WELFARE EFFECTS OF TAXATION OF INCOME FROM CAPITAL

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Introduction

Is taxation of capital income inefficient? And if so, why do democratic governments persist with such taxation? In this paper, we evaluate the likely impact of capital taxation in the United Kingdom. The theoretical argument displaying the overall inefficiency of capital taxation is made by Chamley (1986). If individuals have infinite planning horizons, and face complete, competitive markets, government expenditures should not be financed by the taxation of capital income. These taxes discourage capital accumulation, and lower aggregate income and wages. The same level of expenditure is better financed by taxing wages directly. Lucas (1990) made a forceful case by demonstrating the quantitative impact of actual capital taxation in the US. More recently, Cooley & Ohanian (1997) evaluate the impact of substantial taxation of capital in the UK during and after the Second World War. They find that, compared with a tax-smoothing policy, the actual pattern of tax rates reduced welfare by about 2 per cent although this rises to 3 per cent if it is assumed that the growth rate is completely endogenous. They do not look at the welfare cost of the actual policy compared to the alternative of no tax on income from capital.

The theoretical argument that income from capital should not be taxed needs many assumptions: that households have infinite, or at least very long planning horizons, and that markets are complete, allowing them to borrow and lend any amount, and insure against every contingency in the indefinite future. The argument delivers, in turn, a very strong conclusion indeed, that capital taxes make everyone worse off, *i.e.* that they are Pareto-inefficient. Actual economies – including that of the UK – are unlikely to satisfy all these assumptions, or allow such an unequivocal comparison. Imperfections in capital markets can overturn the theoretical result. Individuals who are unable to borrow may save too much; Aiyagari (1995) shows that capital taxation may correct the resulting dynamic inefficiency. This suggests that capital taxation may not be inefficient, after all, but does not justify the levels of taxation that we observe. Imrohoroglu (1998) conducts a quantitative analysis, in an economy where individuals cannot fully insure against the risk of unemployment. In a model calibrated to mimic the US economy, he shows that a 10 per cent tax on capital income maximizes average welfare, and that this is unrelated to dynamic

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inefficiency. By implication, questions of Pareto-efficiency are immaterial in empirically relevant worlds. Taxing capital, rather than labour income, redistributes wealth, consumption, and welfare. Societies have to judge the extent to which these redistributions are desirable.

In this paper, we ask what are the likely effects of capital taxation in an economy calibrated to mimic the UK? We evaluate aggregate effects – on output, and capital accumulation, as well as the distributional effects.

1. The effects of taxing capital income

The economic argument against capital taxation is simple, and intuitive. Imagine that individuals are infinitely lived, and can save or borrow to smooth their consumption. At the steady state of the neo-classical growth model, the rate of return on capital must equal the rate at which individuals discount the future. A tax on capital income is distortionary because it drives a wedge between the two. In response, the level of capital stock must fall. This decline in capital stock lowers aggregate output, wages, and consumption levels permanently, and this is the source of its inefficiency.

The argument may fail in the presence of one, or another departure from the assumptions. We feel that two institutional features are important in this situation: the welfare state, and borrowing constraints on individuals. The provision of social benefits associated with a welfare state can change the incentive to save and thus affect the distributional effects of taxation of capital income: for example, Feldstein (1978) points to the effect of state pensions, and Zeldes (1989) to the effect of free medical care for the elderly. If such benefits are available at flat rates, they affect the saving of poor people more than rich people. A tax on income from capital is redistributive and favoured by those for whom social benefits are particularly important.

If households are unable to borrow against future earnings to finance current consumption levels or tax payments, the taxation of capital rather than labour income redistributes from the young to the old: in effect, it allows individuals the opportunity to postpone their tax payments. This is beneficial if borrowing constraints bind. They are likely to do so if the age-earnings profile is steep, in the manner described by Mincer (1974). The argument is much the same as that made by Aiyagari (1995) in the context of infinitely lived consumers. It has yet more force if individuals have finite lives. In an overlapping generations economy, as we consider, a realistic age-earnings profile for individuals is consistent with stationary production possibilities in the aggregate economy.

So, in the presence of state benefits, the poor are likely to want capital taxes; and in the presence of borrowing constraints, the young would agree. At this point, it is tempting to quote Lucas (1990), who displays one, or perhaps both features, in saying: “When I left graduate school in 1963, I believed that the single most desirable change in the US tax structure would be the taxation of capital gains as

ordinary income. I now believe that neither capital gains nor any of the income from capital should be taxed at all."

In the Ramsey model studied by Chamley, the representative individual does not change his mind. In the environment we analyze, individuals prefer capital taxes when they are young, and change their view with age, particularly so if they have a large positive shock to their earning power. The model allows us to assess these issues affecting the taxation of income from capital in terms of its effect on the welfare of the population currently alive and the lifetime welfare of the young. We begin with an account of the taxation of income from capital in the United Kingdom and then proceed to set out our model and to investigate the effects of capital income taxation.

2. Taxation of income from capital in the United Kingdom

In the mid-Thirties profits, dividends and interest were taxed on the grounds that they were income. A tax on excess profits had been imposed during the First World War but it was abolished in 1928. Two taxes were levied on high incomes, Income Tax and Surtax. The maximum rate of the two together was 50-55 per cent, levied on incomes above £50,000 p.a. (£1.65m in today's spending power). While high tax rates were criticized for their disincentive effects, we have not been able to find any early indication of the modern criticism of taxes on income from capital – that they are regressed onto labour and drive a wedge between the rate of return and the rate of time preference.

