ESTIMATING THE GAINS FROM WAGE AND CAPITAL INCOME TAX CUTS

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Introduction

In recent years, a significant number of industrialized countries have taken steps towards cutting wage income taxes. In the EU, for example, the largely unfinanced tax cuts implemented by a substantial majority of member states amount to 1-1.5 per cent of GDP on average.

Although there is a good deal of variation across countries, a key aim seems to have been the reduction of the tax burden at the low end of the income distribution, thus potentially enhancing participation incentives among these groups.

However, broadly aimed tax cuts also imply significant revenue costs that may exacerbate the pre-existing long-term fiscal sustainability problems confronted by most governments. As indicated by the results in Frederiksen (2003), the average EU member state would thus have to accelerate fiscal consolidation by 3-3.5 per cent of GDP to ensure fiscal sustainability.

Therefore, the question arises whether broad reductions in labor income taxation are likely to lead to supply side adjustments sufficiently strong to justify the fiscal cost. Accordingly, it seems relevant to examine whether, e.g., more narrowly aimed reductions in the marginal tax rate (*i.e.*, a reduction in the progressive elements of the tax code rather than more or less proportional income taxes) might be more cost effective.

Also, in a wider perspective, one may ask whether the key focus should in fact be on labor income taxes rather than the taxation of capital income, as the latter is fraught with a number of well known problems implying both intertemporal and inter-asset distortions which furthermore tend to rise with the rate of inflation.

The objective of this paper is to present a simple and operational approach to comparing the benefits from alternative tax policy options and specifically highlight the relative merits of wage versus capital income tax cuts. It aims at providing a rough first approximation of the relative benefits building on essentially the well-known concept of the marginal cost of public funds, or *MCPF* (see, e.g., Mayshar, 1991, and Dahlby, 1998). The basic idea is to measure in a simple, yet consistent way the potential welfare gains without having first to construct a full general equilibrium model embodying the key behavioral relationships.

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In the analysis, we exploit the key insight that the efficiency impact of a small tax change is equal to the change in government net revenue resulting from the behavioral response. Computing the "revenue recovery ratio" – *i.e.*, the fraction of the revenue loss that is offset by behavioral changes – is therefore identical to estimating the efficiency gain per marginal dollar of tax revenue sacrificed and therefore also provides a useful tool for comparing the relative attractiveness of alternative tax policy options, including the choice between wage and capital income tax cuts. The *MCPF*, in turn, is closely related to the revenue recovery ratio.

This approach is fairly straight forward as far as wage income taxes are concerned. In the next section we recapitulate some basic insights using the distortive labor taxation *MCPF*. Things are somewhat more complicated when reforms of capital income taxes are considered. First, capital income taxes may change not only household saving, but also portfolio composition. Hence, several margins of choice are affected, and we single out four key ones, namely total savings, business investment, residential housing investment and the allocation of household financial assets across institutional (*i.e.*, pension fund and life insurance reserves) and non-institutional investment.

Second, by the very nature of capital accumulation, the effects of tax changes are likely to come about only gradually. Therefore, we employ a simple adjustment to take this into account, thereby computing a revenue recovery ratio that expresses the effects of behavioral changes on fiscal sustainability.

The approximate nature of the results to be reported shortly is related to, first, the absence of general equilibrium effects. We thus ignore all general equilibrium repercussions and hence, e.g., the interactions between changing factor supplies and factor price determination. Second, potential interactions between the distortions under investigation are left unexplored. Third, the present analysis abstracts from issues related to transition – *i.e.*, the potentially important incentive and allocative effects arising from gradual changes in the tax treatment of capital income. An analysis of this issue clearly requires a full general equilibrium model.

1. Wage income taxes

To develop (or, rather, restate) the basic insights, we consider a three-good static model, where households select labor supply, and therefore leisure time, and consumption of goods. We cut through the complexities caused by general equilibrium considerations by assuming that the market wage rate, reflecting the marginal productivity of labor, is constant. Also, we consider an economy populated by (a large number of) identical households, thus allowing us to ignore distributive issues.

Below, our purpose is initially to show two alternative, and from a first glance very different, ways of deriving the well-known expression for the *MCPF* and explaining why they are in fact closely related. The first method involves the examination of how the marginal efficiency condition for public good provision, *i.e.*

the Samuelson rule, is changed when the provision of public goods necessitates the use of a distortionary labor income tax. We consider both a proportional and a progressive tax system.

In the second case we proceed by asking the extent to which the required tax change is affected by the endogenous response of private sector behavior. It turns out that the magnitude by which the change in the tax rate must be augmented is precisely the *MCPF*.

1.1 The traditional way of deriving the MCPF

The individual household chooses labor supply and the consumption of goods and services so as to maximize utility subject to a budget constraint, which states that consumption is equal to after-tax wage income, *i.e.*:

In selecting labor supply L as well as consumption C, the household takes:

$$\underset{\{C,L\}}{\text{Max}}\, U = U(\overset{(+)}{C}, \overset{(-)}{L}, \overset{(+)}{G}) \quad \text{s.t} \quad C = (1-t)wL \tag{1}$$

as given the amount of the public good, G, that is provided free of charge by the government, as well as the after-tax wage rate, $(1 - t)w$.

Carrying out the usual optimization produces the first order conditions:

$$U_C = \lambda; \quad -U_L = (1-t)w\lambda \;\Rightarrow\; -U_L = (1-t)wU_C \tag{2}$$

where λ is the Lagrange multiplier associated with the household budget constraint. The first-order conditions in (2) imply that labor is supplied up until the point, where the additional sacrifice of an hour of leisure is just compensated, in utility terms, by the increase in consumption that may be financed by incremental after-tax income.

