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**RETURNS AFTER PERSONAL TAX ON UK EQUITY AND GILTS,
1919-98**

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RETURNS AFTER PERSONAL TAX ON UK EQUITY AND GILTS, 1919-98

Abstract

This paper investigates whether personal tax could help explain the size of the historic equity premium in the UK measured before personal tax. If there has been a higher tax burden on equity, some of the premium could be viewed as compensation for tax. We estimate that personal tax reduces the arithmetic mean nominal return on equity from 13.3% to 11.1% pa during 1919-98, and the mean return on gilts from 7.1% to 5.6% pa. Thus, personal tax accounts for a slightly higher proportion of the before-tax return on gilts than on equity, implying that the equity premium is not a compensation for a higher tax burden on equity.

Keywords: personal tax; equity risk premium; long term returns.

JEL classification: G12; H24.

1. Introduction

Returns on equity and government bonds are normally measured before personal tax. The familiar sources of annual returns data are Barclays Capital's *Equity-Gilt Study* for the UK and Ibbotson Associates' *Stocks, Bonds, Bills and Inflation Yearbook* for the US, both published annually. Alternative estimates of returns in ten countries since 1900 have recently appeared in Dimson, Marsh & Staunton's *Millenium Book* (2000). All these studies calculate returns before personal tax: they ignore income tax on dividends and interest, and they ignore capital gains tax. This paper provides, for the first time, estimates of returns on UK equity and gilts after personal tax. The period covered is the 80 years 1919-98.

The main reason why returns have been measured before personal tax is probably that investors have different tax circumstances. This means that a market return after tax has to be estimated as an average across investors: it can not be observed. But an estimate of the return after tax is of interest, because personal tax is one factor which might have affected the size of the historic equity premium. A historic premium is the difference between average returns on equity and average returns on a default-free asset measured over a certain time interval, usually several decades. The historic premium has attracted much attention in recent years; it is larger than can easily be explained by theory, and many observers do not believe that the premium in the future will be as large as it has been in the past, at least in the UK and USA

(see Freeman and Davidson, 1999, or Cornell, 1999, for a recent review). There appears to have been no empirical study of the impact of personal tax. It is possible that returns on equity have been taxed more heavily than returns on gilts, in which case some of the premium measured before tax could be viewed as compensation for the higher tax burden on equity, not as compensation for bearing risk.

The next section comments briefly on the use of a historic premium before and after tax in estimating the cost of equity. Sections 3 and 4 explain, respectively, how ownership weights and effective personal tax rates are arrived at for the different categories of investor by tax status. Section 5 describes the calculation of returns after tax and presents the results. Section 6 concludes. Throughout the paper, before or after tax means before or after personal tax.

2. Use of a historic premium

The historic or ex post premium, or excess return, is an important number because it is often used as a proxy for the ex ante premium in estimating the cost of equity, as is recommended in leading textbooks (for example, Brealey & Myers, 2000, pp. 153-60; Ross, Westerfield & Jaffe, 1997, p. 279). The underlying principle is simply that the premium observed over a sufficiently long period is an adequate proxy for the premium investors expected in the past, and that investors continue to expect a similar premium in the future. The principle can be questioned. For example, one may believe that the historic premium has turned out to be larger than was expected, and that it is therefore not a good proxy for the ex ante premium. But there would still remain the question of why the historic premium is so large.

One issue which arises is whether to calculate a historic premium from returns measured before or after tax. If there were no restrictions or costs of investing in different assets, in equilibrium all assets would have the same expected risk-adjusted return *after* personal tax, and all investors would face the same tax rate, otherwise there would be pure or quasi arbitrage opportunities (Scholes & Wolfson, 1992, especially chs. 5 and 6). To illustrate, suppose Bonds A and B are default-free one year zero coupon bonds, with the gain on A taxed at 50% and on B at 0%. The potential for pure arbitrage ensures that the bonds must return the same after tax, say 5%, which means that the returns measured before tax are 10% for Bond A and 5% for Bond B. If either or both of the bonds were risky, the gain from a tax-arbitrage trade would not be certain, so such a trade would be quasi arbitrage. But we would expect

both bonds to have the same risk-adjusted return after tax, that is, the same return after deducting their respective risk premia after tax.

In a frictionless market such as this, a historic premium measured before tax could obviously be a misleading guide to the premium investors require for taking risk. If the tax rates on two assets differed, some of the observed return before tax on the more heavily taxed asset would be compensation for the higher tax rate. For example, the actual arithmetic mean returns before tax during 1919-98 were 13.3% pa on equity and 7.1% pa on gilts, so the historic equity premium was 6.2% pa. Suppose effective personal tax rates during this period were, say, 40% on equity and 20% on gilts (with no frictions, all investors would have paid the same rate of tax on an asset). Then the historic returns on equity and gilts measured after tax would have been 8.0% pa and 5.7% pa respectively, and investors would have received a premium of 2.3% pa after tax. Had equity been taxed at the same rate as gilts, 20%, the return before tax need only have been $8\%/0.8 = 10.0\%$ pa to have provided an after-tax premium of 2.3% pa ($2.9\% \times 0.8$). So more than half ($3.3\%/6.2\%$) of the historic premium measured before tax would have been attributable to the higher personal tax rate on equity, and not to the reward required for taking equity risk.¹

But more than one personal tax rate on an asset exists in practice, because individuals and investment vehicles face differing tax rates and there are restrictions and costs of switching across individuals and investment vehicles. An example of a restriction is the limit on how much an individual can invest in a tax-exempt pension fund. An example of costs is the difficulties individuals face in reaching reliable agreements between themselves to exploit opportunities to reduce tax (such agreements would anyway be restricted if they became widespread). This situation means that an asset's observed return after tax varies across investors, that the effect of tax on an asset's price is uncertain, and that it is problematic to infer risk premia from observed returns measured either before or after tax.

