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THE TAXATION OF REAL RETURNS FROM SHORT TERM DEPOSITS

Abstract: This papers considers the effects of taxing nominal rather than real returns from short term deposits. A system for taxing real returns is developed, using financial mathematics techniques familier to actuaries: the possible results from a change in the method of taxation, to the one proposed in the paper are discussed.

INTRODUCTION:

This paper is written very much with the United Kingdom in mind as far as the analysis of the economic situation and position with regard to the taxation of short term deposits is concerned. The propositions discussed are equally applicable to any country in which nominal rather than real returns from short term deposits are taxed, however.

One of the features of some major Western economies in recent years has been the low level of saving, relative to borrowing. A consequence of this, in such economies, is that, particularly during times of economic expansion, a balance of payments deficit tends to arise, which is matched by a corresponding inflow of capital, often short term capital, which is necessary to finance the borrowing plans of domestic consumers and industrial investors. In the U.K. the savings ratio rose above 5% towards the end of 1989, to its highest level since 1987 (BEQB 1990) but it remains to be seen how much of this rise can be attributed to very high short term interest rates and temporary increases in pension fund funding.

The U.K. Government maintains that the balance of payments deficit and low savings ratio are essentially short term, private sector problems which are caused by the rational decisions of private individuals and that there is, therefore, no reason to take any interventionist action to rectify the situation. Regardless of one's views on this particular point, it must be said that, given the short term uncertainties and structural difficulties that balance of payments deficits can produce, it would seem unwise to continue with a taxation system which distorts capital markets in such a way that it reduces the incentive to save.

The current system of taxing interest from bank and building society deposits, in the U.K., is such that the whole of the interest from a deposit is taxed, even if the largest proportion of that interest arises from the need to compensate investors for the fall in the real value of their deposit due to the effects of inflation. Many proposals have been made, in recent months, for the reform of the taxation system and two major changes to the system of taxing deposit interest were proposed in the 1990 Budget. It is the aspect identified above which is in the most urgent need of reform however.

PART 2: A PROPOSAL FOR REFORM:

The current system of taxing deposit interest, in the U.K., has been subject to at least two reform proposals recently. Firstly, when the number of non taxpayers increases, due to the separate taxation of men and women, it will be necessary to move to a system whereby the full rate of income tax will be charged on interest bearing deposits, whilst allowing non taxpayers to accrue interest gross. Secondly authors writing for The Institute for Fiscal Studies have proposed that deposits in savings accounts are brought into the realm of Personal Equity Plans or PEP's (IFS 1989). This second proposal has effectively been satisfied by the introduction of "Tax-Exempt Special Saving's Accounts" or TESSA's in the 1990 Budget.

A further proposal for reform, which should be considered, is a change in the taxation system so that only the real return (ie the return after allowing for inflation) from bank and building society deposits is taxed. Of the two former proposals mentioned above, the first would be unaffected by any move to change the taxation system so that only the real return on deposits were taxed, the second may become unnecessary, and even undesirable, and is discussed at greater length in Booth (1990).

Under the Composite Rate Tax system, which is still in operation, most bank and building society deposits are taxed according to the gross interest which is paid by institutions, at a rate a little lower than the basic rate of income tax. Depositors receive interest net of tax and no further tax is payable, in the case of basic rate taxpayers. Higher rate taxpayers pay an additional 15% tax on interest received, and this is paid, in arrears, on the basis of individual assessment.

Even in times of moderate inflation, most of the interest from deposits is not interest in the economic sense at all- it is merely compensation to the investor for the fall in the real value of the deposit; in technical terms, it is premature return of capital. Broadly speaking, the real returns from labour and from property and equity investments are taxed by the current taxation system: this aim is partly achieved through the indexing of capital gains, a reform of the early 1980's, over which there is now

very little dissent. A change in the taxation system should be possible, so that only the real return from bank and building society deposits is taxed, thus ending the rather arbitrary treatment of the returns from these forms of investment. There will be implications for the symmetry of the tax system, but this can be dealt with by further minor reforms.

It has been proposed in Australia that the tax system should be changed so that only the real return from savings deposits is taxed, but reform was rejected on the grounds of complexity. In the main, that complexity arose because tax was paid on the basis of individual assessment rather than deducted at source as in the U.K. Thus, most of the arguments for the rejection of the system in Australia do not apply in the U.K. Before discussing the details of any reform further, and discussing their effect on the neutrality and symmetry of the present tax system, it would be useful to discuss the extent of the problem caused by the taxation of nominal rather than real interest from deposits.

PART 3: THE DISTORTIONS CAUSED BY THE CURRENT TAXATION SYSTEM:

Broadly speaking, if i is the nominal effective rate of interest received on deposits throughout a year and r is the annual rate of inflation, the real rate of return received by an investor is equal to $(i - r) / (1+r)$; for a detailed discussion of the derivation of real rates of return, the reader is referred to M^{c}Cutcheon and Scott (1986) and Wilkie (1984). If tax is paid by the saver, at rate t, on the nominal return, then the net real rate of return is equal to

$$[(1-t)i-r]/(1+r)$$
$$=[(i-r)/(1+r)] - ti/(1+r)$$
$$= [(i-r)/(1+r)] - t[(i-r)/(1+r)] - tr/(1+r) \quad \text{---------- 1}$$

In other words, the net real rate of interest is equal to the gross real rate of interest less tax on the gross real rate of interest less a factor, which at moderate rates of inflation will be very close to the tax rate times the rate of inflation. The government is therefore collecting an arbitrary tax, the magnitude of which rises almost linearly with the rate of inflation.