In 1937 Mr Chamberlain, then Chancellor of the Exchequer, announced a National Defence Contribution intended to raise £20-25m towards the cost of the government's rearmament programme. The initial proposal was extremely complicated, but intended to be levied on profits arising from the armament programme itself. The tax was welcomed from unexpected quarters. Sir Stafford Cripps, an austere Socialist who was Britain's wartime ambassador in Moscow and Chancellor of the Exchequer from 1947-50 commented (Cripps 1937): "This little start that he has made here can be the beginning of a form of taxation which will enable us to terminate the capitalist system much earlier than we should otherwise be able to do."

But the proposed tax led to substantial criticism from many Members, most notably from Mr. Churchill (Churchill, 1937) who argued that it was reasonable for Parliament to tax income but wrong for it to tax different types of income differently. Mr Chamberlain became Prime Minister while the budget was passing through Parliament. His successor, Sir John Simon, replaced Chamberlain's proposal with a tax of 5 per cent on all profits above £12,000 with lower rates on smaller amounts of profit. This was levied on profits net of interest payments but gross of dividends. Thus, until 1937, high taxes on profits arose only to the extent that those profits accrued to individuals facing high rates of surtax. The 1937 tax was the first step towards very high general taxation of income from profit from

1939 onwards. The last budget before the Second World War (27 April 1939) saw the introduction of an Armaments Profit Duty as a second attempt to recoup excess profits resulting from arms spending. An Excess Profits Tax was also introduced to put the government in a position to recoup any abnormal profits, assumed to arise from war. 60 per cent of profits above those earned in 1937, and reported in 1938 were to be paid in tax. The first wartime budget, on 27th September 1939 saw the rate of income tax raised to 37.5 per cent and the top rate of tax, taking income tax and surtax together, set at 85 per cent. Far from this being a Keynesian policy as suggested by Cooley and Ohanian, Sabine (1970) records: "The Chancellor could have turned to Keynes but it was quite clear the country was not receptive enough to his proposals".

Sabine was referring to the post-war credits, introduced later, but his comment supports the notion that there was nothing particularly Keynesian about trying to finance the war from taxation as far as was possible. The first Keynesian Budget came in 1941. The Chancellor, Sir Kingsley Wood, spoke not just about the need to pay for government spending but about the overall state of demand relative to supply in the economy as a whole. The budget saw the income tax rate raised to 50 per cent with a maximum overall rate, including surtax, of 97.5 per cent.

Looking at the debate about the taxation of profits and taxation in general in this period, it is plain that the notion of levying taxation, rather than relying on inflationary finance, in order to pay for government spending was widely supported throughout the House. There was some concern that the Excess Profits Tax whose rate was raised to 100 per cent on 22nd May 1940 would lead to inefficiency. Firms had no incentive to control their costs if the whole of any saving accrued to the Government. But it is easy to understand why there was little debate when it was imposed. It came in as part of an Act which passed hurriedly through Parliament on the day that German troops reached Boulogne and as the full scale of the catastrophe in France became apparent. The Act included the power to require "persons to place themselves, their services and their property at the disposal of His Majesty. for securing the defence of the Realm. or the efficient prosecution of any war in which His Majesty may be engaged".

The war situation handicapped discussion of economic issues. In the brief debate on the Excess Profits Tax it was suggested moral suasion would be enough to prevent waste.

A contemporary view of taxation of profit is offered by Hicks, Hicks and Rostas (1941)[p. 43]. They argue: "All taxes on profits have some adverse effect on the efficiency of production... But since taxes have to be raised… this general restrictive effect of taxation is usually (and properly) regarded as a minor consideration. The restrictive effect of excess profits tax is, however more considerable. Excess profits taxes, where the rate of tax is from 20 to 50 per cent are innocuous as compared with taxes where the rate is 60 to 80 per cent. A 100 per cent tax is... beyond all question, very dangerous indeed".

They also noted, that, as compared with the First World War "Industry has learned to bear more and Labour to ask it".

Later on in the text their view on distortionary taxation seemed to have changed somewhat. We read: "The effect of high income taxation of the willingness of the businessman to bear additional risks... is a much more serious matter than its effect upon the supply of labour" (p. 192).

But the authors were concerned about the effect of taxation on the "equity premium" that may be required over and above the interest costs of financing marginal capital and not about the effects of any wedge between the rate of interest and the rate of time preference. It is plain that, from 1941 onwards profits were taxed very heavily. This was, in the main, a consequence of the very high level of general taxation which was regarded as a better means of paying for the war either than inflationary finance or a greater reliance on borrowing. Such a view was the conventional fiscal orthodoxy rather than, as Cooley & Ohanian (1997) suggest, a Keynesian innovation. Nevertheless an element of fiscal drag operated which much increased the average tax burden on profits.

Normal profits, and therefore excess profits were defined in nominal terms. Prices rose by 56 per cent between 1939 and 1945, while the various tax bands were not adjusted and the Excess Profits Tax continued to be calculated with reference to nominal pre-war profits. Thus a powerful fiscal drag raised the rate of widening the scope of the Excess Profits Tax and, at the same time brought more people into the various tax nets. This raised both the average and the marginal rates of tax on all types of income.

