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# On the optimality of the Nordic system of dual income taxation

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**Abstract**

In recent years the Nordic countries have introduced a so-called dual income tax which combines a proportional tax on capital income with progressive taxation of labour income. The paper argues that this asymmetric treatment of the two types of income can be defended on pure efficiency grounds, because the progressivity of the labour income tax serves to reduce the private return to human capital investment, thereby offsetting the tendency of a proportional comprehensive income tax to discriminate in favour of such investment. The analysis is based on an overlapping generations model of a small open economy where consumers face a trade-off between investment in human capital and investment in non-human capital. Extended versions of the model allow for liquidity constraints and an endogenous labour-leisure choice.

*Keywords:* Dual income tax; Optimal income taxation; Human capital investment

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## 1. The move towards "dual" income taxation in the Nordic countries

In the last few years all of the four major Nordic countries have abandoned the principle of global income taxation in favour of a system of

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so-called 'dual' income taxation. Under a conventional global income tax a common progressive tax schedule is applied to the **sum** of the taxpayer's income from all sources, so in principle the taxpayer faces the same marginal tax rate on all types of income. By contrast, the new Nordic system of dual income taxation combines *progressive* taxation of labour and transfer income with a separate *proportional* tax rate on all capital income, including corporate income[1].

The introduction of this new tax system was motivated by desires to reduce the distortionary effects of progressive capital income taxation in an inflationary environment, to strenghten private savings incentives, to limit the scope for tax arbitrage, and to eliminate the revenue losses stemming from deductibility of nominal interest expenses against the high top marginal income tax rates. Growing doubts about the long run viability of high marginal tax rates on capital income in a world of increasing capital mobility also appear to have been an important driving force behind recent Nordic tax reforms[2].

Critics have argued that the new unorthodox combination of proportional capital income taxation with progressive labour income taxation violates established norms of horizontal equity; that it creates new opportunities for tax avoidance through transformation of heavily taxed labour income into more lightly taxed capital income, and that it complicates the income tax system, mainly because of the need to split the income from small enterprises into a labour income component and a capital income component.

The purpose of this paper is to draw attention to a somewhat neglected theoretical argument in favour of the new Nordic tax system. The thrust of the argument is that the conventional income tax tends to favour investment in human capital at the expense of other forms of investment. Indeed, since human capital investment is essentially taxed on a cash flow basis, the private rate of return to such investment will not be reduced by a purely proportional tax on labour income, whereas the private return to other forms of investment will be driven below the social return through the tax on capital income. In order to offset this distortionary bias against investment in non-human capital, it may therefore be efficient to combine a proportional tax on capital income with a progressive tax on labour income,

[1] The Nordic system of dual income taxation exists in its pure form in Norway and Sweden and - with some modifications - in Finland. In Denmark - which was the first country to introduce the new system in 1987 - the recent 1993 tax reform bill represents a move away from the dual income tax, although income from capital continues to be taxed at a lower marginal rate than income from labour.

[2] Sørensen (1994) provides a thorough discussion of the many motives for the recent income tax reforms in the Nordic countries. Zimmer (1993) and Tikka (1993) also discuss various aspects of the system of dual income taxation.

since progressivity of labour income taxation serves to reduce the private return to human capital investment, thereby bringing it more into line with the after-tax rate of return on alternative forms of investment.

Of course, a social preference for vertical equity may in itself justify some amount of progressivity in the taxation of labour income. Thus, Atkinson (1973) has modelled the determination of the optimal degree of progressivity of labour income taxation as a trade-off of the social gains from vertical equity against the efficiency losses from distortions to human capital investment. The present paper supplements Atkinson's study by showing that even on pure efficiency grounds there is a rationale for progressive taxation of labour income, once the accumulation of non-human capital and taxes on income from non-human wealth are allowed for.

Writers such as Varian (1980), Sinn (1994) and several others have stressed that progressive taxation may be justified by pure efficiency considerations because it may provide a welfare-improving form of social insurance in the presence of risk and uncertainty. Furthermore, Agell and Dillén (1994) have pointed out that progressive income taxation may serve to increase the degree of nominal price flexibility, thereby reducing or even eliminating the negative macroeconomic externality stemming from nominal price rigidities under conditions of imperfect competition.

The present study supplements these earlier contributions by showing that progressive taxation of *labour* income can be efficient even when there is perfect foresight and perfect competition. Our analysis also suggests that the conclusions derived from the classical analyses of optimal labour income taxation by Mirrlees (1971) and others must be modified in the presence of investment in human and non-human capital. Thus, Mirrlees (op.cit.) and Tuomala (1990) found that when redistribution towards the poor can be achieved through a lump sum transfer financed by the income tax, it will be optimal to allow the marginal labour income tax rate to *decline* with the level of income, because the additional revenue generated by an increase in the marginal tax rate over some income interval will be smaller relative to the efficiency loss, the higher the income bracket under consideration. By contrast, the present study indicates that declining marginal labour income tax rates would be equivalent to a *subsidy* to human capital investment and would hence exacerbate the tax distortion in favour of human capital investment under the conventional income tax.