Returning to the two risk-free bonds described above, suppose now that there are two categories of investor, High Tax and Low Tax. High Tax investors face a 50% tax rate on Bond A's return, Low Tax investors face a 25% rate. We can no longer say ex ante what the return on Bond A will be before or after tax. For there to be equilibrium prices for the two bonds, investors must face restrictions or costs which limit feasible tax arbitrage, or they must face progressive tax rates such that some marginal tax rates across investors exist at which arbitrage gain is not possible (Dammon & Green, 1987). The nature of the equilibrium - the prices arrived at - depends on the frictions and marginal tax rates investors face. Suppose we

observe a return for Bond A of 8% before tax, so that Low Tax investors receive 6% and High Tax investors 4% after tax. The return on the tax-exempt Bond B remains at 5%. These returns imply that it would cost Low Tax investors the equivalent of at least 1/6 of the return on Bond A to sell B bonds and buy A bonds, and it would cost High Tax investors at least 1/5 of the return on Bond B to sell A bonds and buy B bonds and at least 2/6 of the return on Bond A to invest via Low Tax investors in Bond A. The marginal returns available after taxes and costs are 5% for Low Tax and 4% for High Tax investors.

Since both bonds are risk-free, the risk premium investors require between them is zero. Yet the interplay between taxes and costs of switching can produce a difference in the returns measured before and after tax. The returns before tax are 8% for Bond A and 5% for Bond B. The return on Bond A after tax depends on the tax rate assumed or estimated, which would lie in the range 25% to 50%. There is no guarantee that the return after tax on Bond A would equal the 5% on the tax-exempt bond. Thus, in markets with frictions and with investors taxed at different rates, a premium calculated from returns measured either before or after tax provides an unreliable guide to the risk premium required by investors collectively. The point for our purposes is that an after-tax measure provides at least as good a guide. With no frictions, it would clearly be wrong to use the before-tax measure. If there are frictions, there will not be a single market-wide personal tax rate on each asset, and asset prices will be affected by the taxes and frictions in what may be a complex way. But we would expect the asset on which more tax is paid in aggregate per unit of return to have a higher observed rate of return measured before tax than a less heavily taxed asset. The well-known difference in yield between taxable and tax-exempt US bonds of the same risk supports this idea.

The single tax rate on an asset class estimated in the current paper is an effective rate defined as $(R_{\text{gross}} - R_{\text{net}})/R_{\text{gross}}$, where R_{gross} is the total return to all investors before personal tax, and R_{net} is the return after subtracting the total amount of personal tax paid. We follow the method of previous studies² which have estimated an effective personal tax rate by calculating a weighted average of the tax rates faced by owners of the asset, with the weights given by the proportions held by each category of owner in the relevant year.

3. Ownership of equity and gilts by category of investor

For the purpose of calculating tax rates on dividend income, we allocate holdings of equity to one of three categories of investor: individuals, including unit trusts; life assurance funds; and tax-exempt investors, including self-administered pension funds, insured pension

funds (managed by life offices) from 1956, charities, the public sector and individual holdings under personal equity plans, introduced in 1987. These categories faced different rates of tax which are discussed in the next section. Other UK shareholders - companies, banks, investment trusts, general insurance companies and other financial institutions - paid no tax on dividend income received from UK companies (known since 1965 as ‘franked investment income’). We follow previous studies in assuming that franked investment income was distributed to the recipient company’s shareholders as dividend, and so ultimately was taxable income received by the three categories in proportion to their ownership weights. Overseas shareholders are assumed to have paid the same personal tax rate as the weighted average rate calculated for the three categories. The holdings of ‘other UK shareholders’ and of overseas shareholders are therefore ignored, which means they are re-allocated between the three categories in proportion to their ownership weights.

In the case of gilts, we have five categories of investor; individuals, life funds, tax-exempt, UK companies and building societies. The tax-exempt category contains pension funds, charities and the UK public sector, as for equity. It also includes holdings of overseas central banks and international organisations. We assign half of ‘official holdings’ of gilts to the tax-exempt category and the other half to the individuals category. This is because around half of official holdings were investments made on behalf of depositors in the Post Office Savings Bank and trustee savings banks, and the interest therefore flowed to individuals and was taxable (*Bank of England Quarterly Bulletin*, March 1969, describes official holdings). 60% of gilts held by the banking sector are assumed to be financed ultimately by interest-paying deposits held by individuals, and are assigned to the individuals category, except for 1985-90 when they are assigned to the building societies category. The remaining 40% are assigned to the tax-exempt category because they are assumed to be financed by current accounts bearing negligible interest, and therefore not taxed, or by deposit accounts held by depositors paying little or no tax (see King & Fullerton, 1984, pp. 68-73 for a justification of this allocation). UK companies (other than banks) are a separate category because gross interest on their gilts holdings forms part of their taxable income, which we assume is taxed at the standard rate of income tax before 1965 and the corporation tax rate thereafter. Building societies are a separate category because the interest on their deposits, and on bank retail deposits from 1985, was taxed at a flat ‘composite rate’ until it was abolished in 1991, and this rate is assumed to apply to their gilt holdings. Thereafter building societies are treated in the same way as banks. Holdings of private sector overseas investors and of unidentified