Taxes paid by companies had risen from £88mn in 1938, and £325mn in 1941 to £634mn in 1946 while gross trading profits rose from £673mn in 1938 to £1,202mn in 1941 and £1,484mn in 1946. Taxes paid by the personal sector rose from £295mn in 1938 to £1,053mn in 1946, while personal sector income rose from £4,601mn to £7,443mn. Thus the effect of the fiscal drag was to increase the tax burden on the corporate sector disproportionately, particularly after 1941. There is no reason to believe that the Conservative inventor of the Excess Profits Tax realized what effect it would have. During the period before the Second World War prices had fallen from 1922 to 1933 and people did not think in terms of inflation. Thus nowhere in the debate on the Excess Profit Tax is it suggested that the base for the tax should be calculated after adjusting peacetime profit levels for changes to the value of money. There is a very marked contrast with 1977 when an amendment to the Finance Bill required the Government to index tax allowances to the Retail Price Index.

The first proposals for the shape of the post-war environment, due to Beveridge (1942), formed the core of both parties' proposals in the 1945 General Election, suggesting that, whatever the outcome of the Election, public spending would have been much higher after the War than it had been in the Thirties. A separate, and less foreseen factor behind public spending was the need to maintain a high level of peacetime defence spending; this reached 9 per cent of GDP during the

Korean War. That the root of continued high taxation lay in the new spending programme rather than the consequences of war finance may be seen from the fact that between 1936 and 1948 debt interest slightly more than doubled (from £223m to £507m) while consumption of goods and services rose from £252m to £1,265m with a smaller increase in transfers to persons. With a higher level of spending it was natural to develop a tax structure which took as its starting point the framework left over from the war. The problems of the Excess Profits Tax were, however addressed at an early stage. In September 1945 Dr Dalton, the Chancellor of the Exchequer in the Labour government, reduced the rate to 60 per cent. At the end of 1946 the Excess Profits Tax was abolished, and the National Defence Contribution was renamed the profits tax. In this regime, which lasted until 1952, companies paid tax on their profits at a rate which was fixed initially at 25 per cent on distributed profits and 10 per cent on undistributed profits. Income tax was payable at the standard rate (45 per cent rising to 47.5 per cent in 1951) on the residue after the profits tax had been paid. Recipients of distributed profits were allowed to offset the income tax, but not the profits tax against their own tax liability. The maximum rate tax rate on individual incomes remained at 97.5 per cent until 1952. In 1949 the rate of profit tax on undistributed profits was raised to 30 per cent with a further increase to 50 per cent in 1951. The rate on undistributed profits remained at 10 per cent throughout this period. True to form, the Conservative government, which came to power in 1951, imposed a new Excess Profits Levy in 1952. This amounted to a levy of 30 per cent on an average of profits calculated for 1947-49, but limited to a total of 15 per cent of taxable profits. It was not allowed as an expense when assessing either income tax or the standard profits tax. However, the tax was abolished at the end of 1953. In 1952 the tax structure was reformed. The tax rate was reduced to 22.5 per cent on undistributed profits and 2.5 per cent on distributed profits, but income tax was calculated on the amount gross rather than net of profit tax. Thus the total corporate tax bill on £1 of distributed profits fell from 72.5p to 67.5p, but the income tax component, which could be offset against personal tax, rose from 22.5p to 45p. The tax rate on undistributed profits fell from 50.5 per cent to 47.5 per cent.

The rate of profit tax levied on distributed profits was raised to 27.5 per cent in 1955 and 30 per cent in 1956, with the rate on undistributed profits rising from 2.5 per cent to 3 per cent in 1956. From 1958 a uniform rate of profits tax of 10 per cent was imposed. This was raised to 12.5 per cent in 1960 and 15 per cent in 1961. However, during this period, the standard rate of income tax was gradually reduced to 38.75 per cent, so that in 1961 the total tax charge on corporate profits, whether distributed or not, was 53.75 per cent; the income tax component could be set off against personal taxation. The maximum rate of surtax remained at 50 per cent on incomes above £15,000, so that a top rate tax payer who received a dividend would pay a total tax of just over 90 per cent on it (15 per cent profits tax and then 88.75 per cent income and surtax on the residue).

In 1965 the combined profits and income tax regime was replaced by one of corporation tax, levied on profits at 40 per cent (rising to 42.5 per cent in 1957 and 45 per cent in 1968) whether they were distributed or not. Dividends were treated as paid net of income tax but, until 1973, there was no tax credit, so that recipients of

dividends who did not pay income tax (most notably pension funds) were unable to recoup any of the corporation tax paid on their behalf. In 1973 a tax credit, equivalent to income tax at the standard rate was imputed. The high rates of tax on personal incomes remained in force until 1979 although the tax structure changed considerably. In 1967 a one-off "special charge" was imposed on investment incomes. The charge was 45 per cent on incomes of £8,000 or more, paid in addition to the income tax of 41.25 per cent and surtax of 50 per cent. It was, in effect, a tax on wealth. The Conservative government, which came to power in 1970, consolidated income tax and surtax, with a maximum combined rate of 75 per cent. Labour, returning in 1974, raised this to 83 per cent with an investment income surcharge of 15 per cent. But when the Conservatives regained office, in 1979, they set a maximum tax rate to 60 per cent which was reduced to 40 per cent in 1989. The view that high tax rates were a damaging way of raising revenue became a cross-party consensus. The Labour Government of 1997 did not revive of high tax rates. The Corporation Tax structure was, however, changed once again, with a lower tax rate (of 30 per cent). At the same time imputed tax credits were reduced to 10 per cent on payments to individuals and abolished on payments to pension funds, although dividends paid out of post-tax corporate income were again regarded as having had tax paid on them at the standard rate. This change did not affect most individual tax payers, but it did mean that pension funds and others which were exempt from income tax were unable to reclaim any tax credits.