This system of taxing the whole of the nominal return gives rise to several major problems. The first of these is that capital markets are distorted, with the extent of this distortion becoming greater in times of high inflation. One accepts that all taxes cause distortions, but the tax in capital markets should be limited to a tax on real returns so as to ensure equality of treatment between different factors of production. Any distortion is likely to cause a welfare loss and, in this case, it arises because there will be savers willing to save at the real rate of interest that investors are willing to offer, but most, if not

all, of that real interest will be taken in tax and thus the saving and investment will not take place, even though it would benefit both parties.

Secondly, because the net rate of interest is reduced by the taxation system, the savings ratio is likely to fall. In addition, the gross real rate of interest, which borrowers have to pay is likely to be increased, because of the reduction in savings. The extent to which the effect of the taxation system is to increase gross real interest rates and the extent to which the effect is to reduce the level of savings will depend on the elasticities of demand and supply of savers and borrowers and cross elasticities between other segments of the capital market. It is likely that there will be a mixture of the two effects with real interest rates rising and savings being reduced.

A further point related to the above is that the equilibrium gross short term rates of interest necessary to maintain a given monetary stance are likely to be increased. The fact that the extent of this increase is likely to be greater in times of higher inflation is of particular significance.

An additional element of risk is introduced for savers who use short term savings instruments. Such individuals can be unsophisticated investors and they should not be exposed to any unnecessary risk of the value of their deposits falling in real terms. Many savers who use building society and bank deposits will do so, rightly or wrongly, to deposit money for long periods and the effect of negative net real interest rates can be catastrophic and can reduce confidence in the idea of saving per se. One expects short term real interest rates to be volatile in times of variable inflation, due to lags and distortions caused by the employment of monetary policy, but the volatility induced by the tax system is unnecessary and undesirable.

Finally, the current taxation system leads the incidence of the tax burden to depend on arbitrary factors such as the rate of inflation; it is difficult to justify this on economic grounds.

PART 4: THE EXTENT OF THE PROBLEM:

The empirical analysis, discussed below, of the effect of the current taxation system is purely static, based on the actual rates of interest which have been in force over the last twenty years. The analysis refers to the U.K. As has been mentioned, the current taxation system may raise equilibrium gross rates of interest, thus mitigating some of the effects on savers which are described here, whilst causing other forms of welfare loss.

In order to examine the effect of the current system of taxation on net rates of interest in a world of

stable short term gross real interest rates (which may arise, even in times of high inflation, as long as inflation is stable), it is of interest to calculate the net rate of interest which will be provided, given a tax rate of 25% and a constant real gross rate of interest of 2.5%, at various rates of inflation. Of particular interest, is the level of inflation at which the net real return becomes zero, as a result of the current tax system.

From equation 1, at any rate of inflation, the net real rate of interest will be

$i_r(1-t) - tr/(1+r)$ where i_r is the real gross rate of interest.

The following table shows the net real rate of interest at various rates of inflation with a tax rate of 25% and a gross real interest rate of 2.5%

table 1

rate of inflation %	net real rate of interest %
0	1.88
1	1.63
2	1.38
3	1.15
5	0.68
7	0.24
10	-0.40
15	-1.39
20	-2.29
25	-3.13
30	-3.89

The intention of any fair tax system should be to tax the gross real rate of interest such that the net real rate is 1.88% (the net real rate when inflation is zero), if the real gross rate of interest is 2.5%. It can be seen from the table that the net real rate is over 5% below this level when inflation is 25% (more or less the peak level of inflation during the 1970's).

At 5% inflation (a level below which inflation has rarely been consistently during the last 20 years) the net real rate of interest is 1.2% below that which would pertain if only the real return were taxed. At

the level of inflation which pertains at the time of writing, the real net return would be below zero if real gross interest rates were 2.5% (although real interest rates are currently high in an effort to bear down on inflation). At a rate of inflation of 8.1%, the net nominal interest rate would be just sufficient to compensate the investor for the fall in the value of money.

The variation of real net interest rates described above, it should be emphasised, is merely a quirk of the tax system, and is before any effect caused by short term interest rates lagging behind inflation.

PART 5: THE EFFECT OF THE TAX SYSTEM OVER THE LAST TWENTY YEARS:

As has been mentioned, because of the existence of lags and because of the tax system itself, the equilibrium gross rate of interest will change as inflation varies. It is therefore of interest to examine the effect of the tax system on net rates of interest received by investors over the last twenty years. The following data were used to produce the figures tabulated in the Statistical Appendix:

i) Composite Rate Tax: this is the rate of CRT agreed between the building societies and the Government during the period covered. The rate quoted relates to the rate in force from April of each calendar year.

ii) Building society share rate: until 1984 these are the average rates paid on building society share accounts, as published by the Building Societies Association; after this date they are calculated from the monthly returns to the Registry of Friendly Societies. The quoted, average monthly rates have been averaged arithmetically, rather than geometrically, over the year: this approach may cause slight inaccuracies if the variance of rates is high. However, during the period covered, even in the years of highest variance, figures calculated to two decimal places are accurate.

iii) Retail Price Index: monthly data were used to calculate annual inflation figures for the purpose of calculating real interest rates.

