)t} + \tau a e^{-at}}{\varphi + (1-\tau)(1+\sigma)}, \text{ and} \tag{14}$$

$$D(t) = \beta e^{-(\delta-\pi)t} + \varphi W(t). \tag{15}$$

The difference from our model is that β is now discounted.[25] The repurchase of shares must also be added to the present value function of the investment, now taking the form

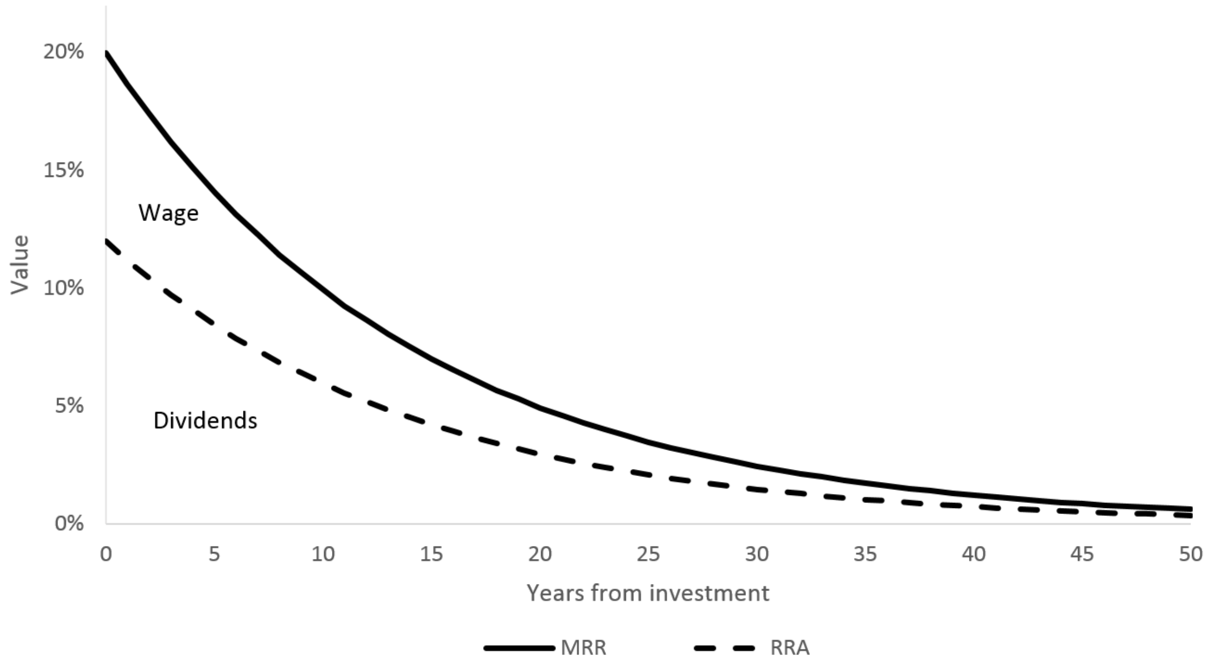
$$V(0) = \int_0^\infty \left(\frac{(1-\tau_w)}{(1-\tau_c)} W(t) + \frac{(1-\tau_d)}{(1-\tau_c)} D(t) + (\delta-\pi)e^{-(\delta-\pi)t} \right) e^{-\frac{i(1-m)t}{(1-\tau_c)}} dt. \tag{16}$$

The division of income with repurchases of shares could also be described graphically (see Figure 2), in line with the earlier model without repurchases of shares portrayed above.

[24] Sørensen (2008) is an updated and a more general version of the Lindhe et al. (2003) model. The technique in Lindhe et al. (2002) is somewhat different because the cost of capital function is derived using a utility maximization problem in which the corporation's owner supplies and hires labor and chooses an optimal capital stock. Lindhe et al. (2004) draw on and extend Lindhe et al. (2002, 2003).

[25] This assumption implies that the equity base—on which the RRA is calculated—diminishes at the same rate as the marginal rate of return of the investment project. With reasonable parameter values, both the wage and dividend payments as expressed by Equations (14) and (15) will go to zero as time goes to infinity.

Figure 2. The division of income between wages and dividends from an investment (*MRR=20%*) financed by new share issues, with repurchases of shares.



Note: MRR is the (discounted) marginal rate of return on an investment. To facilitate understanding, repurchases are left out of the illustration. If they were included, they would be a fixed proportion of the Dividends area. RRA is the rate of return allowance.
Source: Own figure.