owners are ignored.³

Surveys of share and gilt ownership present a single figure for insurance holdings which include, from a tax perspective, three categories of owner; life funds, insured pension funds and general insurance funds. We have attempted to assign insurance holdings to these categories, rather than assume that they are all life funds. Estimates of assets held by insurance companies, split between life and general insurance funds, are available for 1957 (*Radcliffe Report*, 1959, Memoranda of Evidence, Vol. 2, p. 36), 1970 (Revell, 1973, p. 473), 1976 onwards (Carter & Godden, 1983 and later editions) and 1988 onwards (*Financial Statistics*). According to these sources, the relative importance of general insurance funds peaked in the mid-1970s. They accounted for 9% of shares and 12% of gilts held by all insurance companies in 1957, 23% of shares and 18% of gilts in 1976, and 4% of shares and 11% of gilts in 1998. We assume a 10% general/90% life split for shares and gilts before 1957. The proportion of life assurance assets represented by pension fund assets has been estimated at 24% in 1978 (*Wilson Report*, 1980, pp. 532 and 579) and 15% in 1993 (*Share Register Survey*, 1993, p. 10). The investment income of insured pension funds was exempted from tax in 1956, and by then life offices were transacting a substantial amount of pension business (Fisher & Young, 1965, pp. 68-75). We include insured pension funds in life funds for the years before 1956, and we assume that pension fund assets were 24% of total life assurance assets throughout 1956-78. By using these estimates and interpolating figures for ‘missing’ years, we break down the single figure for shares or gilts held by insurance companies, first by separating out general insurance assets and adding them to holdings of other UK companies, then by dividing life assurance assets between life and pension funds, and adding pension assets to the tax-exempt category from 1956 onwards.⁴

Our estimates of the proportions of equity and gilts owned by category of investor, after making all the above adjustments, are shown at ten-yearly intervals in Table 1. These proportions have been derived to enable weighted average personal tax rates to be calculated: they do not provide a full picture of asset ownership and changes therein. For both equity and gilts, direct ownership by individuals has fallen steadily since the 1940s, whilst ownership by life funds and tax-exempt investors, mainly pension funds, has increased.

Table 1 around here

4. Personal tax rates by category of investor

4.1 Individuals

Individuals have faced a progressive income tax schedule, with dividend and interest income taxed in a similar way to income from employment.⁵ We update the effective tax rate estimates of Orhial & Foldes (1975) and King (1977), following them in treating investment income as marginal income, and so subject to the highest rate of tax paid by the individual concerned. The method used is explained in the Appendix and the rates for each year are shown in Table 2. The estimated effective tax rates for individuals on both dividends and interest are the same until 1973, when separate data become available for dividend and interest income received by individuals in differing tax bands, resulting in slightly different estimates of the tax rate on dividends and interest for the individuals category from 1973. The effective rate paid by individuals was 30-40% in the interwar years and rose sharply to above 60% during most of the 1940s. It remained around 60% until the mid-1970s, and has since declined steadily to 30% by the mid-1990s (the individuals category excludes holdings under personal equity plans, which were exempt).

Table 2 around here

4.2 Life funds

The complicated taxation of life offices is explained in detail in MacLeod and Levitt (1992 and 1999). Since 1915 life offices have been taxed on an ‘investment income less expenses’ (I-E) basis. Under this system as it was before 1989, all the office’s management expenses and commissions to intermediaries, including expenses attributable to pension business, were set against the investment income of the life fund, ie income from assets attributable to life assurance business, which from 1956 did not include income from assets attributable to pension business. Investment income which was relieved in this way was not taxed. If income tax had been deducted at source, for example tax at the basic rate on gilts or advance corporation tax paid by a company on dividends, it was offset against tax payable by the life office or reclaimed.⁶ Various changes were made in 1989 with a view to increasing the amount of tax paid by life offices, the most important of which was that expenses attributable to pension business were no longer available to relieve income attributable to the life fund.

Annual data from 1981 on investment income, expenses and tax paid are published in Carter & Godden (various editions) for virtually all life offices operating in the UK. For the

industry as a whole, expenses have averaged approximately 50% of all investment income, including pension fund income, and we assume this was the case before 1981. Investment income not relieved of tax under I-E was taxed at the standard rate of income tax before 1940, at a rate of 37.5% from 1940 until 1985, at the corporation tax rate during 1986-88 and at the basic rate of income tax from 1989 onwards.

During 1956-88, all the expenses, which we take to be 50% of investment income, could be set off against $(1 - P_{\text{pen}})$ of the investment income, where P_{pen} is the proportion of life office assets represented by pension fund assets. So the tax rate on investment income at the level of the life office is $T_{\text{life}}(1 - P_{\text{pen}} - 0.5)$, where T_{life} is the tax rate applicable to unrelieved investment income (eg, 37.5% during 1940-85). P_{pen} is set to zero for the years before 1956⁷ and after 1988.