The source of the data was Financial Statistics (1969 to 1990).

The above data were used directly to calculate the following: grossed up annual interest rates; real gross interest rates; real net interest rates; the accumulation of £1 from each year to the end of the investigation period (in real terms); the accumulation of £1 from the start of the investigation period to the end of each year (in real terms) and the real accumulation of £1 per annum invested in advance, each year throughout the twenty years. The real rates of return from each of the above investments

was also calculated.

The only significant data problem is the fact that the composite rate tax years overlap the twelve month period for which rates of interest have been calculated. This is unavoidable because the change in the method of reporting building society share rates prevents any consistent interest rate data being derived for tax years. This data problem does not affect the analysis significantly and, in the derivation of real net rates of return over the twenty year period, the effect of using overlapping periods is minimal. In order to reduce this inconsistency and so that consistent deposit interest rates can be used, the data is for years running from 1st February to 31st January, rather than calendar years.

It should be noted that the analysis applies to only one particular form of deposit rate, the short term building society share rate. The same analysis could be undertaken using other short term interest rates. In general, the lower the level of real gross interest rates offerred by the deposit taking institution, the greater is the distortion caused by the present taxation system as a greater proportion of the interest will merely be compensation for inflation.

Using the data in the Statistical Appendix, net and gross real rates of return can be calculated, easily, from the starting point to any time during the twenty year period and from any time to the last year of data. The data falls fairly neatly into two halves: the 1970's, during which net real interest rates were generally negative and the 1980's which was generally a period of positive net real rates of return. The reasons for this change in interest rate behaviour between the 1970's and 1980's are twofold: firstly, there was a change in the emphasis of monetary policy, with the primary aim in the 1980's being the reduction of inflation through the use of high short term interest rates to reduce money demand; secondly, a change in the competitive structure of the building society market led to higher interest rates being offerred to savers. Bearing this in mind, the following results, from the analysis of the data, are of particular interest:

1) If a single sum of money were invested for the whole of the twenty year period, the gross real rate of return would be -0.1% per annum, the net real rate of return is -2.3% per annum. This net real rate of return would lead to each pound deposited in 1969 depreciating to 62p by the end of 1988.

2) If a sum of money were deposited from 1969 to the end of 1978, the gross real rate of return is -3.1%, the net real rate of return is -5.2%. This level of net return would, in the ten year period, lead to each pound depreciating, in real terms, to 58p.

3) A sum of money deposited from 1979 to 1988 would earn a gross real rate of return of 3.0% per

annum, this being reduced to a net return of just 0.5% per annum, by the effects of the current tax system.

4) If an account were opened, at the beginning of the twenty years under consideration, and a constant sum of money deposited in it at the beginning of each year, the real gross return per annum from such a deposit would be 1.5%; this reduces to a net return of -0.5%. In this case, the tax system turns a positive return into a negative one.

If one considers the years individually, the following further results are obtained:

5) In four of the twenty years the tax system causes a positive real rate of return to become a negative net real rate of return.

6) In ten further years, a negative gross return is obtained from investment in short term deposits: this negative return is exacerbated by the tax system which requires the investor to pay tax, in spite of the fact that the return from his investment is negative. If negative real interest is received, from deposits, it could be argued that either no tax at all should be payable, or a tax credit should be granted: this will be discussed later in Booth (1990).

7) In the remaining six years an effective rate of tax, on the real return from deposits, of between 40% and 53% is incurred.

These results are striking: the lowest rate of tax, incurred in any year, on the real returns from deposits is nearly twice the level of composite rate tax. In fourteen of the last twenty years, the tax system has actually taxed the whole of the real interest and eroded the real capital.

The above statistics apply to basic rate taxpayers (and also any non taxpayer who chooses to use building society deposits as a savings medium), the situation for higher rate taxpayers would be even more extreme. It could be argued that the situation described may well not only have reduced levels of saving because reduced real returns were available from deposits, but also shaken the confidence of a generation of savers who discovered that they could not increase their purchasing power by saving.

PART 6 : A PROPOSAL FOR REFORM:

The aim of the alternative tax system, which will be discussed in the remainder of this paper, is to ensure that only the real return from bank and building society deposits is taxed. Two alternative

proposals will be discussed, one in detail and the other in outline. In the context of this paper, the details of a proposed alternative system are less important than the principles, particularly as the details would ultimately depend on the administrative procedures of the institutions concerned.

The following assumptions will be made:

1) tax is payable at the end of the financial year
2) the gross annual effective interest rate that banks and building societies wish to offer is known
3) the prospective annual rate of inflation is known: the difficulty caused by the inflation rate not being known with certainty is discussed in Booth (1990), and it is shown, in that paper, that the use of one year's rate of inflation in the following year's tax computation does not cause a significant difficulty in the operation of taxing real returns
4) the rate of interest used by banks and building societies for daily compounding is such that, if the rate of interest remains constant throughout the year, the net rate of interest equivalent to the gross annual effective rate which the society desires to pay will materialise on deposits.

Problems of six monthly compounding etc. offer no new difficulties in principle.

The mathematical exposition is far more elegant if continuous, rather than daily, compounding is used: daily compounding is a fairly good approximation to continuous compounding and thus this slight deviation from the true position is of little practical significance.