Heckman (1976) and Driffill and Rosen (1983) have previously observed that capital income taxation encourages people to acquire too much human capital, but they did not draw the implication for the optimal corrective taxation of labour income. It should be stressed that our efficiency case for progressive labour income taxation is a typical second-best argument, relying on the assumption that the government has committed itself to tax income from non-human capital. Such a commitment could be motivated by

equity considerations or by a desire to protect the tax base, given that a zero capital income tax rate would imply a strong incentive for taxpayers to transform taxable labour income into tax free capital income[3].

Following a review of our general assumptions in section 2, sections 3 through 5 describe the basic version of our formal model. Section 6 characterizes the second-best Pareto efficient tax policy under a system of dual income taxation of the Nordic type, and section 7 interprets and discusses our optimal tax rule. In section 8 we analyse optimal tax policy in a more general model allowing for an endogenous labour-leisure choice, while section 9 investigates the implications of liquidity constraints for optimal labour taxation. In the final section 10 we point out a couple of caveats to our analysis, suggesting directions for future research.

All results reported but not explicitly derived in the paper are demonstrated in a technical appendix available from the authors.

## 2. General assumptions

Our analytical framework is an overlapping generations model of a small open economy with perfect international mobility of capital and an internationally immobile labour force. In the basic version of our model there is no labour-leisure choice. The life cycle of the individual consumer is divided into two periods. During the first period of his life the consumer allocates his exogenous total time endowment between work in the labour market and time spent on education and training. In the second period, the consumer spends all of his time in the labour market. By foregoing some labour income and engaging in education during the first period, the consumer may increase his labour productivity and hence his labour income during the second period. As an alternative, he may raise his second-period income and consumption by saving part of his first-period labour income and investing it in financial assets. During young age, the consumer thus faces a trade-off between accumulation of financial capital and accumulation of human capital.

Since population growth is inessential to our argument, we assume a stationary population. During each time period, a young generation and an old generation are alive. Capital income taxation is based on the (pure) residence principle; i.e. wealth owners are taxed at the same rate on their foreign-source and their domestic-source capital income. With perfect

[3] Various arguments for taxing capital income when it is difficult to distinguish labour income from capital income can be found in Jones et al. (1993), and Gordon and Mackie-Mason (1993).

capital mobility, this implies that the domestic real interest rate before tax is tied to the exogenous foreign pre-tax interest rate. Following convention in optimal tax analysis, we take the level of government expenditure to be fixed exogenously. This enables us to abstract from any welfare effects stemming from changes in the supply of government services[4]. While public expenditure is held constant, we assume that the government may adjust the stock of public debt so as to ensure that the welfare gains from tax reform accruing to future generations are not achieved at the expense of welfare losses to the present generations. In other words, we derive criteria for a Pareto efficient tax reform.

In the pure version of the Nordic system of dual income taxation the lowest personal marginal tax rate on labour income is set equal to the tax rate on capital income. However, income from labour is also subject to social security taxes and to indirect consumption taxes which tend to drive the effective tax rate on labour income above the tax rate on capital income, even if the two types of income are subject to the same tax rate within the personal income tax system. On the other hand, the capital income tax is typically levied on the *nominal* rather than the *real* return to capital. In times of inflation, this means that the effective tax rate on real income from capital tends to exceed the statutory capital income tax rate. Moreover, the effective tax burden on capital income is further increased by the existence of wealth taxes and in some cases also by economic double taxation of corporate source income.

For these reasons we assume that the basic tax rate on labour income is not constrained to equal the capital income tax rate[5]. The labour income tax schedule takes the form of a basic tax rate applying to all labour income plus a surtax on income above a certain threshold, in accordance with practice in the Nordic countries. In our model, an unskilled worker is subject only to the basic tax rate, while a skilled worker is also subject to the surtax at the margin. Again, this is not a bad approximation of conditions in the Nordic countries.

In the following sections we present our formal analysis. For notational convenience, our variables do not carry any time indices indicating historical time, except in section 5 where we describe the transition scheme relating to the Pareto efficient tax reform. Unless otherwise indicated, all variables denote the steady state magnitudes prevailing after the tax reform has been phased in.

[4] Note, though, that our general characterization of the optimal tax rates will be valid for any permissible level of government spending, including the optimal one.

[5] In the technical appendix previously referred to we show that our proposition on the optimality of progressive labour income taxation is in fact also valid even if the basic tax rate on labour income is constrained to equal the tax rate on capital income.