Comparing Figures 1 and 2, it is clear that the payment scheme, and hence the effective tax rates, will differ depending on whether one assumes repurchases of shares. Without repurchases, wage payments will be lower, dividend payments will be higher, and if there are other incomes in the corporation, the new investment will potentially transform part (or all) of these from high-taxed labor income to low-taxed capital income. [26]

Lindhe and Södersten (2016) have shown that repurchases of shares are a favorable remuneration policy from a tax perspective that will lower the cost of capital (lower METR), and this possibility should, hence, be taken into account when the METR is calculated.[27] However,

[26] Furthermore, if the repurchase rate is lower than the depreciation rate in the repurchase case, the modeled wage payments will be negative over time, and the dividend payments will exceed the total income from the investment. Hence, the interest rate *i*, which solves equilibrium condition in Equation (8) using Equation (16), will lack economic meaning.
As shown in Wykman (2022), even if one assumes that the rate of repurchase equals the depreciation rate, the wage can actually also be negative, taking into account the repurchase and tax depreciation allowances (not depicted in the figure).
[27] In their model, shares are repurchased at the original price, and there will be no capital gains tax, i.e., the investors are allowed a tax-free return of the original capital, a case that they call the "partial equity-trap." They argue that

although repurchasing shares may be an optimal tax strategy for non-CHCs, this remuneration policy is not necessarily an optimal tax strategy for active owners of CHCs because there is a punishment for active owners of reducing the equity base (and, as a result, the RRA).[28]

To conclude, the METR for new share issues can be calculated based on repurchases of shares, no repurchases of shares without the possibility to utilize the tax savings, or no repurchases of shares with the possibility to use the tax savings. In each case, the value of the investment (given by Equation 10, 13 or 16) together with the equilibrium condition and remuneration functions can be used to derive the interest rate *i*, and Equations (1) and (2) are then finally used to calculate the different METRs.[29] These expressions are, however, often tedious and uninformative, and in section 4, we will instead show how the estimated METR will be altered. Finally, note that assuming nondepreciating assets will have the same impact as assuming repurchases of shares in Figure 2, i.e., the relationship between MRR and RRA will remain constant over time.

Our analysis above enhances and improves earlier theoretical works evaluating the Swedish DIT system with its income splitting rules based on the King and Fullerton framework. The difference between the equity base and real assets gives rise to problems that have not been completely addressed earlier. In particular, we have analyzed the effective tax rates without the assumption of no depreciation or a continued repurchase of shares at the same rate as real assets depreciates, making it possible to capture the tax effect of differences in a constant equity base and depreciating real assets. Our general model also makes it possible to explicitly incorporate the change of rules in 2006, where (part of) the owner's own wage is included in the RRA, complicating the optimal remuneration choice.

3.2.3 Retained Earnings

The model for new share issues is easily changed to the case of retained earnings by updating the non-arbitrage and equilibrium conditions as well as the remunerations. When retained earnings

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earlier contributions, e.g., Auerbach (1983), overestimate the cost of capital for new share issues because they ignore the possibility of repurchasing shares.

[28] In addition, Lindhe and Södersten (2016) do not account for the depreciation of real assets, which will further underestimate the benefits of not repurchasing shares and keeping the equity base (and RRA) constant. See Appendix E for further details on the optimal behavior of active owners of closely held corporations.

[29] As stated in section 2, a part of the RRA was also exempt from all personal income taxation between 1997 and 2005 (see Wykman, 2022 for further details and how this can be incorporated in the model).

are used, there will be no increase in the equity base, and the analysis of tax savings in section 3.2.2 is not applicable.[30]

Retained earnings from the owner's perspective means giving up income in the present for a future return. Given the pecking order, it is preferable to reduce wages to finance an investment. After 2006, when the own wage was included in the RRA, a reduction in (increase in) wage payments also induces lower (higher) dividend payments. The non-arbitrage condition for retained earnings will in principle be the same as for new share issues, with the difference being that there are no new stocks to theoretically repurchase because no new shares have been issued.

Since the withdrawal of wage and dividend payments to finance a unit investment does not affect the equity base of the corporation, the wage and dividend functions will simplify to

$$W(t) = \frac{(1-\tau)MRRe^{-(\delta-\pi)t} + \tau a e^{-at}}{\varphi+(1-\tau)(1+\sigma)}, \text{ and} \tag{17}$$

$$D(t) = \varphi W(t). \tag{18}$$

In equilibrium, the value of the investment project (net of taxes) should equal the cost of the investment project. For retained earnings, the (opportunity) cost of the project is the after-tax value of the amount forgone (payments withdrawn) to finance the investment, which in this situation is a combination of wage and dividend payments. As a result, the equilibrium condition for retained earnings will be

$$(1-\tau_c)V(0) = \frac{(1-\tau_w)}{\varphi+(1-\tau)(1+\sigma)} + \frac{\varphi(1-\tau_d)}{\varphi+(1-\tau)(1+\sigma)}.\text{[31]} \tag{19}$$

In Equation (19), φ determines the mix between wages and dividends withdrawn. The first term on the right-hand side is the total after-tax value of the share that is withdrawn as wage payments, and the second term is the total after-tax value of the share that is withdrawn as dividend income.[32]

[30] Based on the Norwegian tax system, Södersten (2020) argues, correctly, that this kind of tax savings also may affect investments financed with retained earnings because the share price will increase. This is true for the Norwegian system analyzed by Södersten but does not hold for the Swedish system, since the tax savings from a larger equity base are only valuable to an owner of a closely held corporation and will not necessarily impact the price of shares when selling on the market (see Södersten, 2020, for further discussion).