Table 1

Tax Rates on Income from Labour and Capital in the United Kingdom, 1946

	Tax Rate on Labour Income	Tax Rate on Income from Capital
1946	11.7%	45.2%
1950	12.2%	37.3%
1960	13.9%	23.2%
1970	22.7%	29.3%
1980	25.6%	17.3%
1990	29.6%	18.8%
1995	28%	15.2%

The figures are calculated from data in successive editions of National Income and Expenditure. They are approximate only because a number of assumptions had to be made in their calculation. All trading incomes are treated as income from capital as is the tax levied on them although national insurance contributions paid by the self-employed are treated as a tax paid by labour. The Council Tax and its predecessor, the Community Charge (the Poll Tax), which are regarded as direct taxes, replaced domestic rates, which were an indirect tax in the Eighties. These taxes have been excluded from the total revenue of direct taxes when calculating the figures for 1990 and 1995. Taxes on expenditure are excluded completely from the calculations.

Thus the overall picture is one in which very high rates of tax on income from capital, both on average and at the margin, were established in the Second World War, but building on a framework in which there were already high marginal tax rates levied on individuals with high incomes. Table 1 provides a guide as to how rates of tax on income from labour and capital have changed since the Second World War. We now describe the model we need to look at the factors which might influence people's choices between labour income and capital income taxation in a situation where a given amount of revenue needs to be raised.

3. The General Equilibrium Model

The model used to understand the factors influencing the setting of tax rates on income from capital is a generalization of the overlapping generations economy described by Diamond (1965). Its structure is similar to the model that Huggett (1996) used to show that a lifecycle economy can replicate most of the salient features of the US economy and in particular its wealth distribution. Our model is described in detail in Sefton, Dutta & Weale (1998) and the numerical solution algorithm in Sefton (2000). It incorporates all the principal factors that can affect individuals' saving behaviour; uninsurable income risk, wealth constraints, retirement, state pensions, bequest motives and an annuity market.

3.1 The population

The economy consists of 5000 households. We treat the household as the basic economic unit, and describe its life span and composition. Each household begins life at τ=0 and consists of a man and a woman who are both 20 years old. The household dies when the second of the spouses dies and it is immediately succeeded by a successor household consisting of two twenty-year olds.[1] The life of each adult is uncertain, but we assume that the maximum age of each spouse is 90 (τ=70). We denote the conditional probability of the household dying at the end of period τ given that it has survived to the beginning of that period as $\psi\tau$ implying of course that ψ_{70}=1.[2] It follows that the probability that a household will survive another *i* years from period τ, $\varphi_{\tau,i}$, is simply the cumulative product of the conditional probabilities $\varphi_{\tau,i} = \prod^{\tau+i-1}_{j=\tau} (1 - \psi_j)$.

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[1] This convenient mechanism thus assumes that the successor household is comprised from two children who are both twenty at the time of the household's death, whether this be when the second spouse is 25 or 90.

[2] These probabilities were estimated from the UK life tables; we consider both the mortality rates found in the life tables from 1952-54 and for 1991-93. As both the male and female adults are aged 20 when the household starts, we estimated the conditional probability ψ_r as the probability that both adults had died after τ years, but at least one of them has been living at $\tau - 1$ years.

Table 2

The Values of the Demographic Constants Used in the Model

Household age at end of period	Year	5	10	15	20	25	30	35
Age of Adults		25	30	35	40	45	50	55
P(dying) at period end	1991	0	0	0	0	0	0.001	0.002
Average Age of Adults	1991	2	1.994	1.988	1.98	1.963	1.953	1.927
Average Number of Children	1991	0.137	0.579	1.161	1.589	1.471	0.977	0.429
McClements Family Size	1991	1.003	1.051	1.155	1.284	1.359	1.3	1.152
Household age at end of period		40	45	50	55	60	65	70
Age of Adults		60	65	70	75	80	85	90
P(dying) at period end	1991	0.006	0.016	0.04	0.087	0.173	0.313	1
Average Age of Adults	1991	1.884	1.817	1.715	1.581	1.427	1.273	1.142
Average Number of Children	1991	0.107	0.011	0	0	0	0	0
McClements Family Size	1991	1.017	0.939	0.89	0.837	0.777	0.716	0.665

The Before Housing Costs McClements equivalent scale is used by the UK Department of Social Security in all their Household income statistics. The scale is normalised so that a two adult household has a value of one. To calculate the score add the following scores: 0.61 for the first adult, 0.39 for the second, and for each dependent aged 0-1 add 0.09, aged 2-4 add 0.18, aged 5-7 add 0.21, aged 8-10 add 0.23, aged 11-12 add 0.25, aged 13-15 add 0.27 and for each dependent over 16 add 0.36.

During its existence the size of the household varies for two reasons. First because children are born and secondly because one of the spouses may die. We use figures for the number of children belonging to mothers of different ages to calculate the number of children in each household as a function of the age of the latter. In order to do this, we assumed that no child ever dies and every child leaves home at 19. Secondly, from the life tables we can calculate the average number of adults as a property of the age of each household. We then convert the number of adults and children in each household to an adult equivalent using the standard McClements scale to take account of economies of scale in household management; this scale is summarised in Table 2. We denote the McClements equivalent size of the household at age τ as m_τ. This effective household size influences the utility that the household derives from any particular level of consumption. But we also need to keep track of

the number of adults in each household in order to assess voters' preferences. This depends on the mortality rates of the men and women who can make up the adult component of the household. But in the cases we examine there are just under 9000 adults in the population.