We turn now to the optimization problem faced by the (benevolent) government. The government's job is to select the amount of the public good, G, to supply and hence, by way of the public sector budget constraint, the tax rate on labor income, t. The social welfare function is of the utilitarian type, and we may accordingly express the government's decision problem as:

$$\underset{\{G,t\}}{\text{Max}}\, W = NU(C,L,G) \quad \text{s.t} \quad pG = twLN \tag{3}$$

In order to identify the condition characterizing optimal provision of the public good, we totally differentiate the SWF and the two budget constraints. This yields:

$$dW = NU_C dC + NU_L dL + NU_G dG = 0 \tag{4}$$

$$pdG = twNdL + wLNdt \tag{5}$$

and

$$dC = (1-t)wdL - wLdt \tag{6}$$

Inserting first the household's first order condition from (2) in (4) gives:

$$dW = NU_C\{dC - (1-t)wdL\} + NU_G dG = 0 \tag{7}$$

By combining (5) and (6) we obtain:

$$dC = wdL - twdL - wLdt = wdL - \frac{twNdL + wLNdt}{N} = wdL - \frac{pdG}{N} \tag{8}$$

which may be used to replace dC in equation (7). Doing so, and re-arranging, produces:

$$U_G\, dG = U_C\left\{\frac{pdG}{N} - twdL\right\} \tag{9}$$

Equation (9) shows how the level of provision of the public good is determined. Optimality thus calls for the marginal benefit to the individual household, *i.e.* the left-hand side, to equate marginal cost. Marginal cost, in turn, is made up of the two components appearing on the right hand side. The first one is the direct resource cost equal to the share of total cost borne by each individual. The second component is the change in the deadweight loss due to the use of distortionary taxation. This is the induced change in the tax base, *wdL*, times the wedge capturing the discrepancy between private and social valuation of the marginal hour of labor time. The wedge, of course, is the marginal tax rate, *t*.

Thus, equation (9) indicates how the use of distortionary taxation acts to augment the cost associated with, and hence the required marginal benefits from, government spending programs. In order to arrive at an expression that lends itself directly to numerical application, we insert equation (5) into (9), thus obtaining

$$N\frac{U_G}{U_C} = \frac{wLdt}{wLdt + twdL}\, p = \frac{p}{1 + \frac{tw}{wL}\frac{dL}{dt}} = \frac{p}{1 + \frac{t}{L}\frac{dL}{dt}} \tag{10}$$

The final term in the denominator is the tax elasticity of labor supply, which may be more conventionally written using the wage elasticity of labor supply, ε_L, *i.e.*:

$$\varepsilon_L \equiv \frac{dL}{L}\Big/\frac{d[(1-t)w]}{(1-t)w} = \frac{dL}{L}\frac{(1-t)w}{d[(1-t)w]} = -\frac{dL}{L}\frac{(1-t)w}{wdt} - \frac{1-t}{L}\frac{dL}{dt} \Rightarrow \frac{dL}{dt} = -\frac{L}{1-t}\varepsilon_L \tag{11}$$

We then get the following condition characterizing the optimal provision of the public good *G*,

$$N\frac{U_G}{U_C} = \frac{1}{1-\frac{t}{1-t}\varepsilon_L}p \tag{12}$$

Equation (12) is the familiar Samuelson condition, modified to take into account the fact that we are using a distortionary, proportional tax to finance government spending instead of the standard textbook assumption of lump sum taxation. The intuitive content of (12) is that aggregate marginal willingness to pay, *i.e.* the summation over the marginal rates of substitution between private and public goods, should be equated to total marginal cost, which consists of the direct resource cost, *i.e.* p, augmented by the marginal increase in the deadweight loss.

We refer to the efficiency cost of collecting a unit of revenue as the "marginal cost of public funds", or *MCPF*. Hence,

$$MCPF \equiv \frac{1}{1-\frac{t}{1-t}\varepsilon_L} \tag{13}$$

1.2 *Progressive taxation and non-wage income*

When deriving equation (13), we assumed a simple proportional wage tax, and that wages is the only source of household income. Clearly, it is relevant to consider how the result changes when we allow for progressive taxation. Also, the presence of income taxable transfer payments or private pension benefits implies that part of the tax base is unresponsive to changes in the income tax rate.[1]

We can modify equation (13) to cover these cases by introducing a per capita income tax deduction, *D*, and an amount of exogenously given, taxable per capita income, *S*. The household budget constraint then reads:

$$C = (1-t)(wL+S)+Dt \;\Rightarrow\; dC = (1-t)wdL-(wL+S-D)dt \tag{14}$$

while the government's budget constraint becomes:

$$S + pG = t(wL+S-D)N \;\Rightarrow\; pdG = twNdL+(wL+S-D)Ndt \tag{15}$$

[1] Of course, we could alternatively introduce a parameter capturing the elasticity of the *tax base* rather than the elasticity of *labor supply*. However, for easier interpre-tation and application, we derive below an expression for the *MCPF* that explicitly incorporates the part of the tax base, which is invariant to (labor) income taxation.

while equation (7) applies unchanged. Going through the same steps as above yields:

$$MCPF = \frac{1}{1 - \frac{wL}{wL+S-D}\frac{t}{1-t}\varepsilon_L} \tag{16}$$

Unsurprisingly, progressive taxation, *i.e.* $D > 0$, implies higher *MCPF*, because the revenue impact of a marginal tax increase is reduced, while the incremental efficiency loss is unchanged. Per unit of revenue, therefore, the cost of financing government spending goes up. Hence, the cost-benefit comparison necessitates a higher aggregate willingness to pay for the benefits enjoyed from the marginal unit of government spending, *G*.