There was no tax payable by the policyholder on the lump sum from a life policy when it matured, and life assurance premium relief (LAPR), introduced in 1853, was available until 1984. 40% of the premium could be set against the policyholder's taxable income, and relief obtained at the standard or basic rate of income tax. The proportion was increased to 50% of the premium in 1973. The value of LAPR was disconnected from the basic rate in 1979 and expressed as a percentage of the gross premium; 17.5% for 1979-80, 15% for 1981-88 and 12.5% thereafter. LAPR was restricted to 'qualifying' policies in 1968, which excluded single premium policies, and was abolished for all new policies in 1984. Revell (1973, p. 434) estimates that single premiums were 10% to 15% of total premiums in the mid-1960s and the proportion was 20% in 1981 (Carter & Godden, 1983). We have assumed that 80% of total premiums were for qualifying policies during 1968-83, falling by eight percentage points per annum from 1984, so that by 1994 LAPR disappears from the calculations altogether.

The arrangements outlined above resulted in very small or negative effective tax rates on life fund investment income until the late 1980s (shown in Table 2). LAPR meant that £1 of premium was worth $\text{£}1/(1 - \lambda)$, where λ is the value of the relief as a percentage of the gross premium. Combining the grossing-up effect of LAPR with the tax rate on investment income at the level of the life office, $T_{\text{life}}(1 - P_{\text{pen}} - 0.5)$, gives the formula for the effective tax rate on life fund investment income, T_{E} . In 1980, for example, the formula is

$$1 - T_{\text{E}} = q[1 - T_{\text{life}}(1 - P_{\text{pen}} - 0.5)]/(1 - \lambda) + (1 - q)[1 - T_{\text{life}}(1 - P_{\text{pen}} - 0.5)],$$

where q is the proportion of premiums paid for qualifying policies. For 1980 our estimate for q is 0.8, the tax rate on unrelieved investment income (T_{life}) is 37.5%, our estimate for the proportion of pension assets (P_{pen}) is 22.5%, and λ is 0.175. The resulting value for T_E is -4.9%. The reason for the negative rate is that the benefit of LAPR exceeds the estimated tax rate on investment income for the life fund. Our treatment of the taxation of income received by life funds is materially different from that of Orhial & Foldes (1975) and King (1977). They adjust for LAPR but assume that all life office investment income was taxed at 37.5% (from 1940), which ignores the I-E system. So their estimates of the effective tax rates for life fund investment income are much higher than ours.

4.3 *Tax-exempt investors*

The tax rate for this category is 0% until 1997. All tax-exempt investors could reclaim income tax deducted at source until July 1997, when the law was changed for pension funds. Our treatment of this change is explained in Section 5.2.

The investment income of self-administered pension funds was exempted from tax in 1921, and the income of insured funds was exempted in 1956 (very little tax had been paid on it before then - see note 7). Most of the payments to the policyholder have been taxed as income when received, but pension contributions within prescribed limits have attracted relief from tax at the contributing employer's or employee's marginal rate. In line with previous studies, we take the view that taxation of payments 'cancels out' the initial relief on contributions (and we ignore the relief obtained on some charitable donations).⁸

4.4 *Capital gains tax and stamp duty*

Capital gains tax (CGT) was introduced in 1965 and has remained in force since then, though CGT regulations and rates have changed several times. Because CGT is paid on realisation of the gain and not on an accruals basis, it is difficult to estimate annualised effective CGT rates. Our estimates are based on the actual amounts of CGT paid on listed shares. *Inland Revenue Statistics (IRS)* reports the total amount of CGT paid in each tax year since 1965, and reports estimates of the CGT attributable to gains on listed shares for 1985 onwards.⁹ The CGT on listed shares has been 33% of total CGT on average since 1985, and we assume this proportion holds for the years before 1985. To arrive at estimates of annualised effective CGT rates, we first calculate the aggregate annual capital gain or loss on listed shares on the simple assumption that investors hold shares for various fixed intervals

ranging from one to ten years. The gain or loss for year t assuming a one year holding period is $\Delta C_{1t} = V_{t-1}(I_t - I_{t-1})/I_{t-1}$, where V_t is the market value of the FT-Actuaries All Share Index at the end of year t and I_t is the level of the Index. The gain or loss assuming, say, a five year holding period is $\Delta C_{5t} = [V_{t-5}(I_t - I_{t-5})/I_{t-5}]/5$. Shareholders sell one fifth of their shares each year, so the annual realised gain or loss is one fifth of the accumulated gain or loss over five years.

The second step is to deduct the actual CGT paid from the gain or loss for the year. The returns for the year after CGT for the one and five year holding periods are, respectively, $[(\Delta C_{1t} - CGT_t)/V_{t-1}] - 1$ and $[(\Delta C_{5t} - CGT_t)/V_{t-5}] - 1$. Table 3 shows the arithmetic mean annual returns from changes in market value during 1969-98 before and after CGT for holding periods of one, three, five and ten years (CGT payments were tiny during 1965-68). Changes in market value in Table 3 are measured over tax years, which start on 6 April. The difference due to CGT is 0.17% pa for the one year holding period, 0.28% pa for the five year period and 0.50% pa for the ten year period. Survey evidence indicates that the average holding period for institutional investors is five years (Marsh, 1990, p. 40), so we assume the effective CGT rate is 0.3% pa starting in 1969. We ignore CGT on gilts, partly because most of the return comes from interest, partly because gilts held for more than one year were exempt during 1968-85, and all gilts were exempt during 1986-95.