To ensure that the population of households stays constant, we assume that on a death of a household a descendent household is born immediately. This descendent household inherits not only the remaining physical assets of its parent household but also a proportion of its human capital characteristics.

3.2 The income process

Households earn until age 65 (τ=45) and then retire. During their working lives, their labour endowment, or earning power, $h_{i\tau}$ varies randomly. To maintain the distinction between calendral time, t and the age of a typical household, τ, we write $\tau\ (i, t)$ to represent the age of household *i* at time t. Earnings are $y_{it}=s_t h_{i\tau}$, where s_t is the market wage rate. Earnings are taxed at a rate t_{lt} . In addition households save and earn interest on their savings. This interest income is taxed as well, at rate t_{kt} so that the rate of interest net of tax is $r_t(1 - t_{kt})$. At retirement households may annuitize an amount z_i. Annuity income or private pensions are taxed in the same way as interest; tax is levied on the interest component of the annuity but not on the repayment of principal. Retired households also receive uniform state pensions free of taxes.

3.2.1 Persistence across generations

The initial level of earning power of the descendent household, *j*, h_{j0} is related to the earning power of its parent household, i, when it started work, h_{i0}. We use the simple mean reversion model:

$$\log h_{j0} = \lambda \log h_{i0} + (1 - \lambda^2)\varepsilon^* - (1 - \lambda)\,\sigma^{*2}/2 \qquad (1)$$

where ε^* is independently distributed as $\varepsilon^*_\tau \sim N(0,\ \sigma^*\ )$ and the parameter λ represents the degree of persistence across generations. The process has been normalised so the steady-state of the distribution of log of earning power is $N(-\sigma^{*2}/2,\ \sigma^*)$, which also implies the distribution of earning power has a mean of 1. These parameters are detailed in the Table 3.

3.2.2 Labour income during working life

The evolution of earning power of a household working life is the first order autoregressive process studied in Atkinson, Bourguignon & Morrisson (1992):

$$\log h\tau+1 - \log h^*\tau+1 = \rho(\log h\tau - \log h^*\tau) + \varepsilon i\tau$$

where $\varepsilon_{i\tau}$ is an uncorrelated innovation processes drawn from the distribution $\varepsilon_{i\tau} \sim N(\mu_\tau, \sigma)$ and h^*_τ is the mean level of earning power for a household of age τ. The mean μ_τ is calculated so that the distribution of earning power has mean $\exp(h^*_\tau)$, hence given $\mu_{-1} = -\sigma^{*2}/2$, then:

$$\mu_\tau = \rho^2 \mu_{\tau-1} - \sigma^2/2$$

This is the model of income dynamics studied in detail in Atkinson *et al.* (1992) and used by Huggett (1996) in his equilibrium model of the US economy but differs from that adopted by Imrohoroglu (1998) who assumes that people are either employed or unemployed, and when employed they earn the mean wage for their age. As Atkinson *et al.* state, our autoregressive process has a number of desirable properties. First, if earning power is lognormally distributed for the youngest cohort, it remains so for every cohort thereafter. This is useful the log normal distribution has for a long time be used as a reasonable fit of the earnings distribution. Secondly it can be easily calibrated to fit the observed earnings distribution.

3.2.3 Pensions and retirement

Households cease to work at τ=45. At retirement they can choose to annuitize all or part of their wealth, z_i at actuarially fair rates; the annuity income represents their private pension. The state pays a fixed and tax-exempt pensions p_{st} to each retired household. In retirement a household's income consists of private and public pensions and the return on the remainder of their wealth.

At the beginning of its retirement each household annuitises all its wealth, w_{i45}, at the actuarially efficient rate, χ, giving a private pension p_{pi}, where:

$$ppi = w_{i45} / \chi i(t_k) \tag{2}$$

and

$$\chi i(tk) = \sum_{n=45}^{70} \frac{\phi_{45,n-45}}{\prod_{j=45}^{n} \left(1 + (1 - t_k) r_{tBirth,i+j}\right)} \tag{3}$$

with $tBirth,i$ being the year in which household i is born. We have defined the annuity rate as a function of the capital tax rate so as to succinctly express the tax take from annuity payments later. Thereafter its income consists of this annuity or private pension, p_{pi} , the state pension, p_{st} , as well as the post-tax return to its remaining wealth.

3.2.4 Calibration

We used data from the British Household Panel Survey data on household gross labour income to calibrate the coefficients of our income process. These

Table 3

Parameter Values for the Income Process
(all at annual rates)

Parameter	ρ	σ^2	λ	σ^{*2}				
Value	0.993	0.013	0.6	0.203				
Household age at end of period	5	10	15	20	25	30	35	40
Age of Adults	25	30	35	40	45	50	55	60
Mean earning power	1	1.225	1.386	1.482	1.515	1.486	1.394	1.241
Var(h_τ)	0.203	0.251	0.296	0.338	0.378	0.414	0.448	0.48
Gini (exp(h_τ))	0.25	0.277	0.299	0.319	0.335	0.349	0.361	0.371

coefficients are detailed in Table 3. The mean estimates of earning power are also given in Table 3, where they have been normalised so that the mean household's earning power in the first period of working life is 1. In the table we have also included the variance of the distribution of each cohort's log of earning power and the Gini of the distribution of earning power.