Equivalently, for a given value of the labor supply elasticity, the presence of, for example, taxable transfers or deferred income tax pension assets acts to reduce the marginal cost of revenue through the lower responsiveness of the overall tax base.

1.3 An alternative derivation of the MCPF

Above, we derived an expression for the *MCPF* by asking how the Samuelsonian rule of optimal public good provision is modified by the need to resort to distortionary taxation. In this section we shall see that an identical expression emerges when we seek to determine the magnitude of the tax change that is required to raise a pre-specified amount of net revenue.

The change in tax revenue may be written:

$$dR = (wL + S - D)Ndt + twNdL = \left(1 - \frac{wL}{wL + S - D}\frac{t}{1-t}\varepsilon_L\right)(wL + S - D)Ndt \tag{17}$$

where again we have made use of equation (11). If required revenue is equal to, say, *pdG*, we obtain the following expression:

$$dR = pdG \quad \Rightarrow \quad dt = \frac{1}{1 - \frac{wL}{wL+S-D}\frac{t}{1-t}\varepsilon_L}\frac{pdG}{(wL + S - D)N} \tag{18}$$

Consider now the expression for the required change in the tax rate, *dt*. The last term is net revenue, *pdG*, divided by the ex ante tax base, *i.e.* $(wL + S - D)\,N$. This is the required change in the tax rate if behavior does not respond. The first term is equal to the *MCPF*.

Hence, the *MCPF* may be thought of as *either* the true cost in terms of private utility sacrificed in order to raise one unit of revenue *or*, alternatively, as the “mark-up” that must be applied in order to determine how much the tax rate must be raised in order to provide a given amount of tax revenue.

Unsurprisingly, the key component in the computation of the *MCPF* is the amount by which government revenue is diluted through the behavioral changes induced by taxation. From the perspective of the individual household, this essentially represents the operation of a "fiscal externality": When the individual household is induced to change hours of work, the marginal substitution of leisure time for consumption of goods and services *per se* leaves welfare unaffected, and the social cost derives entirely from the implied loss of government net tax receipts.

When examining a tax cut (rather than as above where, for illustrative purposes, we followed the analysis of the theoretical literature and therefore considered a tax increase) this implies that we may identify the marginal welfare gain by computing the "revenue recovery ratio", *i.e.* the share of the revenue loss which is clawed back as a result of the change in private sector behavior.

Obviously, such fiscal externalities are not confined to changes in labor income taxation. If, e.g., the taxation of capital income is altered, similar effects will be at work reflecting tax-induced differences between social and marginal rates of return prevailing at the outset.

Hence, in section 2 we adapt the *MCPF* approach to deal with capital income tax changes, but before doing so, we examine the fiscal externality effects at work when labor income taxes are reduced in order to provide a basis for comparison between this option and the effects of changes in capital income taxation to be examined shortly.

Table 1 below shows the revenue recovery ratios for the three income tax brackets in the Danish tax system, assuming that the wage elasticity of labor supply is equal to 0.1 throughout the income range. The welfare gain per dollar of direct revenue loss is equal to 0.2 for a cut in the lowest income bracket tax rate, while a cut in the top rate produces 88 per cent revenue recovery and hence is almost self-financing.

Of course, the results would be modified if, e.g., the wage responsiveness of labor supply varies throughout the income distribution; however, judged on purely efficiency grounds, a reduction in the low bracket (essentially proportional) tax rate would have to elicit a labor supply increase about five times larger than a cut in the top bracket rate for the former initiative to be cost-effective.

2. Capital income taxes

In the previous section, we saw how the efficiency impact from (small) tax changes takes the form of a fiscal externality, namely the change in government net revenue implied by the change in private sector behavior. Below we show how to quantify the size of the fiscal externalities generated by a (hypothetical) reform aimed at streamlining and lowering capital income taxes, taking the current Danish tax system as the benchmark situation.

Table 1

Wage Income Revenue Recovery Ratios

	Bracket income tax rate *(percent)*	Payroll tax rate *(percent)*	Effective indirect tax rate[1)] *(percent)*	Share of tax-payers[2)] *(percent)*	Average marginal tax rate *(percent)*	Wage base/tax base ratio *(share)*	Revenue recovery ratio[3)] *(share)*
Low bracket	38.8	8.0	32.5	49.6	61.7	1.04	0.17
Mid bracket	44.8	8.0	32.5	30.0	65.9	2.58	0.50
Top bracket	59.7	8.0	32.5	20.4	72.1	3.42	0.88

Notes: 1) VAT and excise duties net of subsidies. Expressed as a revenue-equivalent "augmented VAT" rate.
2) Percentage of tax payers with marginal tax rate in the respective income brackets.
3) The after-tax wage elasticity of labor supply is assumed to be 0.1 for taxpayers in all three marginal rate brackets.

The elements of the hypothetical tax reform as well as the direct revenue impacts are shown in Table 2. The reform involves imposing a uniform 25 per cent income tax rate on personal capital income (typically household net interest income plus certain components of the profits from privately held businesses) instead of the current progressive taxation of positive net capital income. The tax rates applicable to dividends and capital gains are reduced from 28 or 43 per cent to 20 per cent, while the corporate income tax rate is reduced from 30 to 25 per cent. As the table shows, the revenue loss at unchanged behavior equals about 0.5 per cent of GDP.

In the next four subsections we develop an analytical toolkit that may be used to assess – through the computation of an appropriate revenue recovery ratio directly comparable to the results in Table 1 – the attractiveness of launching a reform such as the one outlined above.