## 3. The household sector

The lifetime utility of the representative consumer is given by a utility function of the form

$$U = U(C_1, C_2), \quad U_1 > 0, \quad U_2 > 0, \quad U_{11} < 0, \quad U_{22} < 0 \tag{1}$$

where $C_1$ is consumption during the first period of life, and $C_2$ is consumption during the second period. In the first period, the consumer faces the budget constraint

$$S = W(1 - t_1)(1 - E) - C_1 \tag{2}$$

with $S$ denoting financial saving, $W$ denoting the pre-tax real wage rate, $t_1$ being the (marginal and average) tax rate on "low"income from (unskilled) labour, and $E$ indicating the time spent on education. We have normalized the consumer's total time endowment in each period at unity such that 1-$E$ represents the time spent working in the labour market in the first period of life.

In the second period of his life, the consumer may consume his after-tax wage income plus the principal and the after-tax interest income from the previously accumulated financial assets. Total pre-tax wage income is the product of the wage rate and the consumer's effective labour input which is a function $g(E)$ of the time spent on education during the first period. All earnings up to the maximum amount $W$ which may be earned by an unskilled worker are taxed at the constant marginal rate $t_1$. For the wage income $W[g(E)\text{-}1]$ above this level the marginal tax rate is $t_2$. The budget constraint for the second period of life thus becomes

$$\begin{aligned} &C_2 = [1 + r(1 - \tau)]S + W(1 - t_1) + W(1 - t_2)[g(E) - 1] \\ &E \geq 0, \quad g(0) = 1, \quad g' > 0, \quad g'' < 0 \end{aligned} \tag{3}$$

where $r$ is the pre-tax real interest rate and $\tau$ is the exogenous proportional tax rate on capital income. Note that the properties of the human capital "production function"$g(E)$ imply positive but diminishing returns to time spent on education and training. Notice also that provided the consumer spends some amount of time on education in his first period of life so that $E > 0$, he will be more productive and hence earn a higher wage rate during the second period than during the first period.

Equations (2) and (3) may be combined to give the lifetime budget constraint

$$\begin{aligned} &C_1 + pC_2 = w_1(1 - E + p) + pw_2(g(E) - 1)\,, \\ &w_1 \equiv W(1 - t_1)\,, \quad w_2 \equiv W(1 - t_2)\,, \quad p \equiv 1/[1 + r(1 - \tau)] \end{aligned} \tag{4}$$

where $w_1$ is the average and marginal after-tax real wage rate for unskilled

workers, $w_2$ is the marginal after-tax real wage rate per unit of effective labour input for *skilled* workers, and $p$ is the relative price of future consumption in terms of present consumption. The consumer must maximise lifetime utility (1) subject to the budget constraint (4). The first-order conditions for the solution to this problem may be combined to give

$$\left(\frac{w_2}{w_1}\right)g'(E) - 1 = r(1-\tau) = \frac{U_1}{U_2} - 1 \tag{5}$$

Equation (5) states that the tax-adjusted rate of return on human capital investment (the expression on the LHS of (5)), the after-tax rate of return on financial investment, and the rate of time preference will all be identical in the consumer's optimum.

Combined with the budget constraint (4), the first-order conditions imply consumption demand functions and a demand function for (time spent on) education of the form

$$C_1 = C_1(w_1, w_2, p)\,, \quad C_2 = C_2(w_1, w_2, p)\,, \quad E = E(w_1, w_2, p) \tag{6}$$

which in turn means that the consumer's indirect utility function **V** takes the form

$$V(w_1, w_2, p) \equiv U(C_1(w_1, w_2, p), C_2(w_1, w_2, p)) \tag{7}$$

The derivatives of the indirect utility function with respect to the two after-tax wage rates can be found to be

$$\partial V/\partial w_1 = \lambda(1 - E + p)\,, \quad \partial V/\partial w_2 = \lambda p(g - 1) \tag{8}$$

where $\lambda$ denotes the marginal utility of income earned in the first period of life. When we address the government's optimal tax problem, we shall exploit these properties of the indirect utility function.