[31] Cf. Öberg's equilibrium condition for retained earnings (based on the rules before 2006 when the own wage was not part of the RRA), $(1-\tau_c)V(0) = \frac{1-\tau_w}{(1-\tau)(1+\sigma)}$, where only wages will be forgone to finance the investment.

[32] The right-hand side of the expression can formally be derived by solving $(1-\tau_w)W + (1-\tau_d)D$, given that $W(1-\tau)(1+\sigma) + D = 1$ and $D = \varphi W$.

Analogously to new share issues, Equations (5), (17) and (18) can be used together with the equilibrium condition (Equation 19) to determine *i*, *s* and the METR.

4 Results

To illustrate the result generated by the extended model and to compare it with the earlier models, we calculate the METR derived with the different methods using the tax rules and tax rates for 2018 as an example. A summary of the different (tax) parameters used is presented in Appendix C.[33] Above all, we compare the METR for investments financed with new share issues, as this source of finance modifies the earlier models the most. Table 1 reports the results. The results from the different models cannot and should not be compared at face value without considering the different assumptions and purpose underlying the specific models and methods used.

The original King-Fullerton model does not have any tools to divide the total income into labor and capital; hence, the whole income will be taxed as either labor income or capital income. The lower METR (34.5%) refers to the case when all income is taxed as capital, and the higher METR (73.2%) refers to the case when all income is taxed at the highest labor income tax rate. This model is too crude to capture the main idea of a DIT system and the associated income splitting rules for CHCs, and these results function only as a benchmark.

The Öberg (2003) model reflects a situation with repurchases of shares. This will diminish the equity base and RRA over time, but it will also in her model allow a substantial share of income to be taxed at a relatively low effective accrued capital gains tax rate. The METR is 36.5%, i.e., only slightly higher than the King-Fullerton model generated when everything is taxed as dividends (capital income).

The Sørensen (2008) model is different in the sense that it uses a fixed-r approach. The reported METR is based on an investment with (slightly) different marginal rate of return. While Öberg includes both depreciation (economic depreciation and tax depreciation allowances) and repurchases of shares, Sørensen ignores depreciation-related items and excludes repurchases of shares. The main purpose of Sørensen was to analyze differences between legal forms while overlooking factors that affected all organizational forms equally. However, since a CHC is the

[33] The results exclude some special tax allowance and deference rules also applicable in 2018, primarily the periodization fund (*periodiseringsfonden*), with negligible impact on the problems considered here. See Wykman (2022) for a description of the special tax rules in place and how to include them within this framework.

only legal form that allows for income shifting, this may be an oversimplification. Furthermore, this type of model cannot account for different depreciation rates or capture the tax savings effect described in section 3.2. The calculated METR will be 40.2%, i.e., somewhat higher than in Öberg's model.

Table 1. Marginal effective tax rate (METR) financed with new share issues, different methods, 2018.

Method	METR (%)
King and Fullerton (1984)	
Personal income taxed as dividends	34.5
Personal income taxed as labor	73.2
Öberg (2003)	36.5
Sørensen (2008)	40.3
Extended model	
With tax savings	33.4
Without tax savings	41.4

Note:
The King and Fullerton (1984) model is calculated with a fixed-p approach but could also be derived with a fixed-r. Using the nominal interest rate that yields a METR of 33.6% in the extended model, the original King-Fullerton model will in this case give approximately the same result when income is taxed as dividends and be approximately 5 percent lower when income is taxed as labor.
The Öberg (2003) model incorporates the rules from 2006, where (part of the) owner's wage is included in the RRA, as the calculations should refer to the rules in 2018. Öberg (2003) could, of course, not take these rules into account when she made her calculations. The METR without inclusion of the wage in the RRA will be 37.8%. Furthermore, as shown in Wykman (2022), the model suffers from the complication of negative wage payment. However, specifying the model correctly has only a minor impact on the result, raising the METR from 36.5% to 37.5%. A correct specification also allows for income shifting, as in the extended model, lowering the METR to 36.7%.
Sørensen (2008) is a generalization of *Lindhe et al. (2003, 2004)* and is calculated with a fixed-r approach. We use the cost of capital function in Equation (4.25) in Sørensen (2008, p. 155), which corresponds to Equation (8) in Lindhe et al. (2003, p. 9) or equation (10S) in Lindhe et al. (2004, p. 475). For comparison reasons, the nominal interest rate is the same as the rate that yields the METR of 33.6% in the extended model.
Source: Own calculations.

The extended model reports two values, both with (33.6%) and without tax savings (41.4%). The reason for this difference is that the model with tax savings captures the full tax effect, including the owner's possibility of shifting additional income from higher taxed labor income to lower taxed dividend income. If only a part of the tax savings can be used, the METR will be somewhere between these two values.

When including the possibility of using the whole potential tax savings, the METR is lower than the METR from the Öberg model, i.e., it is not the most favorable option for the owner to repurchase shares as modeled by Öberg if tax savings are possible. The METR with tax savings is even lower than the METR from the original King-Fullerton model, in which the whole income is taxed as dividends. The value of being able to shift higher taxed income to lower taxed income following new share issues can, hence, be substantial.