Table 3 around here

CGT is a personal tax paid by individuals and trusts. The *IRS* data for CGT paid do not include tax paid by companies on their capital gains, but this forms part of corporation tax and so does not constitute additional personal tax. Tax on chargeable gains attributable to life fund policyholders is also not included. Life fund shareholdings were one sixth of the value of taxable individual shareholdings in 1970, and approximately the same value as individual holdings by 1998 (Table 1). To make rough allowance for tax on life fund capital gains, we assume that on average during 1969-98 the amount paid was one third of the CGT paid by individuals, ie 0.1% pa. So our effective total tax rate on equity gains is 0.4% pa starting in 1969.

Stamp duty has been charged on purchases of shares, but not gilts, since 1891. The rate was 1% for 1919-46, 2% for 1947-62, 1% for 1963-73, 2% for 1974-83, 1% for 1984-86 and 0.5% for 1987-98 (*Finance Acts and Stock Exchange Handbook*, various years). We assume,

as for CGT, that investors turn over one fifth of their shareholdings each year, so the effective rate of stamp duty is one fifth of the rate prevailing for the year.

5. Returns after personal tax

5.1 Calculation of returns after tax

Our source for annual returns on equity and gilts before tax is the *Equity-Gilt Study* (2000). The *Study* has been published annually since 1956 and is widely referred to in the UK. Returns on gilts are calculated using undated gilts before 1962, and gilts with an average term to maturity of 20 years for 1962-89 and 15 years for 1990 onwards. Returns on equity are calculated using the FT-Actuaries All Share Index from 1963 and an index constructed by Barclays for the preceding years. The index constituents during 1935-62 are the companies in the FT 30 Index. The equity return estimates for the years up to 1935 were substantially revised downwards in the 2000 edition of the *Study*, because the Barclays index for those years now contains the 30 largest companies each year by market capitalisation, instead of an unchanging list of 30 large companies chosen to be similar to those in the FT 30 Index when it started in 1935. The effect has been to reduce the estimated arithmetic mean nominal return on equity during 1919-98 from 14.7% to 13.3% pa, and to reduce the historic premium from 7.6% to 6.2% pa.

The *Study* does not show nominal annual returns, nor the values for nominal annual dividend and interest income which we need to calculate the income after personal tax, but fortunately these numbers can be inferred from information in the *Study*. To illustrate, the equity index values for end-1994 and 1995 are 6,286.4 and 7,450.2 respectively. We are given the gross dividend yield for each year, which is 3.8% for 1995. This is worth $7,450.2 \times 3.8\% = 283.1$ in index points, so the nominal return for 1995 is $(7,450.2 + 283.1)/6,286.4 = 23.0\%$. (This tallies with the figures in the *Study* for real return and inflation for 1995 of 19.2% and 3.2% respectively.) To calculate the return after tax, we multiply the value of the dividends by one minus our weighted average personal tax rate for the year, 11.7%, and add the net dividends to the year-end index value. The return after income tax is $[(7,450.2 + 283.1(1 - 0.117))/6,286.4] - 1 = 22.5\%$, from which we subtract our estimate of the effective CGT and stamp duty rates, 0.4% and 0.1% respectively.

The interest on gilts for 1995 can be calculated from: the relevant index values, 32.2 and 35.5; the real return on gilts, 15.3%; and the inflation rate of 3.2%. The nominal value of the gross interest, in terms of index points, is $32.2(1.153)(1.032) - 35.5 = 2.81$, and the

nominal return before tax is $[(35.5 + 2.8)/32.2] - 1 = 19.0\%$. Our weighted average tax rate on interest for 1995 is 10.5%, so the nominal return after tax is $[(35.5 + 2.81(1 - 0.105))/32.2] - 1 = 18.1\%$. For simplicity and clarity, we ignore the difference between the calendar year and the tax year, so the tax rates applicable to dividend and interest income in each year are those in force from 6 April.

5.2 *Returns after tax and changes in the tax system*

The *Study* returns are calculated as though all investors were tax-exempt, except for 1998. This is true whether a classical or an imputation tax system was in force. Under a classical system, companies pay corporation tax on profit, and dividends are treated as untaxed income at the shareholder level. The personal tax rate for an exempt investor, for example, is 0%. Under an imputation system, some or all of the corporation tax also counts as income tax. Consider the version of the imputation system in force during 1973-96. Companies paid advance corporation tax (ACT) on dividends, which was part of corporation tax and provided a tax credit to set against the shareholder's income tax liability. Shareholders exempt from tax could reclaim from the Inland Revenue the ACT paid by the company. The dividend yields recorded in the *Study* are gross of ACT, which assumes that all ACT was reclaimed, or in other words that all investors were tax-exempt. Therefore, the tax rate to apply to dividends as they appear in the *Study* is 0% for an exempt investor under both a classical and an imputation system, and the calculation of after-tax returns described in Section 5.1 is the same whichever system was in force. This is not to deny that the burden of tax on profits distributed as dividends is reduced under an imputation compared with a classical system. The benefit in the *Study* is reflected in higher equity values, and probably larger dividend payments, than would otherwise have been the case, and therefore higher returns on the index in some years.