We illustrate how the effects on four dimensions of behavior can be evaluated. The first is household savings while the remaining three essentially relate to the composition of private sector asset holdings, namely business capital formation, residential housing investment and pension/life-insurance asset accumulation.

Throughout we assume that the real before tax market rate of return is 4 per cent, while the inflation rate is 2 per cent in our baseline scenario. When reporting the combined revenue recovery ratio, we examine further the consequences of

Table 2

Tax Rates on Capital Income Before and After Hypothetical Reform

	Pre-reform (2003) *(percent)*	Post-reform *(percent)*	Revenue impact at unchanged behavior *(percent of GDP)*
Negative net personal capital income	33.3	25	0.38
Positive net personal capital income	38.8-59.7	25	–0.31
Dividends and capital gains	28-43	20	–0.18
Corporate income	30	25	–0.37[1)]
Pension and life insurance asset returns	15	15	0.00
Total	-	-	**–0.48**

Notes: 1) After adjustment for shareholder level taxes assuming ownership shares of one-third each for domestic households, domestic pension funds and foreign investors.

changing the assumption regarding inflation in order to illustrate the quantitative significance of the interaction between nominal income taxation and inflation. Finally, we assume that the annual real wage growth rate (which is relevant for computing present values as well as the derivation of effective real tax rates on pension assets) is 1.5 per cent.

2.1 Household savings

As shown in Table 3, the hypothetical reform implies a reduction in the average tax rate applicable to household net capital income from 37.3 per cent (*i.e.*, a weighted average of the statutory rates shown in Table 2) to 25 per cent. Allowing for inflation, the real effective tax rate is cut from 56 to 38 per cent thus producing a 0.7 percentage point permanent increase in the after-tax rate of return.

Increased household savings imply that, as private sector assets are gradually built up, tax receipts increase. To facilitate comparison with the results concerning wage taxation, we need to compute the equivalent permanent revenue effect – *i.e.*, the impact of behavioral changes on fiscal sustainability. We thus need to track the dynamic evolution of private financial assets and convert the implied additional revenue into an annuity.

Table 3

Effect on Private Savings

Pre-reform average statutory income tax rate on capital income *(percent)*	37.3
Post-reform average statutory income tax rate on capital income *(percent)*	25.0
Pre-reform effective real tax rate1) *(percent)*	56.0
Post-reform effective real tax rate1) *(percent)*	37.5
Change in effective real tax rate *(percentage points)*	–18.5
Implied increase in real return *(percentage points)*	0.74
Impact increase in savings2) *(percent of GDP)*	0.369
Effect on fiscal sustainability3) *(percent of GDP)*	**0.134**

Notes: 1) Denotes tax on interest income expressed in per cent of the pre-tax real rate of return. The nominal interest rate is assumed to be 6 per cent, while the rate of inflation is 2 per cent.
2) Based on the assumption that a 1 percentage point permanent increase in the after-tax rate of return yields a 0.5 per cent of GDP short-run increase in private savings.
3) Based on a marginal propensity to consume out of total wealth (*i.e.*, discounted disposable labour income plus net household financial assets) equal to 4 per cent. See Annex 1.

To do so, it is useful to parameterize the effects on household asset accumulation, using two key magnitudes, namely the impact increase in household saving, *dS*, and the marginal propensity to consume out of private assets, Δ. The implied gain in net tax receipts – that is, the fiscal externality and hence the contribution from private savings to the revenue recovery ratio – may then be expressed as:[2]

$$d\sigma = \frac{\tau i}{\tau i + \Delta} dS \tag{19}$$

where τ is the capital income tax rate, *i* is the nominal market interest rate, while $d\sigma$ denotes the permanent stream of incremental tax revenue that is equivalent in present value to the gradually increase in capital income tax revenue generated by the hypothesized rise in household savings.

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[2] See Annex 1.

In other words, equation (19) shows how to compute the impact on fiscal sustainability arising from the behavioral response to lower taxes on household net capital income.

Table 3 reports results based on the assumption that a 1 percentage point sustained increase in the post-tax real return generates at short-run increase in private savings of 0.5 per cent of GDP. The marginal propensity to consume is set to 4 per cent, reflecting calibration of the key intertemporal parameters in an extended version of the Blanchard-Weil overlapping generations model, as shown in Annex 1.

As shown in Table 3, revenue recovery from this component of the reform is equivalent to a sustained increase in government net tax receipts of 0.13 per cent of GDP. Notice also that this amount in fact exceeds the direct (*i.e.*, ignoring behavioral changes) reduction of tax receipts shown in Table 1 (0.38 – 0.31 = 0.07 per cent of GDP). Hence, even with a fairly modest[3] impact on private savings, this part of the overall package is in fact more than self-financing.

2.2 Business investment

The hypothetical reform of capital income taxation affects business investment through the reduction in the taxation of household interest earnings (which tends to increase the hurdle rate that business investment must satisfy) as well as the lowering of the corporate tax rate and the tax rates applicable to household dividend income and capital gains.

The net effect of the tax system on business investment is summarized by the standard concept of the cost of capital *c*, *i.e.*:

$$c = \left\{ \frac{(1-t^c)}{(1-\theta)(1-\tau)} r + \frac{\tau + (1-\tau)\theta - t^c}{(1-\theta)(1-\tau)} \pi \right\} - \left(\frac{\tau}{1-\tau} \right) \left[\frac{\left(\frac{1-t^c}{1-\theta}\right)(r+\pi)}{\left(\frac{1-t^c}{1-\theta}\right)(r+\pi) + \tilde{\delta}} \right] \left(\tilde{\delta} + \pi - \delta \right) \qquad (20)$$

where we have assumed that the marginal investment project is financed through retained earnings, while θ is the tax rate on dividends and capital gains, t^c is the tax rate on interest income, τ is the corporation tax rate, while $\delta, \tilde{\delta}$ denote, respectively, the rates of physical and tax depreciation and π is the inflation rate.