## 4. The business sector

The domestic business sector produces a single good which is a perfect substitute for foreign goods, the exogenous price of which is normalized at unity. Total domestic output net of depreciation ($Y$) is determined by a well-behaved neoclassical constant-returns-to-scale production function of the form $Y = F(K,N)$, where $N$ is total effective labour input. In a steady state where work effort is constant over time, this total labour input will be given by $N = (1\text{-}E) + g(E)$. Assuming that firms may deduct their cost of finance as well as an allowance for true economic depreciation from taxable profits, profit-maximising competitive firms will carry investment to the point where the pre-tax marginal productivity of capital equals the pre-tax real rate of interest, and employment will be taken to the point where the

marginal product of effective labour input equals the real wage rate per unit of effective labour input. Given the linear homogeneity of the production function, these optimum conditions may be written as $f'(k) = r$ and $W = f(k)\text{-}rk$, where $k$ is the capital intensity of production. Domestic capital intensity and the domestic pre-tax real wage rate are thus determined by the exogenous foreign real interest rate. Hence domestic pre-tax factor prices will be unaffected by changes in domestic tax rates. Because of this lack of domestic factor price dynamics, it will take only one period - the time span elapsing before the current old generation is replaced by a new generation - for savings and labour supply behaviour to adjust to a new set of tax rates. This observation will be useful when we specify the government budget constraint below.

## 5. The government sector

The government finances its fixed level of expenditure $G$ partly through the exogenous proportional capital income tax, partly by levying taxes on labour income, and partly by issuing debt ($D$). Since capital income taxation is based on the residence principle, the capital income tax base equals the return to the total stock of non-human wealth owned by domestic residents which in turn equals the financial wealth of the current old generation ($S$).

In some analyses of optimal income taxation (e.g. King (1980), Sandmo (1985), and Sørensen (1990)) the government is assumed to choose the tax rates on income from capital and labour so as to maximise the steady state utility of the representative consumer, subject to the steady state government budget constraint. This procedure may be criticized for ignoring the welfare effects on the generations living during the transition to the steady state. By contrast, the present paper will seek to derive criteria for a Pareto-efficient labour tax reform where tax rates are chosen so as to maximise the welfare of the current young and future generations without reducing the welfare of the current old generation[6].

One way of ensuring such a Pareto-improvement would be to supplement the tax reform by a transition scheme under which the current old generation continues to be taxed according to the old pre-reform tax rates until its time of death and therefore is able to attain an unchanged level of utility, while the current young and future generations are subject to the new post-reform tax rates. In our model such a welfare-preserving transition scheme for the current old generation can be implemented through the simple procedure of introducing the new top marginal tax rate on labour

[6] In our technical appendix we show that this procedure leads to more intuitively appealing results than the optimal tax formulae implied by maximisation of steady state utility.

income with a delay of one period, implying that only the new basic tax rate on the labour income of the young (unskilled) generation takes full effect from the beginning of the period when the tax reform is announced. This transition procedure may be seen as a stylized version of transition schemes encountered in many real-world tax reforms where "old"wealth often continues to be taxed according to "old"rules, at least for a while, to limit arbitrary windfall gains and losses.

To be able to maintain constant tax rates on young and future generations from the tax reform period and onwards, thereby ensuring that all of these generations will gain equal amounts of welfare from the reform, it is necessary for the government to issue (or retire) an appropriate amount of debt in the tax reform period and to keep the new level of debt constant in subsequent periods. With the superscript "o"denoting the pre-reform value of the variable in question, and with variables without superscripts indicating post-reform magnitudes, the government budget constraint for the period when the labour income tax reform is initiated becomes equal to

$$t_1^0 W + t_2^0 W[g(E(w_1^0, w_2^0, p)) - 1] + \tau r S(w_1^0, w_2^0, p) + t_1 W[1 - E(w_1, w_2, p)] + D = G \tag{9}$$

where $p = p^0$, $D$ represents new debt issues (positive or negative), and where we have assumed without loss of generality that the initial level of government debt is zero. If tax rates and the stock of government debt are kept constant in all of the periods following the tax reform period, the government budget constraint for all those subsequent periods will be

$$t_1 W[2 - E(w_1, w_2, p)] + t_2 W[g(w_1, w_2, p) - 1] + \tau r S(w_1, w_2, p) = G + rD \tag{10}$$

## 6. Pareto-efficient labour tax reform

Via its choice of the tax rates $t_1$ and $t_2$ the government may control the net wage rates $w_1$ and $w_2$ entering the consumer's indirect utility function. The lifetime utility of the young generation which is born at the beginning of the period when the tax reform takes effect will be identical to the lifetime utility of all future generations, since the current young as well as future generations are subject to the same post-reform tax rates. Formally, the common level of welfare for these post-reform generations is given by the indirect utility function (7) with the derivatives stated in (8).