The METR without tax savings addresses the situation in which no income shifting is possible and the active owner cannot utilize the tax savings that follow from new share issues (as the owner, e.g., does not have other potentially high taxed income that can be used). The METR without tax savings is very close to the METR in the Sørensen (2008) model, which is reasonable since none of the models account for potential income shifting or include repurchases of shares. However, Sørensen does not account for depreciation, but in this case, this omission seems to have negligible effects on the results.

The extended model includes several improvements over the earlier models. Most important, it does not rely on assumptions on repurchases of shares or nondepreciating real assets. It also captures more aspects of the tax system. In particular, this model yields a lower METR for new share issues than that predicted by earlier models, which is due to the new integration of the difference between the equity base and real assets. In itself, this model deepens the understanding of the popular concept of income shifting (cf. the discussion in Christiansen & Tuomala, 2008; Alstadsæter & Jacob, 2016).

Both the original King-Fullerton and Öberg models only moderately overestimate the METR compared to the extended model with tax savings. The extended model does not, however, rely on the same strong assumptions or simplifications as the other two. However, perhaps more important, the work in this article shows that the King-Fullerton framework in different approaches and extensions is also a robust tool for evaluating the most complex parts of a dual tax system with its intricate income splitting rules.

The extended model may also be used to evaluate the METR for investments financed with retained earnings. As the equity base will not increase for investments financed with retained earnings, there will be no tax savings effect, and the difference between the original and earlier extensions will be negligible. When comparing investments financed with new share issues and retained earnings, notably, the METR for the former is lower, contrary to the case for other owners (see below). The potential tax savings resulting from the increasing equity base and RRA following new share issues in CHCs make this source of finance preferable, in contrast to what is normally concluded in these types of models.

For comparison reasons, the METR for listed widely held corporations (WHCs) as well as for unlisted WHCs and passive owners of CHCs are depicted in Table 2.[34] As the table shows, retained earnings are the preferred source of finance for these categories, in line with earlier results and in contrast to the case for active owners of CHCs. The METR for new share issues will be higher because these owners cannot use the lower tax rate within the RRA and the tax savings that may result from expanding the equity base. The METR for retained earnings will, on the contrary, be lower, as only the effective accrued capital gains tax will matter in this case. For an active owner of a CHC, the RRA will not increase due to an investment with retained earnings, and if the owner does not have any saved RRA, capital gains will be taxed as labor.[35]

Table 2. The marginal effective tax rate (METR), different sources of finance, 2018.

	METR (%)		
Source of finance	CHC	WHC (unlisted) CHC (passive)	WHC (listed)
New share issues	33.4	39.7	44.9
Retained earnings	43.4	26.6	29.2

Note: The baseline scenario is that all tax advantages can be utilized; hence, the lower METR for new share issues from Table 1 is reported for CHCs. The figures for WHC are in the case of new share issues based on the original King and Fullerton model. If the figures were calculated in the vein of Öberg (2004) where the capital gains also matter (see Öberg 2004, p. 32–33), the figures will be somewhat higher.
Source: Own calculations.

5 Concluding Remarks

The King-Fullerton framework is a standard way of measuring and comparing the marginal effective tax rates (METR) on investments between countries and over time. The theoretical model is complicated in itself since it aims to measure marginal taxation in economic equilibrium

[34] Since 2006, dividends and capital gains are taxed at a flat rate of 30% for owners of listed WHCs and 25% for both owners of unlisted WHCs or passive owners of CHCs. The splitting rules of the DIT system do not apply for these categories of owners.
[35] If the owner has saved RRA from previous years or if the capital gain is small enough to be taxed within the present RRA, the METR for retained earnings will be 24.0%. If the capital gain is larger than the ceiling for the labor tax, the METR will be the same as for listed WHCs.
Instead of using equity to finance investments, one can use debt, which is not discussed or analyzed in this article. The METR for debt will be 24.3% and equal for all categories because the income splitting rules do not apply to debt-financed investments made through the market.

with respect to different sources of finance, depreciation rates, inflation and allowances, rather than just summing up tax rates.

The dual income tax system (DIT) that has been introduced in most Nordic countries was accompanied by special income splitting rules for owners of closely held corporations (CHCs) to avoid or reduce income shifting behavior. Calculating the METR for CHCs under these rules requires that the King and Fullerton model is extended, as the original method was not modelled to incorporate this type of complex rules.

The METR for investments in CHCs in Sweden will not only depend on the various income tax rates and sources of finance but might also depend on the acquisition cost of shares, the active owner's own wage bill and the possibility of using other income, not associated with the investment, for income shifting purposes.

All models rely on assumptions, and the King and Fullerton model is no exception. Earlier extensions attempting to incorporate the Swedish DIT cannot analyze the current situation or include assumptions that may veil important aspects of the tax system and its effect on the METR of CHCs.

A major complication of the Swedish legal framework is the distinction between the acquisition costs of shares used to finance an investment and the investment itself, e.g., machinery (real assets). Whereas the former – which determines how much income can be low taxed – will remain unchanged, the latter will depreciate over time, generating a diminishing amount of surplus over time. This difference may give rise to significant tax consequences.