Definitions:

i = gross annual effective rate of interest which the institution is willing to pay

i_r = gross annual effective real rate of interest earned on deposits, given the prospective rate of inflation and the gross annual effective rate of interest (i)

r = prospective annual rate of inflation

δ = force of interest, used in continuous compounding, to obtain the desired net annual effective rate of interest

t = the rate of tax which is deducted from the real interest earned on deposits

δ_i = force of interest per annum, used in continuous compounding, equivalent to the gross annual effective rate of interest offered (i) and is equal to ln(1+i)

δ_r = force of inflation per annum (that is the continuous rate of increase of the price index, expressed as an annual rate, equivalent to the annual effective rate of inflation r) and is equal to ln(1+r)

δ_y = force of real interest, which can be found, simply by subtracting the force of inflation from the nominal force of interest δ_i

The intention of a real rate tax system is to tax the real return, so that the real interest credited to the account at the end of the year is $(1-t)i_r$, this means that the net accumulation per unit deposit, in real terms, is $[1+(1-t)i_r]$ and in cash terms would be

$$(1+r)[1 + (1 - t)\, i_r] = 1 + r + (1 - t)\, i_r\, (1 + r) = 1 + r + (1 - t)(i - r) \quad \text{——————2}$$

[using the relationship that $i_r = (i - r) / (1 + r)$].

It can be shown that, if compounding is carried out on a continuous basis, with a rate of continuous compounding = δ, the accumulation of one unit of money invested after n years is

$e^{n\delta}$, therefore we require δ, such that

$e^{\delta} = 1 + r + (1 - t)(i - r)$ after one year and thus

$$\delta = \ln[1 + r + (1 - t)(i - r)] \quad \text{——————} 3$$

For a discussion of the accumulation of capital under continuous compounding, the reader is again referred to M^{c}cutcheon and Scott (1986).

The rate of interest to be used by the bank or building society, for continuous compounding can therefore be calculated with little difficulty. Thus, as long as tax was deducted at source and paid to the Inland Revenue at the end of the tax year, by the deposit-taking institution, there would be no practical difficulties with a movement to a real rate tax system. Institutions could simply quote net, gross and grossed up annual rates of interest, to customers, in a similar fashion as at present. They would have the option of quoting real rates of return, under different inflation assumptions if they so wished.

There are additional practical difficulties, however, as the Inland Revenue will require institutions to state, at any time (for example, the time of the year when interest is credited, or when an account is closed), the amount of taxable interest earned at that point: this will be equal to the real interest at that time. This can then be taxed further (for example, at a higher rate for certain taxpayers), as the Government of the day desires. The institution must therefore be able to calculate the real interest earned by a depositor at all times during a tax year. This can be done as follows:

The real force of interest can be found by subtracting from the nominal force of interest, the force of inflation. There is no need to divide by a (1 + rate of inflation) factor, in this case because we are dealing, in the limit, with continuous compounding.

In real terms, a deposit of one unit has accumulated, after n years, to

$\exp[n(\delta_i - \delta_r)] = \exp(n\,\delta_y)$ (in this case n will be less than one)

the real interest to be quoted will therefore be $\exp(n\,\delta_y) - 1$. This quoted figure will express the interest in real terms (specifically in beginning year prices), not cash terms. To find the cash amount of real interest in end year prices on which extra tax can be levied, the real interest figure should be multiplied by a factor (1+r).

An important point to note is that, if the real interest calculated in this way is multiplied by the tax rate, it will not equal the tax deducted by the institution (which is the accumulation of the deposit at the force of interest corresponding to the gross annual effective rate of interest minus the deposit plus interest credited to the customer's account) except at the end of the tax year. This is because the tax reserve deducted by the institution can be invested until the end of the year so that the correct amount of tax will arise at that time. It is worth showing, however, that if a deposit is made for a full year, and the rate of interest remains constant during the year, the real interest figure on which tax is charged by the institution will be exactly equal to the real interest credited to the account, as calculated above, at the end of the year:

After one year, the real interest, expressed in beginning year prices, will be the accumulation in real terms minus the original deposit of one unit, ie

$\exp(\delta_y) - 1 = \exp(\delta_i - \delta_r) - 1 = \exp[\ln(1 + i) - \ln(1 + r)] - 1$

$= [(1 + i) / (1 + r)] - 1 = (i - r) / (1 + r)$

which is the real rate of interest per unit deposit.

An alternative method of allowing for inflation, when taxing interest from deposits, would be to make an adjustment to the rate of tax charged on nominal deposit interest, determined such that the adjusted tax rate times the nominal interest on the deposit was broadly equal to the income tax rate times the real return from deposits expressed in end year prices. The adjusted rate of tax could then be announced in advance, in the same way as the rate of composite rate tax is currently.

A change in the tax system, of this sort, would have the advantage of being more easily understandable than a change to a genuine real rate tax system as described in detail. The disadvantage is that the adjusted rate of tax would have to be calculated with reference to some sort of average yield on short term deposits and the anticipated rate of inflation. This would lead to an undesirable degree of arbitrariness in the system and, in particular, low yielding deposits would have a higher effective tax rate on the real return than higher yielding deposits because a higher proportion of the return would be compensation for inflation which would still be taxed, albeit at a lower rate than at present.

The first of the two proposals in this section of the paper will now be considered in an historical perspective.