To design a Pareto-optimal tax reform, the government may therefore choose the post-reform tax rates (and hence $w_1$ and $w_2$) as well as the debt issue $D$ so as to maximise (7), subject to the two government budget

constraints (9) and (10) which embody the transition scheme guaranteeing an unchanged level of utility for the current old generation. Eliminating $D$ by substituting (9) into (10) and using the fact that $S = w_1(1\text{-}E)\text{-}C_1$ plus the definitions of $w_1$, $w_2$ and $p$ stated in (4), we obtain the following consolidated budget constraint:

$$(1+r)(W-w_1)[1-E(w_1, w_2, p)] + w_2 - w_1 + (W-w_2)g(E(w_1, w_2, p)) + \tau r[w_1(1-E(w_1, w_2, p)) - C_1] - (1+r)G - rR = 0,$$
$$R \equiv t_1^0 W + t_2^0 W[g(E^0) - 1] + \tau r S^0 \tag{11}$$

We may now restate the optimal tax problem as one of maximising $V(w_1, w_2, p)$ w.r.t. $w_1$ and $w_2$, subject to (11). The first order conditions for the solution to this problem can be written as

$$\lambda(1-E+p) + \mu\left(\frac{\partial E}{\partial w_1}\right)[(W-w_2)g' - (1+r)(W-w_1)] - \mu\left(1 + (1+r)(1-E) + \tau r\left[w_1\left(\frac{\partial E}{\partial w_1}\right) + \frac{\partial C_1}{\partial w_1} - (1-E)\right]\right) = 0 \tag{12}$$

and

$$\lambda p(g-1) + \mu\left(1 - g + \left(\frac{\partial E}{\partial w_2}\right)[(W-w_2)g' - (1+r)(W-w_1)] - \tau r\left[w_1\left(\frac{\partial E}{\partial w_2}\right) + \frac{\partial C_1}{\partial w_2}\right]\right) = 0 \tag{13}$$

where $\mu$ denotes the shadow price associated with (11).
Eliminating the shadow prices $\lambda$ and $\mu$ from (12) and (13), exploiting the consumer's first-order conditions and budget constraint as well as the definitions of after-tax factor prices, we end up after some manipulations with the following single condition for optimal tax policy:

$$[(t_2 - t_1)(1+r) - \tau r(1-t_1)]\left[(1-E+p)\left(\frac{\partial E}{\partial w_2}\right) - p(g-1)\left(\frac{\partial E}{\partial w_1}\right)\right] = 0 \tag{14}$$

The optimum condition (14) plus the government budget constraint (11) implicitly determine the optimal values of the two income tax rates $t_1$ and $t_2$. The consumer's first-order condition (5) can be shown to imply that $(\partial E/\partial w_2) > 0$ and $(\partial E/\partial w_1) < 0$. Since $E < 1$ and $g > 1$, it is then clear that the term in the first square bracket on the left-hand side of (16) will have to be zero, which in turn requires $t_2 > t_1$, given that $\tau > 0$. In other words, progressive taxation of labour income is optimal when the capital income tax

rate is positive. We also see from (14) that purely proportional taxation of labour income ($t_2 = t_1$) becomes optimal when the capital income tax rate is zero.

## 7. Discussion of the optimal tax rule

The intuition behind the above results may be stated as follows: A capital income tax drives the private return to financial saving below the social return (which is given by the pre-tax world interest rate). By contrast, a purely proportional labour income tax does not affect the private return to human capital investment, since it reduces the opportunity cost of education - which takes the form of foregone after-tax wages during the period of education - by the same proportion as it reduces the additional future labour income which results from education. Hence, a proportional labour income tax would imply equality between the private and the social rates of return on human capital investment, and an optimising consumer would then take human capital investment to the point where its rate of return equals the after-tax rate of return on financial investment, as the reader may verify from the consumer's first-order condition (5). With a positive capital income tax, the social rate of return to human capital investment [$g'(E)$-1] would thus be driven below the social (pre-tax) return to financial investment. To counteract this distortion, it is optimal to introduce some amount of progressivity in the taxation of labour income, since this implies a tax on the return to human capital investment which induces a shift from human capital accumulation to accumulation of net foreign assets carrying a higher social rate of return. This effect of progressive labour income taxation can be inferred from (5) which shows that the consumer's required pre-tax rate of return on human capital investment will ceteris paribus be higher under a progressive tax system where $t_2 > t_1$ than under proportional labour income taxation.

To put it differently, the conventional income tax essentially offers cash flow treatment of human capital investment in the sense that wages are taxed at the time they are paid out. It is well known from the theory of taxation that a proportional cash flow tax which remains constant over time is neutral in the sense that it does not reduce the private rate of return to investment. In a second-best context where other forms of investment are necessarily distorted by taxation, it is not optimal to offer such neutral tax treatment to human capital investment. Rather, since proportional taxation would discriminate in favour of human capital investment under a conventional income tax, it is efficient to counteract this discrimination through progressive labour income taxation.