3.3 Preferences and consumption

Households derive utility from current consumption. Wealth which has not been consumed is left as a legacy to the next generation, but legacies are accidental, arising from premature death rather than any bequest motive. This assumption is in keeping with recent empirical work (Altoniji, Hayashi and Kotlikoff, 1992, Laitner and Juster, 1996, and Wilhelm, 1997) which finds little evidence for any altruism in the bequest behaviour.

Let c_τ and m_τ be consumption and household size at age τ and $U_\tau(c_\tau/m_\tau)$ be the current utility derived from instantaneous consumption. The utility of a household is then derived recursively as:

$$V_\tau = (1-\beta)U_\tau(c_\tau/m_\tau) + \beta\psi_\tau E_t\{V_{\tau+1}\}$$

As before ψ_τ is the probability of surviving to the next period and E_t denotes the expectations operator conditional on survival. We assume that instantaneous utilities are of the constant elasticity of substitution form:

$$U(x) = x^{1-\gamma}/(1-\gamma);\ \gamma > 0$$

We note that the recursive utility function implies "double discounting". First of all, household's discount by a factor β because future consumption is valued less highly than current consumption. Secondly the fact that $\psi\tau$, the survival probability is less than one, means that households adjust the benefits of future consumption for the fact that they may not live to enjoy it.

A household's consumption is limited by the constraint that on its death it must not be in debt. As there is a finite probability of dying in any period, this constraint actually implies that at all times a household's wealth must always be positive or zero. Before retirement in year τ_{Ret}=45 (when the adults are aged 65) a household can either consume or save its post tax income,

$$wi\tau >= 0 \tag{4}$$

and

$$wi\tau+1 = (1+(1-t_k)rt)wi\tau + yi\tau - ci\tau \text{ for all } \tau + 1 < 45 = \tau Ret. \tag{5}$$

where t_k is the constant capital income tax rate and t_{lt} is the varying labour income tax rate. $y_{i\tau}$ is, of course, defined post-tax and $w_{i\tau}$ is the wealth holdings at the beginning of the period.

At retirement, the household annuitize all its wealth so that the budget constraint can be expressed as:

$$wi\tau >= 0 \tag{6}$$

and

$$wi\tau = 0 \text{ for } \tau = \tau Ret \tag{7}$$

and

$$wi\tau+1 = (1+(1-t_k)rt)wi\tau + ppi + pst - ci\tau \text{ for all } \tau >= \tau \text{ Ret} \tag{8}$$

Borrowing constraints imply $w_{it} >= 0$ at each t.

Households foresee wages, interest rates and tax rates and they understand the uncertainty they face about their earnings. They maximise expected utility subject to budget and borrowing constraints, choosing consumption levels $c_{i\tau}$. The parameter values for the demand side are summarised in Table 4.

Table 4

Parameter Values for Preferences
(annual rates for γ *and* β*)*

Parameter	β	γ
Value	0.95	2

3.4 The government

The government must fund a fixed exogenous level of public consumption, C_P , the state pensions and the cost of any minimum income guarantee from its tax revenues. The level of the state pension is fixed to be constant proportion, P, of the mean income level, $p_{st}=Ps_th^*_t$. where h^*_t is the average of earning power over the whole population. The level of capital income taxation is held constant at its pre-determined level but the level of wage income taxation is varied to ensure that budget is balanced. To express this constraint formally we shall index the households born in the same year by i and the cohorts by k, thus for example $c_{i,k,\tau}$ represents the consumption of the i_{th} household of the cohort born in year k, τ years later. Thus the government constraint in year t is:

$$\sum_{i\in X(t)} tltsthi\tau + \sum_{i\in X(t)} t_krtwi\tau + \sum_{i\in X(t)} ppi\ (\chi i(0) - \chi i(t_k)//)\chi i(t_k) = \sum_{i\in X(t)} pst + CP$$

where $X(t)$ is the set of households alive at time t. The age of each household, $\tau\ (i,\ t)$ is a function of its index number and also of the time period in question.

3.5 Production technology

The supply side of the economy is represented by a Cobb Douglas production function. Let gross output be denoted Y_t, the total physical capital be denoted K_t, and total earning power be denoted , $h^*_tL_t$, where h^*_t is, as before, the mean level of earning power of the total working population and L_t is the working population, then:

$$Yt = AK_t^{\alpha}(h^*_t\ L_t)^{1-\alpha}$$

Capital depreciates at an annual rate δ. The capital stock follows the following equation:

$$Kt+1 = (1-\delta)Kt + It$$

where I_t is aggregate investment. Firms maximise profits. As a consequence wages, s_t and interest rates, r_t satisfy:

$$rt = \alpha Yt/Kt - \delta$$

$$st = (1-\alpha)Yt/h^*tLt$$

Goods markets clear in every period so that:

$$Yt = It + \sum_{i\in X(t)} ci,\tau + CP$$

The labour endowment and population size are exogenous. Given a sequence of taxes, state pensions and government purchases, $\{(\ t_{kt}\ ,\ tl_t\ ),\ p_{st},C_P\ \}$, goods market

clearing determines output, the capital stock, wages and interest rates and the distribution of consumption at each t:

$$\{Yt, Kt, st, rt, (cit)i \in X(t)\}$$

The production function is calibrated from the UK national accounts so that the share of output allocated to capital, α, is 36 per cent. The depreciation rate of capital, δ, is set at 6 per cent, which is about average for the complete economy. The technology level A is normalized so that with a mean level of human capital in the economy of 1.0 and a capital/output ratio of 3.0 the aggregate wage is 10.0. These values are summarised in Table 5.