In this article, we have extended earlier models and developed a general method that can be used to estimate the METR for CHCs in Sweden since the introduction of the DIT system. Our model allows for more flexibility and can easily analyze situations in which the return to the active owner is the wage, dividends, capital gains or a combination of any of them. It also warrants analyses of investments with different depreciation rates, depreciation allowances or lifespans.

We compare the METRs based on our updated model and other methods, increasing the understanding of the King and Fullerton framework by illuminating limitations and differences between methods and approaches. Our results indicate that earlier models may have overestimated the METR, especially for investments financed with new share issues, as this type of finance increases the possibilities for income shifting.

The model allows researchers and policy makers to analyze how the METR has changed over time and to evaluate the effect of policy change suggestions. Even if the results in this article are based on the Swedish DIT system, the models can be used to analyze differences between other countries already using a DIT system or to analyze the potential tax effect for countries considering introducing different versions of a DIT system in practice. Our analysis contributes to the discussion concerning the specific construction of a tax system and the design of income splitting rules from both an academic and practical perspective.

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Appendix A. Measuring the METR using the original King-Fullerton framework

The aim of King and Fullerton (1984) is to calculate the marginal effective tax rate (METR) on investment projects in the nonfinancial corporate sector using a framework that takes all personal capital income taxes, corporate taxes, wealth taxes, depreciation allowances and inflation into account. The METR is a theoretical value based on an equilibrium model. Below, we briefly describe the framework and the intuition behind the model.

Taxes drive a wedge between the pretax rate of return on an investment project and the net return received by savers, and the METR is formally defined as

$$METR = \frac{p-s}{p} \tag{A1}$$

where *p* is the pretax real rate of return on a marginal investment and *s* the posttax real rate of return to the saver.

Both *p* and *s* can be further detailed. As stated in the main text, the idea behind the King-Fullerton model is that an investment must yield (at least) the same return *after taxes* as if the saver/investor lent his or her capital on the capital market and received the nominal interest rate, i, i.e.,

$$s = (1-m)i - \pi - w_p \tag{A2}$$

where *m* is the tax on interest income, π is the rate of inflation, and w_p is the wealth tax rate. The real interest rate defined as $r\ (= i - \pi)$ will play an intermediate role between *p* and *s*.

The minimum rate of return that an investment must yield *before taxes* to provide the saver with the same net-of-tax return that he or she would receive from lending at the market interest rate is called the cost of capital and will be equal to *p*. Denoting the marginal rate of return of the investment as MRR and the depreciation rate of the asset invested in as δ, *p* can be further defined as

$$p = MRR - \delta. \tag{A3}$$

The METR can be calculated either given a fixed pretax real rate of return, *p*, or given a fixed real interest rate, *r*. Both methods are widely used, but King-Fullerton primarily base their calculations on a fixed-*p*.[36]

[36] As noted in King and Fullerton (1984), the fixed-r case is also less flexible.

To continue the analysis, the value, V, and cost, C, of the investment project must be specified. The total after-corporate-tax present value of an investment, V, can be described as the annual marginal rate of return in infinite time,

$$V = \int_0^{\infty}(1-\tau)MRRe^{-(\rho+\delta-\pi)t}dt = \frac{(1-\tau)MRR}{\rho+\delta-\pi}, \quad \text{(A4)}$$

where ρ is the discount factor of the corporation.[37]

If the size of the marginal investment is unity and accounting for the fact that investments normally are subject to write-offs and/or other grants, the cost, C, of the investment can further be described as

$$C = 1 - A \quad \text{(A5)}$$

where A denotes (the present value of) any grants or allowances. For machinery, a standard assumption is that the rate of tax depreciation allowance is a continuous exponential function decreasing at rate a.[38]

In equilibrium, the present value of the (marginal) project, V, must equal the cost of the project, C. Using relationships (A3), (A4) and (A5), and taking into account that $V = C$, we can derive the now well-known relationship between the cost of capital, p, and the discount rate, ρ, in the King and Fullerton model as

$$p = \left(\frac{1-A}{1-\tau}\right)(\rho+\delta-\pi) - \delta. \quad \text{(A6)}$$

Given a fixed-p and using Equation (A6), ρ can be determined. The final step is to derive the relationship between the discount rate, ρ, and the nominal interest rate, i, by using the notion that investing in a project should be as profitable as saving in the financial market (an idea termed the "non-arbitrage condition" by, e.g., Sørensen, 2004, and Öberg, 2003). The non-arbitrage condition will differ depending on the source of finance. For an investment financed with *new share issues* to be attractive, the compensation for the investor must, after personal income taxes, be at least as high as lending to the market at rate i such that

$$\left(1-m_{cf}\right)\rho = (1-m)i \leftrightarrow \rho = i\,\frac{1-m}{1-m_{cf}} \quad \text{(A7)}$$

[37] The model can be expressed in continuous or discrete time; both approaches are frequently used. The original model was expressed in continuous time, and the same approach is used here.