A numerical example may be helpful. Suppose a company has profit before tax of £100m and pays gross dividends of £50m. The corporation tax rate is 40% and the income tax rate is 30%. Assume all shareholders pay this 30% rate. If the classical system were in force, the *Study* would record gross dividends of £50m, and income tax of £15m would not be subtracted. The cash outflow from the company would be £90m, £40m corporation tax plus £50m gross dividends. Now suppose instead that an imputation system were in force, under which corporation tax also counts as income tax. The *Study* would still record gross dividends of £50m, so income tax not subtracted would still be £15m. But the cash outflow from the

company would now be £75m, £40m in corporation tax, including £15m which also counts as income tax, and £35m in net dividends. Under either system the dividends after tax are £35m, but the total tax is £15m less under the imputation system. When the switch to imputation is announced, the market value of the company should rise by the present value of the expected future tax savings.¹⁰

Our treatment might appear to be inconsistent with studies, such as Poterba & Summers (1984) and Morgan & Thomas (1998), which note that the effective rate of tax on UK dividends fell sharply with the re-introduction of imputation in 1973, and became negative a few years later. Such studies reckon the effective rate of tax on dividends received by tax-exempt investors to be negative when an imputation system is in force, not 0%, because payment of dividends to tax-exempt shareholders reduces the combined corporation and personal tax take. But they are concerned with the taxation of dividends in comparison with retained profits. Our purpose is different, which is to estimate returns after tax given the way returns are already measured in the *Study*.

The most recent major change in the tax system took effect on 2 July 1997. From this date, pension funds could no longer reclaim ACT on dividend income, and the *Study* records the dividend yield net of ACT for 1998 onwards. Pension funds accounted for most of the tax-exempt category by 1997, so to accommodate this change we change the tax rate for tax-exempt investors from 0% to 20% for 1997 and 1998, and gross up the 1998 yield given in the *Study* by the ACT rate (20%). ACT still counted as income tax for individuals and life funds in 1998, so the tax rates for these categories continue to be applied to gross dividend income.

5.3 Results

Our estimates of the annual weighted average personal tax rates on gross dividend and gilts interest are shown in Figure 1 and Table 2. Tax rates were at their highest during the war years of the 1940s, at around 64% for dividends and 42% for gilts. They have since tended to fall, and by the mid-1990s they were only about 11% for dividends and 10% for gilts. In 1997, however, the effective tax rate on dividends jumped to 21%, because of the abolition of ACT reclaim by pension funds. The reasons for the long decline in the effective tax burden until then are the growth of ownership by pension and life funds, and the reduction in tax rates for individuals since the mid-1970s.

Figure 1 and Table 4 around here

Table 4 reports arithmetic and geometric mean nominal and real returns, and risk premia, before and after personal tax, for the full 80 years and for the 50 years 1949-98. Geometric means are calculated assuming re-investment of dividends and interest. The equity premium measured after tax for the full period is 5.5% pa (nominal) or 5.0% pa (real) using arithmetic means, and 4.0% pa (nominal) or 3.8% pa (real) using geometric means. These premia are 0.7 percentage points smaller than the corresponding premia measured before tax, but this is entirely a consequence of measuring returns net rather than gross. The tax burden was, in fact, greater for gilts than for equity during 1919-98 and 1949-98. The arithmetic mean return on equity for 1919-98 is 13.3% pa before and 11.1% pa after tax, so personal tax reduces the mean return by 17%. The mean return on gilts is 7.1% pa before and 5.6% pa after tax, so personal tax reduces the return on gilts by 21%. The effect of tax is similar using geometric means; the mean return on equity is reduced by 20% and on gilts by 24%. The difference in impact is greater using real returns; personal tax reduces the arithmetic mean real return on equity by 23% and on gilts by 41%. The reason is that tax rates apply to nominal income, and with positive inflation, which occurred in 65 of the 80 years in the sample, a given tax rate is a larger percentage of the real return than of the nominal return. So any difference in the impact of tax on nominal returns will be amplified with real returns.

The reason for the larger impact of tax on gilts is that much of the return on equity has come from capital gain, which has largely been untaxed, whereas almost all of the return on gilts has been from taxable interest. The arithmetic mean nominal capital gain on equity is 8.2% pa and the mean return via gross dividends is 5.1% pa during 1919-98; the mean gain on gilts is 0.4% pa and the return via interest is 6.7% pa.

The assumption that investment income received by individuals is marginal income (Section 4.1), together with the possibilities for tax clienteles and tax avoidance, arguably means that we overstate the proportion of investment income paid as tax by individuals. In addition, data limitations mean that the estimates depend to an extent on somewhat arbitrary decisions about the proportions of dividends and interest received by individuals in different tax bands (Appendix). As a check on the robustness of our results, the calculations are re-worked using the assumption that individuals simply paid income tax on dividends and interest at the standard rate, or basic rate from 1973. The arithmetic mean nominal return after tax during 1919-98 is 11.7% pa on equity, 0.6 percentage points higher, and 6.1% pa on gilts, 0.5 points higher. So the after-tax premium is almost identical to the premium of 5.5%

reported in Table 4, and the finding that the personal tax burden is slightly heavier on gilts is unaffected.

The results imply that high personal tax on equity is not an explanation for the size of the historic premium measured before tax. However, tax rates have not stayed constant, and it could be that changes in tax had the effect of inflating the before-tax premium. If the tax rate on an asset's returns falls unexpectedly, the market price should rise. Furthermore, the impact on price should be greater for equity than for gilts, because shares have a longer lifetime (at least after 1962, when undated gilts ceased to be used in the gilts index). Although returns measured before tax should be lower after a fall in the tax rate than they would have been had there been no fall, the return in the year the fall is announced may be much higher, due to capital gain. Effective tax rates on dividends and interest have moved roughly in parallel (Figure 1), but during the long, gradual fall in rates from 1948 to 1996, the effective rate on dividends fell by more than the rate on gilts, and the equity premium was relatively high (9.3% pa) during this period. On the other hand, there is no sign that the premium was high in years when there was a relatively large fall in the tax rate on dividends. We re-calculate the average returns during 1919-98 excluding each year in which there was a fall in the effective tax rate on dividends of three percentage points or more, together with the preceding year in case the fall was anticipated; 18 years altogether are excluded. The resulting arithmetic mean nominal returns are 14.4% pa on equity and 7.2% pa on gilts, so the premium before tax is 7.2% pa, larger than the premium before tax of 6.2% pa for the full 80 years. However, it must remain a possibility that the substantial fall in the effective tax rate on dividends during 1948-96 explains some of the good performance of equity in this period.