Table 5

Parameter Values for Technology

Parameter	A	δ	α
Value	1.01	0.06	0.36

The model is solved by finding the prices, the interest rate, r_t and the wage rate, s_t, where:

$$rt = \alpha Yt/Kt - \delta$$

$$st = (1-\alpha)Yth*tLt$$

such that the demand and supply sides are in equilibrium.

4. The effects of capital taxation on the economy

Having set out our model we use it to assess the effects of the taxation of income from capital. Representation of heterogeneous households allows us to establish who is helped by particular tax structures and thus to explore whether the taxation of income from capital is likely to command majority support. The first assessment we do is comparative static. We choose values of the state pension, p_s and the rate of tax on income from capital t_k. These affect the aggregate variables, *Y, K, w, r* and t_l and also the distributions of consumption, c_i and expected utility, $E(V_i\tau)$. The model has no aggregate uncertainty; individual incomes are uncertain but the large number of consumers means that mean household income is certain. This in turn implies that, for each value of our policy and behavioural parameters there is a deterministic aggregate steady state which can be found by simulating the model from an initial position.

In Table 6 we present the equilibrium results from our model. Since the model represents overlapping generations rather than infinitely-lived consumers and the economy is stationary, dynamic efficiency requires simply that the interest rate should be positive (Diamond, 1965). This is met without any difficulty. Indeed the tighter condition that the interest rate applicable to a situation with infinitely-lived households, that the interest rate should exceed the discount rate of 5 per cent p.a. is also met. The introduction of a tax on income from capital has the effect of depressing the post-tax rate of return and raising the pre-tax return. However, it can be observed that, in contrast to the situation generated by infinitely-lived consumers, more than half of the tax on income from capital falls on the income from capital, and the reduction in the rate of tax on income from labour allows post-tax earnings to rise even though NDP has fallen. The reason for this may be conjectured as follows. People save up for their retirement. The intertemporal elasticity of substitution, at 1/3, is plausible but low. An increase in the cost of retirement consumption has relatively little impact on savings and the total wealth/income ratio falls only slightly in response to the tax, leading to a relatively modest rise in the pre-tax interest rate.

These results are similar to those presented by Imrohoroglu (1998) who uses a model of similar structure to address some issues associated with taxation of income from capital, but does not address the question of voters' preferences which is central to our study. He finds that an increase in the tax on income from capital from 0 per cent to 40 per cent of income leads to the pre-tax return to capital rising from 5.2 per cent to 6.6 per cent p.a.; our figures show a rise from 7.6 per cent to 8.9 per cent p.a. We show total consumption (taking public and private consumption together, falling by 8.5 per cent while her results show a fall of 5.2 per cent). Our results are not intended to replicate his and the stronger effects may be in part due to the higher base-line interest rate. But the similarities are strong enough to give confidence in both sets of results.

We now look at the distributional changes that result from a change in capital taxation. In Table 7 we show the effect on the level of consumption at different age groups. A tax on income from capital raises the consumption levels and incomes of the young and reduces those of the elderly.

Table 8 looks at the overall effect on welfare in the steady state. We can see that old people gain when taxes on income from capital are reduced, while young people lose out. This is despite the fact that the young people are eventually going to become old people who benefit from low or no taxes on income from capital. Amongst the elderly, it is not surprising that the benefit is higher for people in higher utility quintiles.

5. Conclusions

A simulation model of a panel of households with finite lives suggests that, in such circumstances, it is not true that taxes on income from capital are fully

Table 6

The Aggregate Effects of Taxation of Income from Capital

t_k	*tl*	*r*	$r(1-t_k)$	*s*	$S(1-tl)$	$(W+Z)/Y$	W/Y	Z/Y
0%	45.00%	7.557	7.557	1.084	0.596	2.555	1.51	1.046
5%	43.40%	7.622	7.29	1.08	0.612	2.533	1.497	1.036
10%	41.80%	7.72	7.043	1.075	0.626	2.51	1.482	1.028
15%	40.20%	7.845	6.807	1.068	0.639	2.482	1.466	1.017
20%	38.50%	7.977	6.564	1.06	0.651	2.452	1.447	1.006
25%	36.90%	8.126	6.319	1.052	0.663	2.421	1.424	0.996
30%	35.30%	8.292	6.068	1.043	0.675	2.383	1.399	0.984
35%	33.70%	8.485	5.817	1.033	0.685	2.341	1.37	0.971
40%	32.10%	8.701	5.558	1.022	0.694	2.293	1.337	0.957
45%	30.50%	8.943	5.291	1.009	0.702	2.243	1.302	0.941
50%	28.80%	9.231	5.02	0.995	0.708	2.192	1.266	0.926
55%	27.20%	9.556	4.734	0.98	0.713	2.13	1.223	0.907
60%	25.60%	9.94	4.437	0.962	0.716	2.062	1.175	0.887

t_k	G.D.P.	N.D.P.	$(1-tl)sL$	(1–r)(W+Z)	Ps	CP	C
0%	76.729	66.295	26.988	17.222	6.479	15.6	50.675
5%	76.395	66.096	27.705	16.321	6.457	15.6	50.456
10%	76.001	65.849	28.345	15.467	6.424	15.6	50.209
15%	75.52	65.544	28.934	14.621	6.382	15.6	49.92
20%	74.998	65.211	29.504	13.763	6.338	15.6	49.574
25%	74.446	64.856	30.046	12.914	6.289	15.6	49.232
30%	73.813	64.454	30.563	12.046	6.235	15.6	48.816
35%	73.106	63.998	31.031	11.18	6.175	15.6	48.357
40%	72.282	63.46	31.438	10.299	6.108	15.6	47.806
45%	71.374	62.856	31.789	9.418	6.034	15.6	47.198
50%	70.362	62.155	32.051	8.56	5.95	15.6	46.532
55%	69.333	61.474	32.32	7.685	5.857	15.6	45.821
60%	68.082	60.612	32.443	6.806	5.751	15.6	44.958