In the simple model above this result is predicated on the assumption that

government has committed itself to tax income from capital. If one allows the government to optimise its choice of the capital income tax rate as well as the two labour income tax rates within the framework of the model in section 6, it can be shown that the tax rate on capital income should be set at *zero*. As we have seen, (14) then implies that labour income taxation should be *proportional*. Although striking, this result is quite intuitive: A purely proportional tax on labour income leaves the marginal private return to education equal to the marginal social return. The combination of a proportional labour income tax with a zero tax rate on capital income will thus ensure that the tax system distorts neither human capital investment nor financial investment, enabling the government to achieve the **first-best** allocation of resources, given the simplifying assumptions underlying our basic model.

The model postulates that the opportunity cost of education and training consists solely of foregone labour income. By contrast, Nerlove et al. (1993) focus on the diametrically opposite case in which all of the opportunity cost of human capital investment takes the form of non-deductible pecuniary outlays (e.g., tuition fees). In their model the depreciation of human capital is not tax-deductible, and they therefore find that a comprehensive income tax discriminates against investments in human capital, thus lowering the ratio of human to physical capital.

A situation in which all of the private costs of education consist of money outlays is, of course, rather extreme. Under normal circumstances, one would expect the greater part of the opportunity cost of human capital investment to take the form of foregone wages. At least in a Nordic context, with a tradition of free public education, this is certainly the case. As a first approximation, we therefore believe that our model comes closer to (Nordic) reality than the one set up by Nerlove et alia (op.cit.).

A potentially more serious objection to our optimal tax rule is that it abstracts from an endogenous labour-leisure choice. In the presence of such a choice, the progressive labour tax payable in the second period of life will reduce the 'utilisation rate' of the consumer's human capital by inducing him to substitute leisure for income earning. This in turn will reduce the return to human capital investment and may discourage education and training to such an extent that the case for progressive labour taxation may be undermined. Below we therefore extend our basic model to incorporate endogenous consumption of leisure. By doing so we also implicitly provide an efficiency rationale for capital income taxation, since it will now generally be optimal to raise revenue from the taxation of capital as well as labour to avoid concentrating all of the tax distortions in the labour market (see, e.g. Atkinson and Sandmo, 1980).

Allowing for leisure hence increases the relevance of our assumption that

the capital income tax rate is positive. Since our focus is on labour income taxation, we do not derive the optimal rule for capital income taxation, but the reader should keep in mind that the optimal tax formulae presented below are valid for any level of the capital income tax, *including* the optimal one.

## 8. Introducing leisure

When the consumer endogenously varies the amount of leisure $L_1$ and $L_2$ taken in the two periods, his lifetime utility will be given by the utility function

$$U = U(C_1, L_1, C_2, L_2) \tag{15}$$

where marginal utility is assumed positive, but declining in all four arguments. Suppose that an exogenous fraction $X$ of the maximum potential income $W$ of an unskilled worker is taxed at the basic rate $t_1$ while income above the level $XW$ is taxed at higher rate $t_2$, and suppose that $XW$ lies between pre-tax labour incomes in the two periods. The budget constraints for the two periods of life then become

$$S = W(1-t_1)(1-E-L_1) - C_1\,, \quad W(1-E-L_1) < XW \tag{16}$$

and

$$C_2 = [1 + r(1-\tau)]S + W(1-t_2)g(E)(1-L_2) + (t_2 - t_1)XW\,,$$
$$g(E)(1-L_2) > XW \tag{17}$$

If the government applies a "grandfathering" rule similar to the one described in section 5, its consolidated budget constraint for the periods following the introduction of the Pareto-efficient tax reform modifies from (11) to

$$(W - w_2)[g(E)(1-L_2) - X] + (W - w_1)[X + (1-E-L_1)(1+r)]$$
$$+ \tau r S = G(1+r) - rR^0\,,$$
$$R^0 \equiv (W - w_2^0)[g(E^0)(1-L_2^0) - X] + (W - w_1^0)X + \tau^0 r S^0 \tag{18}$$

Again, the transition rules embodied in (18) will ensure that the welfare of the current old generation is left unaffected by the reform, and that the economy will be in a new steady state for all periods subsequent to the one where the reform is initiated. Following a procedure identical to the one outlined in section 6, and utilising the Slutsky equations to eliminate income effects wherever convenient, we find after considerable manipulations that a

Pareto-efficient labour tax reform maximising the welfare of the current young and all future generations requires fulfilment of the condition