6. Conclusion

Historic returns on equity and gilts measured before personal tax have been available for many years and are widely used. There have been no estimates of returns after tax, perhaps because investors face differing personal tax rates and obtain differing returns after tax on the same asset, so that estimation of a market return after tax involves averaging across categories of investor by tax status. This paper has updated and revised existing estimates of weighted average personal tax rates on dividends and interest, and has provided estimates of effective rates of capital gains tax and stamp duty on equity. It has applied these rates to the nominal returns before tax inferred from Barclays Capital's *Equity-Gilt Study* (2000) to obtain returns after tax.

We use the returns after tax to estimate equity premia after tax and to investigate whether some of the premium measured before tax might have arisen because of higher personal tax on equity. For the 80 years 1919-98, the premium calculated using arithmetic mean nominal returns measured after personal tax is 5.5% pa, compared with a premium of 6.2% pa using before-tax returns. Though the after-tax premium is smaller, this is entirely because it has been calculated using net returns. The tax burden has been slightly heavier on gilts than on equity; personal tax reduces the mean arithmetic nominal return on equity by 17%, and on gilts by 21%. Using real returns, the reductions due to personal tax are 23% for equity and 41% for gilts. From 1948 to 1996, tax rates fell on both equity and gilts, but more so on equity, so it is possible that the falling tax burden was a reason for the capital gains on equity during this period. This would be worth investigating further. However, a simple comparison of the tax burdens on equity and gilts does not suggest that personal tax is an explanation for the size of the historic premium. The premium does not appear to be a compensation for a higher tax burden on equity.

Notes

1. This analysis assumes that the after-tax required premium is invariant with respect to tax rates. It could be argued that the after-tax premium will be negatively related to tax rates. Suppose we believe that, for a given expected rate of return on equity after all tax, a higher personal tax rate on equity implies a higher cost of capital (hurdle rate for new projects). Then a higher tax would imply less corporate investment and reduced demand for equity. If the supply of equity finance is less than perfectly elastic with respect to the after-tax expected rate of return, the equilibrium with the 40% tax on equity would feature a lower return on equity after tax and thus a smaller after-tax premium than would the equilibrium with the 20% tax on equity. This line of thought reinforces the argument that, with a higher tax rate on equity than on gilts, some of the premium measured before tax will be attributable to the difference in tax rates.
2. Including Feldstein, Dicks-Mireaux & Poterba (1983), King (1977), King & Fullerton (1984), Orhnial & Foldes (1975) and Poterba & Summers (1984).
3. Holdings of individuals and private trusts were part of what was a large 'other' category in the Bank of England data, until individuals were distinguished in 1963 and private trusts in 1970. We assign all the 'other' holdings to individuals until 1970, from which date 'other' is ignored.
4. Our assumptions differ in some respects from those of Orhnial & Foldes (1975) and King (1977). They treat all insurance company assets as life assurance assets, and they assume that investment trusts are 100% owned by individuals, whereas we treat investment trusts as 'other UK shareholders' because since the 1950s a large proportion of investment trust shares has been owned by investing institutions (Newlands, 1997, p. 273). For gilts, Orhnial & Foldes treat all official holdings as tax-exempt, whereas we assign half to individuals and half to tax-exempt; they assign all banking sector holdings to individuals, whereas we assign 60% to individuals and 40% to tax-exempt; they assign all company holdings to individuals, whereas treat them as a separate category; and they treat all overseas holders as tax-exempt, whereas we treat overseas public sector holders as exempt and ignore overseas private sector holders.
5. There have been some differences. There was a surcharge on investment income during 1973-82. The basic rate of income tax was 20% on dividends from 1993 and 20% on gilts interest from 1996, slightly lower than the basic rate on income from employment. The income of discretionary trusts is taxed at a special rate, but we ignore this as we have no

information on assets owned by discretionary trusts.

6. This is a simplification in various respects, the most noteworthy being that we do not distinguish general annuity business. We have no data on the proportion of assets represented by general annuity funds and, in any case, the effective tax rates on investment income attributable to such funds do not appear to have been very different from the rates we calculate for non-annuity life funds. From 1956, no tax was payable by life offices on investment income attributable to the general annuity fund, but income tax at the basic rate was deducted by the life office on the part of payments to annuitants not deemed to be return of capital. The worked examples in MacLeod & Levitt (1992, Appendices 1 and 2) illustrate how the pre-1989 I-E system operated.