[38] Formally, it can be depicted as $A = \int_0^{\infty} \tau a e^{-(a+\rho)t}dt = \frac{\tau a}{a+\rho}$.

where m_{cf} is the dividends tax on the cash flow from the corporation to the investor if the return from the extra investment is paid out as dividends.[39] The corporation's discount rate ρ is, by definition, the compensation the corporation has to pay the investor (after corporate taxes). For a given i, Equation (A2) can be used to solve for s, ultimately allowing for the calculation of the METR in Equation (A1) given a fixed-p. Depending on the complexity of A, this can be done by exact calculations or simulations.[40]

[39] In the case of retained earnings, the taxation of the direct personal remuneration will not matter due to the so-called equity trap. Instead, the capital gains tax will matter independent of remuneration, i.e., $\rho = i(1 - m) / (1 - z)$, where z is the capital gains tax. See, e.g., Sørensen (2004) for further discussion.
[40] If a fixed-r approach is used instead, s in Equation (21) can be directly solved, and in parallel, p has to be determined by solving Equation (25) taking into account the relationship between i and ρ.

Appendix B. Deriving the tax savings equation.

Assume that an owner has an unused amount of RRA equal to $(\beta - D^*)$. Further, suppose the owner/investor wants to use this RRA to decrease taxes paid by withdrawing (high-taxed) wages and increasing (low-taxed) dividends. Taking into account the rules (after 2006), where the RRA is affected by the wage, implies that,

$$W(1+\sigma)(1-\tau) + \varphi W \ = (\beta - D^*) \tag{B1}$$

or,

$$W(1+\sigma) + \frac{\varphi W}{1-\tau} = \frac{(\beta - D^*)}{1-\tau} \tag{B2}$$

must be fulfilled, i.e., the wages can be lowered with

$$W \ = \frac{(\beta - D^*)}{(1+\sigma)(1-\tau)+\varphi}.\text{[41]} \tag{B3}$$

On this wage deduction, you earlier paid

$$\frac{(\beta - D^*)}{(1+\sigma)(1-\tau)+\varphi}(\sigma + \tau_w), \tag{B4}$$

in taxes. Now, you instead have to pay

$$\frac{(\beta - D^*)(1+\sigma)}{(1+\sigma)(1-\tau)+\varphi}(\tau + \tau_d - \tau\tau_d) \tag{B5}$$

on the increased dividends (note that the social security contributions are included in the nominator as you decrease both wages and the associated social security contributions). The tax savings by transforming a part of the wages to dividends are, hence,

$$\frac{(\beta - D^*)}{(1+\sigma)(1-\tau)+\varphi}(\sigma + \tau_w) - \left(\frac{(\beta - D^*)(1+\sigma)}{(1+\sigma)(1-\tau)+\varphi}\right)(\tau + \tau_d - \tau\tau_d). \tag{B6}$$

After some manipulations, this can be expressed as

$$\frac{(\beta - D^*)}{(1-\tau)}\frac{(1-\tau)(1+\sigma)}{(1+\sigma)(1-\tau)+\varphi}\left(\frac{(\sigma+\tau_w)}{(1+\sigma)} - (\tau + \tau_d - \tau\tau_d)\right), \tag{B7}$$

and integrating the above expression over time gives equation (12) in the main text.

[41] Note that you have to pay social security contributions on the wages but that wages, on the other hand, are deductible. In contrast, you have to pay corporate taxes before giving dividends. Cf. fn 32.

Appendix C. Parameters used 2018

The calculations in section 4 are based on the parameters in Table C1 below.

Table C1. Parameters used.

Measure	Percentage
Cost of capital, p	10.00
Depreciation, $\boldsymbol{\delta}$	10.00
Corporate tax rate, $\boldsymbol{\tau}$	22.00
Dividend tax rate, $\boldsymbol{\tau_d}$	20.00
Labor tax rate, $\boldsymbol{\tau_w}$	57.12
Statutory capital gains tax rate	57.12/30/25/20
Effective tax rates on accrued capital gains, τ_c	28.56/15/12.5/10
Interest tax rate, m	30.00
Social security contributions, $\boldsymbol{\sigma}$	31.42
Inflation rate, $\boldsymbol{\pi}$	1.80
Government borrowing rate	0.49

Note:
King and Fullerton (1984) assume that $p=10\%$; to conform to this, we assume that $\delta=10\%$ and $MRR=20\%$.
The labor income tax refers to the top marginal income tax rate.
The statutory capital gains tax is the capital gains tax rate outside the RRA (which is the same as the labor income tax, 57.12%)/the tax rate above the capital tax ceiling or the tax rate for listed firms (30%)/the tax rate for unlisted firms or passive owners (25%)/the tax rate within the RRA (20%).
Capital gains are taxed on realization, and this benefit is taken into account by converting the statutory tax rate to an accrued effective tax rate. The accrued effective capital gains tax can be derived endogenously in the model. However, including this possibility will further complicate the calculations and depends on assumptions of the average holding period. For simplicity, we assume that the effective tax rates on accrued capital gains are half the statutory rate. The same assumption is made by, e.g., King and Fullerton (1984, p. 146) and Södersten (2005, p. 422).
Government borrowing rate refers to the rate in November 2017 as this rate is used for the taxation in 2018.
Source: Own table after Statistics Sweden (2019, n.d. a, b), The Swedish Tax Agency (n.d. a, b) and the Swedish National Debt Office (n.d.)