The term in curly brackets is the cost of finance, and it exceeds the real pre-tax rate of interest *r* (and is furthermore increasing in the inflation rate) provided the combined taxation of equity returns at the corporate and investor levels exceeds the taxation of interest earnings.

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3 An alternative perspective on the assumed behavioral effects may be obtained by computing the long-term increase in private sector financial assets implied by the assumptions concerning the path of incremental asset accumulation. This amounts to about 13 per cent of GDP for each 1 percentage point increase in the post-tax return. Given the 56 per cent real tax rate at the outset, the presence of capital income taxation thus depresses private asset holdings by about 30 per cent of GDP, or less than one-fifth of the household asset-to-GDP ratio reported in Table 6 below.

The second term on the right hand side in equation (20) is the contribution from tax depreciation. Specifically, if the tax depreciation rate exceeds the nominal rate of economic depreciation, tax write-offs will reduce the cost of capital and this effect is increasing in the inflation rate.

Table 4 shows the potential consequences of the hypothetical reform, when the elasticity of business investment with respect to the user cost of capital (*i.e.*, the cost of capital computed according to equation (20) augmented by the physical depreciation rate) is assumed to be –0.5.

Table 4

Effect on Business Investment

	Pre-reform	Post-reform
Business capital stock (buildings and equipment) *(percent of GDP)*	137.0	
Physical depreciation rate (avg. for buildings and equipment) *(percent)*	8.0	-
Personal capital income tax rate *(percent)*	37.3	25.0
Dividends and capital gains tax rate *(percent)*	35.5	20.0
Corporate income tax rate *(percent)*	30.0	25.0
Tax depreciation rate (avg. for buildings and equipment) *(percent)*	12.0	12.0
Cost of finance *(percent)*	6.33	5.50
Tax depreciation *(percent)*	–0.84	–0.64
Cost of capital (cost of finance + tax depreciation) *(percent)*	5.49	4.86
User cost (cost of capital + physical depreciation) *(percent)*	13.49	12.86
Change in user cost *(percent)*	-	–4.7
Long-run change in capital stock[1)] *(percent)*	-	2.3
Long-run change in capital stock *(percent of GDP)*	-	3.2
Long-run impact on government revenue *(percent of GDP)*	-	0.048
Effect on fiscal sustainability[2)] *(percent of GDP)*	**-**	**0.038**

Notes: 1) The elasticity of capital demand with respect to user cost is assumed to be –0.5.
2) Assuming that one-half of the remaining adjustment of the capital stock takes place each 3 years. See Annex 3.

The reform leads to a reduction in the cost of capital from 5.5 to 4.9 per cent, thus somewhat alleviating the distortion to investment decisions inherent in the current tax code – although the cost of capital remains above the real interest rate post-reform, thus indicating that socially profitable investment opportunities are left unexploited.

The fact that the cost of capital initially exceeds the real interest rate implies that the subsequent increase in business capital formation improves allocative efficiency. And the magnitude of the gain is equal to the fiscal externality associated with shifting the composition of the private sector asset portfolio towards business assets. In the long term, the government financial balance is thus improved by 0.05 per cent of GDP.

This comes about only gradually, however, as the accumulation of additional productive capital is likely to take time due to, e.g., cost of adjustment. Assuming that half of the remaining adjustment takes three years, the equivalent effect on fiscal sustainability[4] is equal to 0.04 per cent of GDP.

2.3 Residential housing investment

The reduction in the tax rates applicable to household net interest income implies a parallel reduction in the tax preference for owner-occupied housing. The housing cost of capital may be expressed as:

$$c = (1-t^C)i - \pi + t^P = (1-t^C)(r+\pi)i - \pi + t^P = (1-t^C)r - t^C\pi + t^P \qquad (21)$$

where t^P denotes the property value tax. Notice how – unless the property value tax rate is set equal to the capital income tax rate times the nominal interest rate – a higher tax rate on capital income t^c will lower the cost of residential capital.

Similarly, an increased inflation rate (keeping the real interest rate constant in pre-tax terms) also tends to reduce the cost of capital and hence stimulate residential construction.

If we assume that the elasticity of residential housing demand with respect to user cost equals –0.5, the hypothetical tax reform leads to an 8 per cent long run decline in the housing stock as shown in Table 5. This reduction reflects, of course, the drop in the income tax shield due to interest deductibility. As the cost of capital is initially below the real interest rate, the shift in the composition of private sector assets away from housing exerts a positive fiscal externality.

4 The adjustment used is described in detail in Annex 3.

Table 5

Effect on Residential Housing Investment

Residential housing stock *(percent of GDP)*	105.0
Physical depreciation rate *(percent)*	2.0
Pre-reform interest tax shield *(percent)*	37.3
Post-reform interest tax shield *(percent)*	25.0
Property value tax rate *(percent)*	1.0
Pre-reform cost of capital *(percent)*	2.7
Post-reform cost of capital *(percent)*	3.4
Pre-reform user cost *(percent)*	4.7
Post-reform user cost *(percent)*	5.4
Change in user cost *(percent)*	15.8
Long-term change in housing stock[1)] *(percent)*	–7.9
Long-term change in housing stock *(percent of GDP)*	–8.3
Long-term impact on government revenue *(percent of GDP)*	0.111
Effect on fiscal sustainability[2)] *(percent of GDP)*	**0.061**

Notes: 1) The elasticity of housing demand with respect to user cost is assumed to be –0.5.
2) Assuming that one-half of the remaining adjustment of the capital stock takes place each 10 years. See Annex 3.