PART 7: THE EFFECTS OF A MOVEMENT TO A REAL RATE TAX SYSTEM:

A full data set showing the results of caclulations carried out using tax rates which would have been in force if the system of taxation described in Part 6 had been instituted in 1969 (under the assumption that the rate of inflation could be predicted with perfect foresight) is provided in the Statistical Appendix.

All the calculations in the Statistical Appendix have been carried out in and the results expressed in real terms. Any comparisons between alternative tax systems have also been made by comparing real returns and real accumulations etc. An explanation of the data in the Statistical Appendix is provided in the attached Annex.

If, in any year, the real gross rate of return is less than zero, the tax rate has been set to zero. It is possible to make a case for granting a tax credit in respect of an investment which yields a sub-zero real return. The efect of the introduction of a real rate tax system would then be even more significant than is outlined below; in addition, the income tax system would then be fully compatable with the

capital gains tax system.

The use of a real rate tax system, over the twenty years from 1969 to 1988, therefore, would have led to the following results:

1) The annual effective net real rate of return from the deposit of a sum of money in 1969, which was left to accumulate to 1988, would have been -0.6% (compared with -2.3% under the present tax regime).

2) The annual effective net real rate of return from the deposit of a sum of money from 1969 to 1978 would have been -3.2% (compared with -5.2% under the existing system).

3) The annual effective net real rate of return from the deposit of a sum of money from 1979 to 1988 would have been 2.1% (compared with 0.5% under the cuurent system).

4) A deposit of a level sum of money each year from 1969 to 1988 would have led to a net real annual effective rate of return of 0.9% being achieved (compared with a return of -0.5% under the current system).

5) In the four years in which the current tax system leads to positive gross rates but negative net rates of interest, a change in the tax system would have a significant impact on the net real rate of return: in 1969, a real rate tax system would have increased the net return by 1.5%, in 1980 and 1981 by 2.5% and in 1988 by 1.7%.

6) The accumulation of a sum of money deposited from 1969 to 1988 would have been 44% greater if a real rate tax system had been employed, rather than the current system; the accumulation of a deposit from 1969 to 1978 would have been 23% greater; the accumulation of a deposit from 1979 to 1988 17% greater and the accumulation of a deposit of a level sum per annum, throughout the twenty years, would also have been 17% greater under a real rate tax system.

Many other comparisons may also be of interest to the reader and these can be derived from the data in the Statistical Appendix.

It is clear from the above that, if a real rate tax system were to be employed in the U.K., even if it were not possible to estimate the rate of inflation with any great certainty, it would have a substantial economic effect.

The first order effect would be to increase net rates of interest to savers. There would then be a combination of second order effects and the extent to which each would prevail would depend on the elasticities of supply and demand for saving and borrowing. There would presumably be an increase in saving caused by the higher net interest rates available; this would, in turn, lead to lower gross interest rates charged to borrowers. The overall result would be a higher savings ratio combined with a lower equilibrium level of gross interest rates for a given monetary stance.

It is particularly notable that the benefits to savers of a real rate tax system, and correspondingly the effect on the equilibrium rates of interest, are greater when inflation is high relative to the level of nominal interest rates; this is a feature which governments may regard as being politically desirable.

CONCLUSIONS:

The current system of taxing interest from bank and building society deposits is such that the nominal return on deposits is taxed. This leads to higher effective rates of tax than intended and, in times of moderate or high inflation, effectively leads to the imposition of a wealth tax because real capital is eroded by the tax system. It has been shown that the extent of the wealth tax which arises has been substantial, particularly during the ten years from 1969.

The major alternative proposals for dealing with the above distortion in the taxation system have revolved around removing deposits interest from the tax system (at least in part), perhaps by allowing bank and building society deposit personal equity plans, a proposal which has now been adopted by the introduction of TESSA's. The acceptance of such proposals deals with the problem in a rather arbitrary and ad hoc way.

It would appear that the difficulties of changing the taxation system so that only the real interest from deposits is taxed should not be insurmountable. The system would not be difficult to operate in theory and the mathematical steps which are required to calculate the taxation liabilty are straightforward. In addition, it is not difficult to calculate the amount of real interest received so that taxation at higher rates can be levied.

The effect that a move to a real return tax system would have on net rates of interest could be substantial and it would appear that the economic consequences would be beneficial, particularly in a country with an historically low saving's ratio.

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STATISTICAL APPENDIX:

	1968	1969	1970
CRT	32.08	32.25	32.75
building society average share rate		4.82	4.94
grossed up rate of interest		7.11	7.35
RPI	67.7	71	77.1
rate of inflation		4.87	8.59
real gross interest rate		2.14	-1.15
real net interest rate		-0.05	-3.36
real gross accumulation factor		1.0214	0.9885
real gross accumulation from 1.1.69		1.0214	1.0096
real gross accumulation to 31.12.88		0.9803	0.9598
real gross accum.of 1p.a. to date		0.9803	1.9401
real net accumulation factor		0.9995	0.9664
real net accumulation from 1.1.69		0.9995	0.9659
real net accumulation to 31.12.88		0.6188	0.6192
real net accum. of 1p.a. to date		0.6188	1.2380
CRRT real net interest rate		1.4470	-1.1473
CRRT real net accumulation from 1.1.69		1.0145	1.0028
CRRT real net accumulation to 31.12.88		0.8896	0.8769
CRRT real net accum. of 1p.a. to date		0.8896	1.7665
CRRT interest rate difference		1.4989	2.2154
CRRT real net acc. from 1.1.69 ratio		1.0150	1.0383
CRRT real net acc. to 31.12.88 ratio		1.4376	1.4163
CRRT real net acc. 1p.a. to date ratio		1.4376	1.4269