Appendix D. The present value problem[42]

In section 3.2 in the main text, we claim that the non-arbitrage condition

$$i(1-m)V(t) = (1-\tau_d)\left(MRRe^{-(\delta-\pi)t} + ae^{-at}\right) + (1-\tau_c)V'(t) \tag{D1}$$

implies the maximum present value

$$V(0) = \int_0^\infty \left(\frac{(1-\tau_d)}{(1-\tau_c)}\left(MRRe^{-(\delta-\pi)t} + ae^{-at}\right)\right) e^{-\frac{i(1-m)t}{(1-\tau_c)}} dt. \tag{D2}$$

This can be proven by rewriting (D1) as

$$V'(t) - AV(t) = -BU(t) \tag{D3}$$

where

$$A = \frac{i(1-m)}{(1-\tau_c)},\ B = \frac{(1-\tau_d)}{(1-\tau_c)},\ U(t) = MRRe^{-(\delta-\pi)t} + ae^{-at}.$$

The standard technique for solving differential equations yields

$$(A3) \leftrightarrow e^{-At}\left(V'(t) - AV(t)\right) = -BU(t)e^{-At} \leftrightarrow \frac{d}{dt}\left(e^{-At}V(t)\right) = -BU(t)e^{-At}. \tag{D4}$$

Integration yields

$$e^{-At}V(t) = -B\int_0^t U(x)\, e^{-Ax}dx + C \tag{D5}$$

where C is a constant.

Since $e^{-At}V(t) \to 0$ when $t \to \infty$

$$C = B\int_0^\infty U(x)\, e^{-Ax}dx \tag{D6}$$

(C5) and (C6) yield

$$e^{-At}V(t) = -B\int_0^t U(x)\, e^{-Ax}dx + B\int_0^\infty U(x)\, e^{-Ax}dx \tag{D7}$$

which is equivalent to

$$V(t) = Be^{At}\int_t^\infty U(x)\, e^{-Ax}dx. \tag{D8}$$

Solving Equation (D8) yields

$$Be^{At}\int_t^\infty U(x)\, e^{-Ax}dx = Be^{At}\left(\int_t^\infty be^{-(c+A)t}dt + \int_t^\infty ae^{-(a+A)t}dt\right) =$$

$$= \frac{Bb}{c+A}e^{-ct} + \frac{Ba}{a+A}e^{-at} \tag{D9}$$

where $b = MRR$ and $c = \delta - \pi$.

Equation (D9) is strictly declining in t, and hence, the largest value for V must be in $t=0$. Inserting $t=0$ in Equation (D8) yields Equation (D2).

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[42] Helpful comments and suggestions from associate professor emeritus Erik Svensson at the Department of Mathematics, Stockholm university, are gratefully acknowledged.

Appendix E. A short note on the optimal behavior of active owners of closely held corporations

In section 3.2, we refer to Lindhe and Södersten (2016) and their proof for share repurchases as a tax-minimizing strategy.

They assume that an owner of a corporation wants to maximize

$$\sum_{s=t}^{\infty} \frac{(1-\tau_d)D_s - N_s}{(1+r)^{s-t}}, \tag{E1}$$

where τ_d is the tax rate on dividends, D_s is dividends, N_s is capital injections (positive or negative), and r is a discount rate. Solving this maximizing problem, they conclude that the only optimal strategy in period $t + 1$ is to use the corporation's surplus to repurchase shares.

This conclusion holds in the general case but not necessarily for the special case with active owners of closely held corporations because there is punishment for active owners of reducing the equity base. The total marginal tax rate will be determined endogenously in the model and is not exogenous, as assumed by Lindhe and Södersten (2016). Simulations with 2018 tax rates show that Lindhe and Södersten's (2016) theoretical results hold in the general case for owners of widely held corporations, but as indicated above, it is not necessarily the case for closely held corporations.

To see this, assume an owner of a closely held corporation who over time wants to recoup an initial unit investment. This can be done either by repurchases of shares or dividend payments. Furthermore, assume an arbitrary repayment pace $\beth$, and note that $\int_0^{\infty} \beth e^{-\beth t} dt = 1$, which is the maximum allowed repurchase.

With a discount rate r and under the assumption that repurchases are not subject to tax, the present value of the repurchases is

$$\int_0^{\infty} \beth e^{-(\beth + r)t} dt = \frac{\beth}{\beth + r}. \tag{E2}$$

Now, assume an equally large amount of dividend payments that are subject to a total tax denoted τ_T. The present value of the dividend payments is

$$\int_0^{\infty} (1 - \tau_T) \beth e^{-(\beth + r)t} dt = (1 - \tau_T) \frac{\beth}{\beth + r}. \tag{E3}$$

Clearly, the after-tax present value of repurchases is $\frac{1}{(1-\tau_T)}$ percent larger than the present value of dividend payments. However, repurchases of shares reduce the equity base for tax purposes, while dividend payments do not.