However, this effect is likely to come about only slowly, and if one-half of the remaining adjustment takes place every 10 years, the implied permanent net gain equals 0.06 per cent of GDP.

2.4 Pension assets

The tax and transfer system, and in particular the relative tax treatment of institutional (*i.e.*, pension and life insurance) and non-institutional assets, is likely to affect the location of private financial wealth.

The taxation of pension returns is typically quite complicated, reflecting in most countries deductibility of pension contributions combined with the taxation of pension distributions and possibly also means-testing of public old-age benefits.

Furthermore, the Danish tax system features a uniform accrual-based 15 per cent tax on the return on pension assets. The net influence of the tax system on financial asset location reflects the operation of these tax provisions, on the one hand, and the income taxes levied on household capital income on the other hand.

To the extent that the effective tax rate on pension returns is below the one applicable to non-institutional assets, an incentive is created to divert assets into pension and life-insurance reserves. Clearly, institutional and non-institutional assets are not perfect substitutes, as they possess different economic characteristics in terms of risk, insurance and liquidity. Accordingly, households will select the composition of asset portfolios such that the marginal after-tax benefit from the various assets are equated. This in turn implies that investment in the tax-preferred asset will be carried to the point where the marginal net tax benefit is just offset by the marginal net non-tax cost.

Using the approach outlined in Annex 2, the typical Danish household faces a 22 per cent effective real tax rate on pension asset returns, whereas the average real effective tax rate on non-institutional assets is equal to 56 per cent. Consistent with the tax-preference for pension assets, roughly three-quarters of household assets are held in this form as shown in Table 6.

The hypothetical tax reform outlined in Table 2 implies – through the reduction in the tax rate on household capital income – that the return differential is cut by roughly one-half. Assuming that households will react by reallocating assets to an extent corresponding to half of what is required to explain baseline portfolio composition, the long run reduction in pension assets amounts to 6 per cent of GDP.

The long-term effect on the government financial balance, reflecting the shift towards more heavily taxed non-institutional assets, amounts to slightly less than 0.1 per cent of GDP, or 0.06 per cent of GDP on a permanent basis if the portfolio shift kicks in gradually with a "half-life" of 5 years.

2.5 Overall effects of the hypothetical capital income tax reform

The reduction and streamlining of the taxation of capital income implied by the hypothetical tax cut leads to higher savings and a general shift away from currently tax-favored assets (residential property and pension assets) towards business capital as shown in Table 7 which summarizes the long term portfolio changes.

Table 8 indicates the revenue recovery ratio of the overall reform, *i.e.* the share of the 0.5 per cent of GDP direct revenue loss, which is recouped through the behavioral effects. Under the baseline assumption of a 2 per cent inflation rate, revenue recovery amounts to 68 per cent, thus implying that the reform of capital income taxation ought to be a more urgent priority than lower wage income taxes – except for reductions in the top bracket tax rate – at least when judged by a pure efficiency criterion.

Table 6

Effect on Pension and Life Insurance Asset Accumulation

	Pre-reform	Post-reform
Household net asset holdings[1] *(percent of GDP)*	160.2	-
of which: *non-institutional (percent of GDP)*	*43.4*	-
institutional[2] (percent of GDP)	*116.9*	-
Effective real tax rate on non-institutional asset returns[3] *(percent)*	56.0	37.5
Effective real tax rate on pension and life ins. asset returns[4] *(percent)*	21.6	21.6
Difference in effective real tax rates *(percentage points)*	34.3	15.9
Real return differential *(percentage points)*	1.37	0.64
Change in real return differential *(percentage points)*	-	–0.74
Long-run change in pension assets[5] *(percent of GDP)*	-	–6.2
Long-run change in net tax revenue *(percent of GDP)*	-	0.085
Impact on fiscal sustainability[6] *(percent of GDP)*	-	**0.060**

Notes: 1) Includes residential housing equity, bond and share holdings as well as pension and life insurance reserves.
2) Includes reserves held in the private pension and life insurance sector as well as fully funded government schemes.
3) Using the average income tax rate on household capital income shown in Table 3.
4) Includes the effects of the deferred income tax treatment op pension assets, means-testing of government old-age benefits as well as the income taxation of accrued pension returns. See Annex 2.
5) The composition of private asset holdings is assumed to respond to the after-tax return differential by an amount equal to one-half of the sensitivity that is required to explain the deviation between the pre-reform portfolio composition and equal portfolio shares.
6) Assuming that one-half of the remaining adjustment of pension asset holdings takes place each 5 years. See Annex 3.

Table 7

Change in Private Sector Asset Holdings
(percent of GDP)

Total household assets		**+10.0**
of which:	Business capital stock	+3.2
	Residential housing	–8.3
	Pension and life insurance assets	–6.2
	Household non-institutional assets	+21.1

Table 8

Capital Income Tax Revenue Recovery Ratio under Alternative Inflation Rates

	Inflation rate		
Contribution from:	0 percent	**2 percent**	4 percent
Household savings	0.14	**0.28**	0.45
Business investment	0.05	**0.09**	0.13
Residential investment	0.04	**0.16**	0.39
Pension and life ins. assets	0.10	**0.15**	0.20
Total	**0.33**	**0.68**	**1.17**

The table also shows that the attractiveness of capital income tax reform is very sensitive to even low levels of inflation. This reflects the fact that the taxation of nominal capital income becomes more distortive when the inflation rate rises because existing non-neutralities are magnified.