	1971	1972	1973
CRT	31	30	23.5
building society average share rate	4.95	4.88	6.51
grossed up rate of interest	7.17	6.97	8.51
RPI	83.3	89.9	101.7
rate of inflation	8.04	7.92	13.13
real gross interest rate	-0.80	-0.88	-4.08
real net interest rate	-2.86	-2.82	-5.85
real gross accumulation factor	0.9920	0.9912	0.9592
real gross accumulation from 1.1.69	1.0015	0.9927	0.9522
real gross accumulation to 31.12.88	0.9709	0.9788	0.9875
real gross accum.of 1p.a. to date	2.9111	3.8899	4.8774
real net accumulation factor	0.9714	0.9718	0.9415
real net accumulation from 1.1.69	0.9382	0.9118	0.8585
real net accumulation to 31.12.88	0.6407	0.6596	0.6787
real net accum. of 1p.a. to date	1.8787	2.5383	3.2170
CRRT real net interest rate	-0.8030	-0.8819	-4.0803
CRRT real net accumulation from 1.1.69	0.9948	0.9860	0.9458
CRRT real net accumulation to 31.12.88	0.8871	0.8943	0.9022
CRRT real net accum. of 1p.a. to date	2.6537	3.5479	4.4502
CRRT interest rate difference	2.0584	1.9379	1.7678
CRRT real net acc. from 1.1.69 ratio	1.0603	1.0814	1.1017
CRRT real net acc. to 31.12.88 ratio	1.3846	1.3558	1.3293
CRRT real net acc. 1p.a. to date ratio	1.4125	1.3978	1.3833

	1974	1975	1976
CRT	26.25	27.75	27.75
building society average share rate	7.53	7.21	7.02
grossed up rate of interest	10.21	9.98	9.72
RPI	121.9	149.8	174.1
rate of inflation	19.86	22.89	16.22
real gross interest rate	-8.05	-10.50	-5.60
real net interest rate	-10.29	-12.76	-7.92
real gross accumulation factor	0.9195	0.8950	0.9440
real gross accumulation from 1.1.69	0.8755	0.7836	0.7397
real gross accumulation to 31.12.88	1.0295	1.1197	1.2511
real gross accum.of 1p.a. to date	5.9069	7.0266	8.2777
real net accumulation factor	0.8971	0.8724	0.9208
real net accumulation from 1.1.69	0.7701	0.6719	0.6187
real net accumulation to 31.12.88	0.7209	0.8035	0.9211
real net accum. of 1p.a. to date	3.9379	4.7414	5.6625
CRRT real net interest rate	-8.0527	-10.5042	-5.5974
CRRT real net accumulation from 1.1.69	0.8696	0.7783	0.7347
CRRT real net accumulation to 31.12.88	0.9406	1.0230	1.1431
CRRT real net accum. of 1p.a. to date	5.3908	6.4138	7.5569
CRRT interest rate difference	2.2360	2.2535	2.3199
CRRT real net acc. from 1.1.69 ratio	1.1292	1.1583	1.1875
CRRT real net acc. to 31.12.88 ratio	1.3048	1.2731	1.2411
CRRT real net acc. 1p.a. to date ratio	1.3690	1.3527	1.3346

	1977	1978	1979
CRT	24.25	22.5	21
building society average share rate	6.98	6.46	8.45
grossed up rate of interest	9.21	8.34	10.70
RPI	190.6	208.9	248.8
rate of inflation	9.48	9.60	19.10
real gross interest rate	-0.24	-1.15	-7.06
real net interest rate	-2.28	-2.87	-8.94
real gross accumulation factor	0.9976	0.9885	0.9294
real gross accumulation from 1.1.69	0.7379	0.7294	0.6779
real gross accumulation to 31.12.88	1.3253	1.3285	1.3440
real gross accum.of 1p.a. to date	9.6030	10.9314	12.2754
real net accumulation factor	0.9772	0.9713	0.9106
real net accumulation from 1.1.69	0.6046	0.5872	0.5347
real net accumulation to 31.12.88	1.0002	1.0236	1.0538
real net accum. of 1p.a. to date	6.6627	7.6863	8.7401
CRRT real net interest rate	-0.2400	-1.1549	-7.0561
CRRT real net accumulation from 1.1.69	0.7329	0.7245	0.6734
CRRT real net accumulation to 31.12.88	1.2109	1.2138	1.2279
CRRT real net accum. of 1p.a. to date	8.7678	9.9815	11.2095
CRRT interest rate difference	2.0411	1.7112	1.8860
CRRT real net acc. from 1.1.69 ratio	1.2123	1.2337	1.2592
CRRT real net acc. to 31.12.88 ratio	1.2106	1.1858	1.1653
CRRT real net acc. 1p.a. to date ratio	1.3159	1.2986	1.2825