To see how this might alter the results, first note that the income splitting rules always allow a share, β, following a unit investment financed with new share issues, to be taxed as capital income. In the *dividend case* and if β is high enough, all dividends distributed can be taxed as capital income. It might even be possible to transform additional income, not related to the investment, from labor taxation to capital income in the way discussed in section 3.2. If β is not high enough to cover the dividend, part of the dividend will be taxed as labor. In practice, this means that the tax will be a combination of labor (wage) and capital (dividend) taxation.

The present value of the possibility of transforming labor income into capital-taxed dividend income can be depicted as

$$\int_0^\infty \beta \complement e^{-rt} dt = \frac{\beta \complement}{(1-\tau)r}, \tag{E4}$$

where $\complement = \tau_{wage} - \tau_{dividend}$ and is the tax difference between the total tax on labor income (including wage taxes and social security contributions) and the tax on capital income (including dividend and corporate taxes), specified more in detail below. The expression $\beta \complement$ is divided with $(1 - \tau)$ to transform it to the value before corporate taxes.

The present value when using dividend payments can now be depicted as

$$\left(1-\tau_{wage}\right)\frac{ב}{ב+r} + \frac{\beta \complement}{(1-\tau)r}. \tag{E5}$$

where τ_{wage} is the tax applicable if the dividend is wage taxed and the second term adjusts for the fact that part of the remuneration can be taxed as capital.[43]

With *repurchases of shares*, the RRA will, however, shrink over time, so the present value of this tax shifting possibility will in this case only be

$$\int_0^\infty \frac{\beta \complement}{1-\tau} e^{-(ב+r)t} dt = \frac{\beta \complement}{(1-\tau)(ב+r)}, \tag{E6}$$

implying that the present value of the remuneration and the tax savings when using repurchases of shares is

$$\frac{ב+\frac{\beta \complement}{(1-\tau)}}{ב+r}. \tag{E7}$$

Which strategy that is tax preferable can now be calculated by specifying τ_{wage} and $\tau_{dividend}$ in more detail, inserting the parameter values in (E5) and (E7) and comparing the results. Before

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[43] If $(1 - \tau)$ ב equals β, it is easily seen that in the first discrete period, the renumeration would have been $\left(1-\tau_{wage}\right)ב + \frac{(\tau_{wage}-\tau_{dividend})(1-\tau)ב}{(1-\tau)} = (1-\tau_{dividend})ב$, i.e., the whole remuneration would be capital taxed only. In the next period, imitating the repurchase strategy, the dividend payment will be lower and other labor-taxed income can be transformed into capital income.

the change of the rules in 2006, $\tau_{wage} = \frac{\tau_{w+\sigma}}{1+\sigma}$ and $\tau_{dividend} = (\tau + \tau_d - \tau\tau_d)$, where τ_w, σ, τ_d, τ is the applicable labor income tax, social security contribution, dividend income tax and corporate tax.[44] Following the change of rules in 2006, τ_{wage} must be modified to $\tau_{wage} = \frac{(1-\tau)(1+\sigma)}{(1-\tau)(1+\sigma)+\varphi}\frac{\tau_{w+\sigma}}{1+\sigma} + \frac{\varphi}{(1-\tau)(1+\sigma)+\varphi}(\tau + \tau_d - \tau\tau_d)$ because part of the owners' wage increases the RRA, allowing a share of the remuneration to be taxed as capital income, and φ is the share of wages included in the RRA. By the same token, C must be modified to $\tau_{wage} = \frac{(1-\tau)(1+\sigma)}{(1-\tau)(1+\sigma)+\varphi}\frac{\tau_{w+\sigma}}{1+\sigma} + \frac{\varphi}{(1-\tau)(1+\sigma)+\varphi}(\tau + \tau_d - \tau\tau_d)$.

Using the 2018 tax parameters from Appendix C, a repurchase rate ב=0.1 and a discount rate set equal to a government borrowing rate of 4%, an active owner subject to state tax will be worse off repurchasing shares than paying dividends. The present value of the strategy when repurchasing shares is 0.9253, in contrast to 1.245 when giving dividends.[45]

The strategy of giving dividends can be even more favorable if there is old accumulated RRA that can be used to pay the dividends, and the whole increase in the RRA following an investment financed with new share issues can be used to transform other (labor-taxed) income into capital-taxed income. In this case, τ_{wage} in equation (E5) would be changed to $\tau_{dividend}$, and the present value of paying dividends would be 1.279.

[44] Note that in this example corporate income used to repurchase shares is not subject to corporate tax, while dividend payments are, and wage payments are subject to social security contributions. Ignoring the corporate taxation in the repurchase case implies that this case will look more favorable than it actually is in reality. If the strategy to repurchase shares anyhow is less favorable than giving dividends, this ignorance is of less importance for the conclusion.

[45] As noted in footnote 44, the corporate taxation in the repurchase case is ignored implying that the differences is actually even bigger in reality.