$$
\begin{aligned}
&[(t_2 - t_1)(1+r) - \tau r(1-t_1)]\left[(1 - E - L_1 + pX)\left(\frac{\partial E}{\partial w_2}\right)\right. \\
&\quad \left. - p[g(1-L_2) - X]\left(\frac{\partial E}{\partial w_1}\right)\right]\left(\frac{W}{1-t_2}\right) \\
&\quad + t_1 W(1+r)\left[p[g(1-L_2) - X]\left(\frac{\partial L_1^c}{\partial w_1}\right) - (1 - E - L_1 + pX)\left(\frac{\partial L_1^c}{\partial w_2}\right)\right] \\
&\quad + t_2 W g\left[p[g(1-L_2) - X]\left(\frac{\partial L_2^c}{\partial w_1}\right) - (1 - E - L_1 + pX)\left(\frac{\partial L_2^c}{\partial w_2}\right)\right] \\
&\quad + \tau r p\left(\left[\frac{\partial C_1}{\partial w_1} + w_1\left(\frac{\partial L_1}{\partial w_1}\right)\right]\left[\frac{\partial C_2}{\partial w_2} + g w_2\left(\frac{\partial L_2}{\partial w_2}\right)\right]\right. \\
&\quad \left. - \left[\frac{\partial C_2}{\partial w_1} + g w_2\left(\frac{\partial L_2}{\partial w_1}\right)\right]\left[\frac{\partial C_1}{\partial w_2} + w_1\left(\frac{\partial L_1}{\partial w_2}\right)\right]\right) = 0 \qquad (19)
\end{aligned}
$$

where the superscript $c$ indicates a *compensated* demand effect. The first two lines in (19) are a restatement of the term on the left-hand side of the original optimum condition (14), modified to allow for consumption of leisure. As will be recalled, the economic mechanisms reflected by this term work in favour of progressivity of the labour income tax, provided we still have $\partial E/\partial w_2 > 0$ and $\partial E/\partial w_1 < 0$, as would seem plausible[7].

The term in the third line of the optimum condition (19) indicates how the tax schedule and the resulting net wages of unskilled and skilled workers distorts the labour market for unskilled workers. If $L_1$ and $L_2$ are substitutes, this term is unambiguously negative and hence tends to combine with the first term in favour of progressivity. The intuition is obvious: By imposing a relatively low tax rate on unskilled labour, the distortionary substitution towards leisure in the first period of life can be reduced.

By analogy, the fourth line in (19) captures the distortionary impact of the labour tax schedule on the labour market for skilled workers. Given substitutability of leisure across periods, this term is unambiguously negative and hence works in the opposite direction of the previous term. Clearly, to reduce the distortion of labour supply in the second period of life, it would ceteris paribus be desirable to have a relatively low tax rate on the income of skilled workers.

Finally, the expression in the last two lines of (19) reflects how the tax-induced substitution and cross substitution effects on consumption and labour supply impact on the intertemporal distortion caused by the capital income tax. Depending on the degree of substitutability or complementarity

[7] Second-period labour supply would have to be rather elastic to invalidate these inequalities.

of the four goods in the utility function, these substitution effects could either exacerbate or alleviate the intertemporal distortion, and hence we cannot generally sign this final term.

However, if the utility function is additive (no cross-substitution or complementarity effects) and second-period labour supply is inelastic, the term in the fourth line of (19) will drop out. Moreover, one can show in this case that the inequalities $\partial E/\partial w_2 > 0$ and $\partial E/\partial w_1 < 0$ will hold with certainty, and that the coefficient of the capital income tax rate in the last two lines of (19) will be negative. In this special case we then see by comparing (14) and (19) that the introduction of a labour-leisure choice tends to *strengthen* the case for progressivity of the labour income tax schedule. This result suggests that as long as second-period labour supply is not "too"elastic and cross substitution or complementarity effects are not "too"strong, we can be fairly confident that the introduction of endogenous leisure does not destroy the efficiency case for progressive labour income taxation.

Intuitively, to minimise the deadweight loss from the tax system, labour should be lightly taxed in that stage of the life cycle where labour supply is relatively elastic. If this phase of the life cycle coincides with the phase where the consumer has not yet acquired very many skills, a relatively low tax rate on unskilled workers is clearly called for. Casual observation suggests that the labour supply of young unskilled workers is in fact relatively elastic compared to the labour supply of older workers who have accumulated skills and established a family. For instance, young people going through education and training will often have casual low-skilled jobs and be rather flexible in their labour supply.

Yet, whether the conditions for the optimality of progressive labour taxation are met is of course ultimately an empirical question. In a careful study of the impact of labour and capital income taxes on physical and human capital investment, Trostel (1993) calibrated a model with endogenous leisure to U.S. data and found that a one percentage point increase in a comprehensive income tax rate would cause a long run drop in the physical capital stock of 3.42 percent, whereas human capital would drop by only 0.97 percent. These figures support our hypothesis that a proportional comprehensive income tax tends to discriminate against financial saving relative to human capital investment, suggesting a case for the Nordic dual income tax which taxes the return to human capital through a surtax on high income from labour.