	1980	1981	1982
CRT	22.5	25.5	25.25
building society average share rate	10.34	9.19	8.8
grossed up rate of interest	13.34	12.34	11.77
RPI	279.8	310.7	327.3
rate of inflation	12.46	11.04	5.34
real gross interest rate	0.78	1.16	6.10
real net interest rate	-1.88	-1.67	3.28
real gross accumulation factor	1.0078	1.0116	1.0610
real gross accumulation from 1.1.69	0.6832	0.6912	0.7334
real gross accumulation to 31.12.88	1.4460	1.4348	1.4183
real gross accum.of 1p.a. to date	13.7215	15.1562	16.5745
real net accumulation factor	0.9812	0.9833	1.0328
real net accumulation from 1.1.69	0.5247	0.5159	0.5328
real net accumulation to 31.12.88	1.1573	1.1795	1.1995
real net accum. of 1p.a. to date	9.8974	11.0769	12.2765
CRRT real net interest rate	0.6079	0.8668	4.5625
CRRT real net accumulation from 1.1.69	0.6775	0.6833	0.7145
CRRT real net accumulation to 31.12.88	1.3212	1.3132	1.3019
CRRT real net accum. of 1p.a. to date	12.5306	13.8438	15.1457
CRRT interest rate difference	2.4929	2.5360	1.2806
CRRT real net acc. from 1.1.69 ratio	1.2912	1.3245	1.3410
CRRT real net acc. to 31.12.88 ratio	1.1416	1.1133	1.0853
CRRT real net acc. 1p.a. to date ratio	1.2661	1.2498	1.2337

	1983	1984	1985
CRT	25	25	25.25
building society average share rate	7.26	7.74	9.03
grossed up rate of interest	9.68	10.32	12.08
RPI	344	362.7	381.1
rate of inflation	5.10	5.44	5.07
real gross interest rate	4.36	4.63	6.67
real net interest rate	2.05	2.19	3.77
real gross accumulation factor	1.0436	1.0463	1.0667
real gross accumulation from 1.1.69	0.7653	0.8008	0.8542
real gross accumulation to 31.12.88	1.3367	1.2809	1.2242
real gross accum.of 1p.a. to date	17.9112	19.1921	20.4163
real net accumulation factor	1.0205	1.0219	1.0377
real net accumulation from 1.1.69	0.5438	0.5556	0.5766
real net accumulation to 31.12.88	1.1614	1.1381	1.1137
real net accum. of 1p.a. to date	13.4379	14.5760	15.6897
CRRT real net interest rate	3.2666	3.4741	4.9850
CRRT real net accumulation from 1.1.69	0.7378	0.7635	0.8015
CRRT real net accumulation to 31.12.88	1.2451	1.2057	1.1652
CRRT real net accum. of 1p.a. to date	16.3908	17.5965	18.7618
CRRT interest rate difference	1.2137	1.2889	1.2191
CRRT real net acc. from 1.1.69 ratio	1.3569	1.3740	1.3902
CRRT real net acc. to 31.12.88 ratio	1.0720	1.0594	1.0462
CRRT real net acc. 1p.a. to date ratio	1.2197	1.2072	1.1958