In particular, at a moderately high (although by no means extreme) inflation rate of 4 per cent, the efficiency gains in fact exceed the direct revenue loss; *i.e.* the reform is more than self-financing. The results of the analysis in this paper thus also underscore the critical importance of taking account of inflation when assessing the allocative distortions due to capital income taxation.

3. Concluding remarks

This paper outlines a simple methodology, building essentially on the insights from the literature on the marginal cost of public funds, that may be used to compare the attractiveness of various tax policy options, in particular the choice between wage and capital income tax cuts.

The results indicate that policy makers may be well advised to devote more attention to reforming the taxation of capital income rather than across-the-board cuts in broad-based labor income taxes, which seems to be a key trend in recent years.

Taking into account the various dimensions of private sector behavior, which are distorted by capital income taxes, and taking account also of the taxation-inflation interaction, lowering and streamlining the taxation of asset returns seems to promise significant gains in allocative efficiency. And it should be emphasized that the behavioral responses assumed above are quite modest as witnessed by the pattern of savings and asset relocation.

It should also be borne in mind that the argument in favor of capital income tax reform does not depend on considerations associated with international tax competition. The effects discussed in the previous section are solely related to changes in the behavior of domestic residents and firms. Of course, the temptation to attract internationally mobile investments (or individuals), or slow capital flight, may provide additional motivation for countries to, e.g., reduce the corporation tax rate (and, possibly, the progressive elements of labor income taxation).

Finally, while a range of inter-asset distortions have been addressed above, the analysis is by no means complete in this regard. Specifically, we have ignored the important intersectoral and inter-asset distortions arising inside the business sector. Explicit treatment of the efficiency losses associated with the differential tax treatment of long- and short-lived capital, or alternative sources of finance for business firms, is thus likely to raise further the potential gains from capital income tax reform.

ANNEX 1

CALIBRATION OF THE SAVINGS RESPONSE

The effect of additional private savings on the government financial balance reflects, in addition to the tax rate on the real return, the initial impact on savings as well as the propensity to consume out of additional financial wealth.

In this section we show how the latter parameter may be calibrated using a version of the familiar Blanchard-Yaari-Weil (BYW) model (see, e.g., Blanchard, 1985). In this model, aggregate private consumption spending *C* is determined by:

$$C_t = \Delta(H_t + A_t) = \Delta\left(\frac{Y_t}{p + r - (\gamma - \delta)} + A_t\right) \qquad \text{(A1.1)}$$

where *H* denotes the present value of disposable after-tax labor (*i.e.*, wage and transfer) income, *A* is household net financial assets while Δ is the marginal propensity to consume out of household net worth. The discount rate applicable to future labor income reflects the death probability (*i.e.*, the effective time horizon of households) *p*, the real rate of interest *r* as well as the aggregate productivity growth rate γ and the parameter δ describing the path of productivity-adjusted labor income over the lifecycle.

We exploit the simple relationship between financial assets *A* and consumer spending *C* in the BYW model in order to compute the path of additional private assets, and hence also the impact on the government financial balance, generated by a change in the after-tax real return. For this purpose, we need an estimate of the marginal propensity to consume out of financial assets, *i.e.* Δ.

After-tax labor and transfer income equals about 75 per cent of GDP. At a 4 per cent real interest rate, a death probability of 0.02 (that is, corresponding to an effective planning horizon of 50 years for the average household) and γ = 1.5 per cent, while δ = 0.5 per cent, the net present value of labor income equals 13.6 times GDP.

Using the estimate of private sector net financial assets of 1.6 times GDP reported in section 2 then produces total household wealth equal to approximately 15 times GDP. With private consumption at about 60 per cent of GDP, the implied marginal propensity to consume out of total household wealth is roughly 4 per cent.

The increase in private savings, in combination with the assumption concerning the impact on future consumption outlays captured by Δ, gives rise to a gradual increase in household financial assets and hence the capital income tax base. Incremental revenue in period *s*, dT_s, may then be written as:

$$dT_s = \tau i dA_s = \tau i \sum_{u=t}^{s} \left(\frac{1+(1-\tau)i - \Delta}{1+g} \right)^{(u-t)} dS_t \qquad \text{(A1.2)}$$

where τ is the capital income tax rate, i is the nominal rate of return, while g denotes the aggregate nominal growth rate. Calculating the net present value of incremental tax revenue, and converting it into a stream of net tax receipts that remain constant as a percentage of GDP, finally produces equation (19) of the main text.

ANNEX 2

THE EFFECTIVE TAXATION OF PENSION ASSET RETURNS

The tax treatment of institutional savings typically implies that contributions are income tax deductible, while benefits are subject to income taxation as well as means testing of pension benefits from the government. In addition, in some countries – including Denmark – the return on pension fund assets is subject to taxation at accrual.

Obviously, the incentive to hold assets through pension accounts, rather than as "free" household savings, depends on the relative tax treatment of the two types of assets. A convenient way of comparing the attractiveness of institutional and non-institutional savings instruments is to calculate and compare the effective tax rates on the underlying real return. For pension assets, this requires taking into account the tax treatment of pension contributions and pension benefits as well as the taxation of accrued returns.

Below, we estimate the effective tax rate on pension assets by computing, first, the internal rate of return associated with the after-tax cash flow generated by the pension investment. Second, by comparing the internal rate of return to the real market rate of interest, we can compute the fraction of the underlying real return, which is absorbed by taxation. This fraction is the effective (income) tax rate on pension asset returns.