## 9. Allowing for liquidity constraints

We have so far assumed a perfect capital market where the consumer can freely borrow as much as he likes, subject only to his lifetime budget

constraint. In practice young individuals going through education and training are often subject to liquidity constraints, because they cannot borrow freely against their expected future labour income. In so far as such liquidity constraints represent market imperfections - and not just an efficient market response to uncertainty about the future - one might hypothesize that they cause an inefficiently low level of human capital investment, hence providing a case against progressive labour taxation which reduces the private return to education. However, on further reflection this policy conclusion is not obvious, since a relatively mild taxation of young unskilled workers would in itself ease their liquidity constraints.

The simplest way to allow for liquidity constraints in our basic model would be to assume that the consumer must still maximise the utility function (1) subject to the two budget constraints (2) and (3), but that he must also obey the constraint that savings during the first period of life cannot be negative, i.e. that he cannot borrow against future labour income. If this constraint is binding for the representative consumer[8] while all other assumptions underlying our basic model are retained, it can be shown that the optimal system of labour income taxation must conform with the following rule:

$$\left[\frac{t_1 WZ}{1+r(1-\tau)+\nu/U_2}\right]\left[\frac{t_2(1-t_1)}{t_1(1-t_2)}-\frac{1+r}{1+r(1-\tau)+\nu/U_2}\right] + U_2(g-1)(1-E)(r\tau-\nu/U_2)=0 \tag{20}$$

where $\nu$ is the Lagrange multiplier associated with the binding credit constraint and where the magnitude $Z$ is proportional to the term

$$(g-1)\left(U_1+w_1(1-E)U_{11}+g'w_2(1-E)\left[U_{22}\left(\frac{U_1}{U_2}\right)-2U_{12}\right]\right) + g'U_2\left[1+(1-E)\left(\frac{U_1}{U_2}\right)\right] \tag{21}$$

To gain some understanding of the optimal tax rule (20), consider first the special 'knife-edge' case where by coincidence $r\tau = \nu/U_2$. In this case it follows from (20) that $t_2 = t_1$, implying that optimal labour income taxation is purely proportional even though the capital income tax rate is positive. In

[8] Taken literally, this means that all of the domestic physical capital stock in our small open economy is financed by foreign investors. It also means that the net capital income of domestic residents is zero.

other words, this is a situation where the tendency of capital taxation to discriminate in favour of human capital investment is just offset by the credit constraint which tends to hamper education and training, hence eliminating the need for corrective taxation of human capital investment through progressive labour taxation.

Suppose next that $r\tau > \nu/U_2$, implying that capital taxation is fairly heavy and/or that the credit constraint is not very severe so that the shadow value of extra credit is low. Suppose further that the consumer is rather averse to low levels of consumption, having a strongly concave utility function so that the magnitude in (21) (and hence $Z$) is negative. It is then easily verified from (20) that $t_2 > t_1$ in the optimum. This is quite intuitive: With a heavy capital income tax and/or a mild credit constraint, the tax discrimination in favour of human capital investment under a proportional comprehensive income tax is not offset by credit market imperfections, and progressive taxation of labour income is therefore still called for.

On the other hand, in the opposite case of a mild capital income tax and/or a serious credit constraint ($r\tau < \nu/U_2$) we see from (20) that *regressive* taxation of labour becomes optimal for $Z < 0$. In the case where $Z > 0$ it is not possible to derive unambiguos conclusions from (20).

This analysis shows that progressive taxation of labour income will not always be efficient in a world with liquidity constraints. However, in the Nordic countries as well as in most other developed countries governments do in fact try to correct credit market failures by offering loans, grants and other forms of public support for education and training. In so far as such corrective measures can be taken as given, credit market imperfections are unlikely to seriously undermine the efficiency argument for progressive taxation of labour income made in this paper.

## 10. Final remarks

In this article we have identified a second-best situation in which progressive taxation of labour income can be defended by appeal to pure efficiency considerations. Our analysis was carried out within the simplest possible theoretical framework, and the optimal tax rules derived above should of course not be taken too literally. We saw that endogenous consumption of leisure and the existence of liquidity constraints or non-deductible pecuniary costs of education will tend to modify our proposition that a comprehensive income tax discriminates in favour of human capital investment.

Furthermore, if there are significant positive externalities from human capital accumulation, as suggested by some of the recent literature on endogenous growth, it is conceivable that the return to human capital should

not be taxed at all and that it should in some cases even be subsidised so that efficiency might call for *regressive* rather than progressive taxation of labour income[9].

The existence of labour market distortions could provide a further case for tax incentives for human capital investment. For instance, in many European countries a rigid and compressed wage structure seems to imply a concentration of unemployment among low-skilled workers whose wage rates tend to exceed their productivity. If this labour market distortion cannot be remedied by other means, it may be desirable to have a tax system which encourages human capital formation to offset the reduced incentives for skill acquisition implied by the flat wage structure.

Thus, the design of the optimal tax schedule for labour income is a challenging task leaving plenty of room for future research.

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