Key:

t_k tax rate on income from capital *tl* tax rate on labour income
r rate of return on capital (per cent p.a.) *s* wage rate
W aggregate wealth not annuitized *Z* aggregate annuitized wealth
L labour force
C household consumption *p*s state pension
CP public consumption

Table 7

Mean Consumption Levels

Age / t_k	20	30	40	50	60	70	Total
0%	0.5498	0.7216	1.0888	1.0807	1.147	1.1711	1.0082
5%	0.5671	0.7366	1.1019	1.0829	1.1322	1.1443	1.0038
10%	0.5834	0.7504	1.1123	1.0822	1.119	1.1184	0.9985
15%	0.5991	0.7633	1.1217	1.0803	1.1053	1.0923	0.9924
20%	0.6145	0.7754	1.1294	1.0764	1.0854	1.0649	0.9859
25%	0.6298	0.7875	1.136	1.0722	1.0652	1.0387	0.9776
30%	0.6466	0.799	1.1415	1.0664	1.0505	1.0067	0.9694
35%	0.6615	0.8109	1.1451	1.0598	1.0278	0.9768	0.9594
40%	0.675	0.8196	1.1453	1.0491	1.006	0.9458	0.9477
45%	0.6874	0.8281	1.1446	1.0375	0.983	0.914	0.9352
50%	0.6987	0.8367	1.1444	1.0269	0.961	0.8828	0.9232
55%	0.7087	0.8437	1.1394	1.0113	0.9338	0.847	0.9074
60%	0.7174	0.8488	1.1324	0.9936	0.9048	0.8106	0.8901

displaced to labour. We find that the post-tax rate of return falls by 80-90 per cent of the effect of the tax when a tax on income from capital is imposed. Pre-tax returns are nevertheless increased and the tax has the expected effect of reducing aggregate wealth and thus the capital stock, with a consequent reduction in gross and net domestic product.

A high tax on income from capital, and therefore low tax on income from labour has the effect of raising the consumption of the young at the expense of the consumption of the old. There are two reasons for this. First of all, because young people are mostly wealth-constrained, there is an income effect. The young are able to spend more because their taxes are reduced. There is less incentive to plan for consumption to rise over the lifetime because the post-tax interest rate is depressed.

If we look at the welfare effects of tax on income from capital relative to a situation where it is not taxed, we observe a surprising result. Young people are

Table 8

The Percentage Change in Steady-State Lifetime Utility for Each Utility Quintile in Each Age Group on a Move from 20% to 0% Capital Tax Regime

Quintile	1	2	3	4	5
85-89	7.37	5.75	10.22	9.43	14.98
80-84	5.07	6.7	9.37	10.8	18.07
75-79	4.36	7.69	9.33	11.54	17.22
70-74	3.56	6.84	8.31	11.76	16.82
65-69	2.91	8.62	6.96	11.73	17.24
60-64	5.94	5.82	6.99	8.76	13.36
55-59	2.88	3.58	4.72	7.5	9.71
50-54	2.1	3.24	4.08	5.31	7.33
45-49	1.66	1.62	2.68	2.81	5.47
40-44	0.92	1.04	1.01	1.16	1.77
35-39	–0.02	–0.56	–0.29	–0.54	–0.19
30-34	–0.84	–1.78	–2.24	–2.78	–2.76
25-29	–2.11	–3.31	–4.05	–4.96	–6.91
20-24	–3.47	–4.49	–5.58	–7.06	–8.64

For each age group we grouped the households into quintiles in accordance with the ranking of their utility in a 0% capital income tax regime. For each age group and quintile we then calculated the mean percentage change in their utility between this 0% capital regime and a 20% capital tax regime, the calculations being done after the former had reached a steady state.

better off in a situation in which income from capital is taxed than where such a tax is absent despite the distortionary properties of such a tax. This comparison is based on the present discounted value of lifetime utility and therefore takes account of the fact that savings decisions are distorted by the tax. It arises, however, because young people are wealth constrained. They would like to be in debt but they cannot borrow.

A tax on income from capital allows them to put off part of their tax bills until they can afford to pay and thus eases the constraint they face on their consumption when they are young.

The tax system is, in effect, going some way to replacing a missing credit market; it reduces the difference between the amount of credit actually available to the young and the amount that they would like to borrow. In that sense the argument set out for tax on income from capital is plainly a second-best argument: the tax is mitigating a distortion arising from elsewhere. Nevertheless, the absence of good credit markets in which young people can easily borrow against future earnings is easily understood in terms of adverse selection and moral hazard. Thus there seems little point in arguing, as do Atkeson, Chari and Kehoe that the appropriate solution is to deal with the market failure. In reality, it may not be possible to deal with such market failures; second-best solutions to dealing with their consequences should not be despised.

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