At retirement after T periods of contributions, total pension assets W are:

$$W_{T+1} = \sum_{u=1}^{T} \left(\frac{1+(1-t^P)i}{1+\gamma} \right)^u \bar{c} = \left(\rho^T - 1\right)\frac{\rho}{\rho-1}\bar{c} \quad \text{where } \rho \equiv \frac{1+(1-t^P)i}{1+\gamma} \tag{A2.1}$$

where $\bar{c}$ is the (wage-indexed) contribution paid into the pension fund, i is the nominal rate of return before tax, γ denotes the nominal wage growth rate (and hence the rate of growth of contributions), while t^P is the tax rate applicable to pension asset returns.

Assuming that (wage-indexed) pension benefits are paid out over a period of S years after retirement, thus exhausting the value of assets in the pension account at the end of period $T+S$, and denoting by $\bar{b}$ the pension benefit distributed in period $T+1$, this implies that:

$$\sum_{u=T+1}^{T+S} \left(\frac{1+\gamma}{1+(1-t^P)i} \right)^u \bar{b} \; = \; \left(1-\rho^{-S}\right)\frac{\rho}{\rho-1}\bar{b} \; = W_{T+1} \tag{A2.2}$$

Combining (A2.1) and (A2.2) we may now find the pension benefit parameter:

$$\bar{b} \;=\; \frac{\rho^{T}-1}{1-\rho^{-S}}\bar{c} \qquad \text{(A2.3)}$$

Along with the duration of the contribution and benefit periods, equation (A2.3) then determines the pre-tax cash flow (negative during the first T periods, positive during the subsequent S periods) generated by the pension investment.

In order to compute the implied internal rate of return on the pension account we next calculate the net present value of the post-tax cash flow $\tilde{W}$, *i.e.*:

$$\begin{aligned}\tilde{W} &= \underbrace{(1-t^{D})(1-m)\left(1-\tilde{\rho}^{-S}\right)\frac{\tilde{\rho}}{\tilde{\rho}-1}\left\{\frac{\rho^{T}-1}{1-\rho^{-S}}\bar{c}\right\}}_{\text{Present value of net-of-tax distributions}} - \underbrace{(1-t^{C})\left(\tilde{\rho}^{T}-1\right)\frac{\tilde{\rho}}{\tilde{\rho}-1}\bar{c}}_{\text{Net-of-tax cost of pension assets at retirement}} \\ &= \left[(1-t^{D})(1-m)\frac{\rho^{T}-1}{1-\rho^{-S}}-(1-t^{C})\frac{\tilde{\rho}^{T}-1}{1-\tilde{\rho}^{-S}}\right]\left(1-\tilde{\rho}^{-S}\right)\frac{\tilde{\rho}}{\tilde{\rho}-1}\bar{c}\end{aligned} \qquad \text{(A2.4)}$$

where $\tilde{\rho}$ is the growth-adjusted discount rate, t^C is the income tax rate applicable to pension contributions, t^D is the income tax rate on pension bene-fits, while *m* is the rate of means testing (thus indicating the fraction of pre-tax pension benefits which is offset by reduced public retirement benefits). The growth-adjusted internal rate of return is then the value of $\tilde{\rho}$, for which $\tilde{W}$ is equal to zero. It is impossible to derive from equation (A2.4) an analytical expression for $\tilde{\rho}$, but it is easily approximated numerically.

Finally, we recover the effective tax rate on pension returns, $\tilde{t}^{R}$, by observing that:

$$\tilde{\rho} \equiv \frac{1+(1-\tilde{t})i}{1+\gamma} \;\Rightarrow \tilde{t}^{R} \equiv \frac{\tilde{t}\,i}{r} = \frac{1+i-(1+\gamma)\tilde{\rho}}{r} \qquad \text{(A2.5)}$$

Obviously, the effective tax rate on pension assets reflects, in addition the tax rates on contributions, benefits and accrued returns, the duration of the period in which contributions are made as well as the duration of the retirement period.

Assuming that contributions are paid over a period of 30 years followed by 20 years of benefits, combined with a 15 per cent tax rate on accrued returns, a 47.5 per cent tax rate on contributions (corresponding to the average of the middle and top bracket income tax rates), a 41.4 per cent tax rate on distributions (equal to the average of the low, middle and top bracket income tax rates) and a means testing rate of 10 per cent then produces the effective real tax rate of 21.6 per cent reported in Table 6.

ANNEX 3

ADJUSTMENT FOR THE TIME PATH OF REVENUE EFFECTS

In this section we show how to compute the annuity equivalent value, expressed as a constant percentage of GDP, of long-term revenue effects that occur gradually.

If the long-term (*i.e.*, steady state) effect on tax receipts is ΔR_∞, and the adjustment path may be approximated by an exponential speed of adjustment of λ, the NPV-equivalent permanent effect on the government financial balance is

$$\Delta\sigma_t = (i-\gamma)\int_{s=t}^{\infty}\left\{\left(1-e^{-\lambda(s-t)}\right)\Delta R_\infty\right\}e^{-(i-\gamma)(s-t)}ds = \frac{\lambda}{i-\gamma+\lambda}\Delta R_\infty \qquad \text{(A3.1)}$$

where i denotes the nominal rate of interest and γ the growth rate of nominal GDP.

Replacing the adjustment speed by the "half-life" of the deviation between the short- and the long-term impact on the government financial balance, $T^{½}$, yields the expression used in section 2, *i.e.*:

$$\Delta\sigma_t = \frac{\lambda}{i-\gamma+\lambda}\Delta R_\infty = \frac{\ln 2/T^{½}}{i-\gamma+\ln 2/T^{½}}\Delta R_\infty = \frac{\ln 2}{(i-\gamma)T^{½}+\ln 2}\Delta R_\infty \qquad \text{(A3.2)}$$

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