	1986	1987	1988
CRT	25.25	24.75	23.25
building society average share rate	7.83	7.47	7.2
grossed up rate of interest	10.47	9.93	9.38
RPI	396.1	409.1	441.1
rate of inflation	3.94	3.28	7.82
real gross interest rate	6.29	6.43	1.45
real net interest rate	3.75	4.05	-0.58
real gross accumulation factor	1.0629	1.0643	1.0145
real gross accumulation from 1.1.69	0.9079	0.9663	0.9803
real gross accumulation to 31.12.88	1.1477	1.0797	1.0145
real gross accum.of 1p.a. to date	21.5640	22.6437	23.6581
real net accumulation factor	1.0375	1.0405	0.9942
real net accumulation from 1.1.69	0.5982	0.6224	0.6188
real net accumulation to 31.12.88	1.0733	1.0345	0.9942
real net accum. of 1p.a. to date	16.7630	17.7975	18.7918
CRRT real net interest rate	4.7028	4.8414	1.1098
CRRT real net accumulation from 1.1.69	0.8392	0.8799	0.8896
CRRT real net accumulation to 31.12.88	1.1099	1.0600	1.0111
CRRT real net accum. of 1p.a. to date	19.8717	20.9317	21.9428
CRRT interest rate difference	0.9562	0.7865	1.6867
CRRT real net acc. from 1.1.69 ratio	1.4030	1.4136	1.4376
CRRT real net acc. to 31.12.88 ratio	1.0341	1.0247	1.0170
CRRT real net acc. 1p.a. to date ratio	1.1854	1.1761	1.1677

```
Formulas for all variables:

building society average share rate = < Yearly data: 1969 - 1988 >
CRRT interest rate difference=CRRT real net interest rate - real net interest
     rate
CRRT real net acc. 1p.a. to date ratio=CRRT real net accum. of 1p.a. to date/
     real net accum. of 1p.a. to date
CRRT real net acc. from 1.1.69 ratio=CRRT real net accumulation from 1.1.69/
     real net accumulation from 1.1.69
CRRT real net acc. to 31.12.88 ratio=CRRT real net accumulation to 31.12.88/
     real net accumulation to 31.12.88
CRRT real net accum. of 1p.a. to date=RSUM(CRRT real net accumulation to
     31.12.88)
CRRT real net accumulation factor =(1+CRRT real net interest rate/100)
CRRT real net accumulation from 1.1.69=CRRT real net accumulation factor@[1969];
     PREVIOUS(CRRT real net accumulation from 1.1.69)*CRRT real net
     accumulation factor
CRRT real net accumulation to 31.12.88=BEGIN([1969],VALUE(CRRT real net
     accumulation from 1.1.69,[1988])/PREVIOUS(CRRT real net accumulation from
     1.1.69;1))
CRRT real net interest rate =IF(real gross interest rate <0,real gross interest
     rate,real gross interest rate-CRT*real gross interest rate/100)
CRT = < Yearly data: 1968 - 1988 >
grossed up rate of interest=building society average share rate/(1-CRT/100)
rate of inflation=(RPI/PREVIOUS(RPI)-1)*100
real gross accum.of 1p.a. to date=RSUM(real gross accumulation to 31.12.88)
real gross accumulation factor=(1+real gross interest rate/100)
real gross accumulation from 1.1.69=real gross accumulation factor @[1969];
     PREVIOUS(real gross accumulation from 1.1.69)*real gross accumulation
     factor
real gross accumulation to 31.12.88=BEGIN([1969],VALUE(real gross accumulation
     from 1.1.69,[1988])/PREVIOUS(real gross accumulation from 1.1.69;1))
real gross interest rate=(grossed up rate of interest-rate of inflation)/(1+
     rate of inflation/100)
real net accum. of 1p.a. to date=RSUM(real net accumulation to 31.12.88)
real net accumulation factor=(1+real net interest rate/100)
real net accumulation from 1.1.69=real net accumulation factor@[1969];PREVIOUS(
     real net accumulation from 1.1.69)*real net accumulation factor
real net accumulation to 31.12.88=BEGIN([1969],VALUE(real net accumulation from
     1.1.69,[1988])/PREVIOUS(real net accumulation from 1.1.69;1))
real net interest rate=(building society average share rate-rate of inflation)/(
     1+rate of inflation/100)
RPI = < Yearly data: 1968 - 1988 >
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ANNEX TO THE STATISTICAL APPENDIX:

The Statistical Appendix is presented in a form that should enable the reader to calculate a number of statistics which can be used to make historical comparisons of the effect of different tax systems. Much of the Appendix is self explanatory, however, it is worthwhile elaborating some of the definitions and formula used therein.

The following variables have been defined or discussed in Part 5 of the paper, and little more needs to be added: Composite Rate Tax, building society share rate, retail price index, annual rate of inflation, grossed up rate of interest, real gross interest rate and real net interest rate.

The variables below are derived from the data inputs which consist only of the rate of composite tax, the retail price index and the building society share rate:

1) *real gross accumulation factor is the accumulation in, real terms, of a unit invested at the beginning of a year, for the year concerned at the grossed up rate of interest for that year*

2) *real net accumulation factor is the accumulation, in real terms, of a unit invested at the beginning of a year, for the year concerned, at the net rate of interest under the existing tax regime*

3) *CRRT net accumulation factor (which is a variable used in the model but for which calculated*

figures have not been shown) is the accumulation in real terms of a unit invested at the beginning of a year, for the year concerned, if the tax system were such that only the real return were taxed.

4) *real gross accumulation from* 1.1.69 *and real net accumulation from* 1.1.69 *are the accumulation in real terms of a unit invested at the beginning of* 1969 *until the end of the year shown, at the gross and net rates of interest respectively*

5) *CRRT real net accumulation from* 1.1.69 *is the accumulation in real terms of a unit invested at the beginning of* 1969 *until the year shown, if the tax system were such that only the real return were taxed*

6) *real gross accumulation to* 31.12.88 *and real net accumulation to* 31.12.88 *are the accumulation, in real terms, of a unit invested from the beginning of the year shown until the end of* 1988 *at the gross and net rates of interest respectively*

7) *CRRT real net accumulation to* 31.12.88 *is the accumulation, in real terms, of a unit of money invested from the beginning of the year shown until the end of* 1988, *if the tax system were such that only the real return were taxed*

8) *real gross accumulation of* 1 *p.a. to date and real net accumulation of* 1 *p.a. to date are the accumulation, in real terms, of one unit invested at the beginning of each year until the end of the year shown, at the gross and net rates of interest respectively*

9) *CRRT real net accumulation of* 1 *p.a. to date is the accumulation, in real terms, of one unit invested at the beginning of each year until the end of the year shown, at the net rate of interest which would prevail if only the real rate of interest were taxed*

10) *CRRT interest rate difference is the difference between the net interest rate which would prevail if only the real return were taxed and that which was experienced under the present system*

11) *CRRT real net accumulation from* 1.1.69 *ratio is the ratio of CRRT real net accumulation from* 1.1.69 *to real net accumulation from* 1.1.69

12) *CRRT real net accumulation to* 31.12.88 *ratio is the ratio of CRRT real net accumulation to* 31.12.88 *to real net accumulation to* 31.12.88

13) *CRRT real net accumulation of* 1 *p.a. to date ratio is the ratio of CRRT real net accumulation of* 1 *p.a. to date to real net accumulation of* 1 *p.a. to date*

The intention of variables 10 *to* 13 *is to show, in a straightforward way, the effect of changing the system of taxation so that only real rates of return were taxed.*