7. Before 1956, assets attributable to insured pension business were treated as part of the annuity fund. Investment income largely escaped tax because income up to the sum of annuity payments plus the annuity fund's share of expenses was not taxed. Employer contributions were not taxed but pension premiums paid by employees obtained life assurance premium relief only, not full relief of income tax. Annuity payments were taxed at source at the standard rate of income tax, although pension benefits 'could be freely paid as tax-free lump sums' (Fry et al, 1985, p. 10). We treat insured pension funds as part of life funds for the years before 1956. The pre-1956 effective tax rates on life-plus-pension funds work out to be close to zero (Table 2). The rate on life funds drops in 1956 because, for that year onwards, the life funds category excludes insured pension funds (now tax-exempt), yet the expenses attributable to pension funds relieve tax on life fund investment income.

8. The rates for the remaining investor categories for gilts, UK companies and building societies, have been discussed in Section 3.

9. It is not possible to estimate effective income tax rates on dividends and gilts interest by reference to the actual tax paid because there are no published estimates. Annual amounts of advance corporation tax are recorded in *IRS*, but they are gross of repayments and set-offs claimed by tax-exempt shareholders and life funds.

10. Likewise, 'unrelieved ACT', paid by the company but not offsettable against corporation tax, affected market values.

Appendix. Estimation of personal tax rates for the individuals category

The method involves grouping individuals by bands of taxable income, each band being taxed at a rate which represents the maximum rate paid by individuals with taxable incomes in the band. We want to know the proportion of total dividends or interest on gilts received by individuals in each band. *IRS* (or *Surtax Statistics* and *Personal Income Surveys* before 1970) provides a breakdown of investment income received by individuals by bands of total income, whereas we want a breakdown by bands of taxable income. Dividends are not separated out from other investment income until 1973, so the proportion of dividends and gilts interest received by each band is assumed to be the same before then, which means that the estimated effective tax rates on dividends and interest are the same before 1973. First the taxable income bands have to be estimated as corresponding total income bands. *IRS* contains tables of numbers of taxpayers at various levels of total income and taxable income. The relationship between income threshold (Y) and number of taxpayers above that threshold (N) in a given year is estimated as

$$\log(N) = \alpha_1 + \beta_1[\log(Y_{\text{taxable}})] \quad (1)$$

for taxable income and

$$\log(Y_{\text{total}}) = \alpha_2 + \beta_2[\log(N)] \quad (2)$$

for total income, using the data in *IRS* each year. Once the coefficients have been estimated, each of the statutory taxable income thresholds is inserted into (1) to estimate the number of taxpayers N with taxable income in excess of the threshold. This N is inserted into (2) to find the total income threshold which corresponds with each taxable income threshold.

The next step is to read off the amount of investment income received by the individuals in each total income band corresponding with a taxable income band. Table A1 shows the data for 1970 as an example. Investment income received by individuals with taxable income of less than £2,500 in 1970, corresponding with an estimated total income of less than £4,104, is assumed to be taxed at the standard rate of income tax (41.25%). It can be seen that the estimated total income bands, corresponding with taxable income bands, do not match the total income bands in the *IRS* table giving investment income. This means there is some subjectivity in the final weightings assigned to each tax rate. Most awkward is how to allocate the £289m of investment income received by individuals with a total income of £10,000 or more between the four bands of taxable income applicable to such individuals. We assume that half of the £289m was received by individuals with taxable income of £15,000 or more, who paid the highest rate, and a sixth each by those who paid the next three rates down.

Table A1 around here

The above method was used by Orhnia and Foldes (1975) to estimate annual personal sector tax rates on dividends and gilt interest for 1919-69 and by King (1977) to estimate annual tax rates on dividends for 1947-71. The present study continues the series using the method from 1970 onwards, with modifications in some years. The main problem before 1988 is that, as for 1970, much of the dividend and interest income can not be allocated accurately between the higher taxable income bands, because the thresholds correspond with total incomes exceeding the maximum total income threshold in the table giving the breakdown of investment income. The assumption of a log-linear relationship between income levels and numbers of individuals gives implausible results for 1985 onwards, so we estimate the total income corresponding with a given taxable income as the taxable income plus twice the single person's tax-free allowance. The number of income tax rates was cut from seven to three (including zero) in 1988, making the effective tax rates for 1988-98 much easier to estimate.

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Table 1. Ownership of equity and gilts by category of investor

Membership of the categories is defined in Section 3. Separate tax rates apply for each category.

Equity (%)	Individuals + unit trusts	Life funds	Tax- exempt	UK companies	Building societies
1920	100	0	0	re-	zero
1930	99	1	0	allocated	
1940	97	3	0		
1950	94	5	1		
1960	77	8	15		
1970	65	11	24		
1980	42	16	42		
1990	32	19	49		
1998	24	26	50		
Gilts (%)					
1920	78	3	16	3	0
1930	74	5	17	4	0
1940	66	8	22	4	0
1950	55	8	32	4	1
1960	51	6	38	4	1
1970	41	12	39	4	4
1980	29	20	38	6	7
1990	21	25	47	1	6
1998	14	37	49	0	0

Sources*Equity*

1925, 1935, 1943, 1951: Orhnia & Foldes (1975)

1957: Revell (1967, p. 345)

1963, 1969, 1975: Erritt and Alexander (1977)

1981, 1989-93: *Share Register Survey* (1993)

1994-98: *Financial Statistics*

Gilts

1925, 1935: Orhnia & Foldes (1975)

1939, 1956-57: *Radcliffe Report* (1959, p. 198 and Memoranda of Evidence, Vol. 1, p. 111).

1946-48, 1951: *Economic Trends* (December 1961)

1957-61: Revell (1967, p. 454)

1958-98: *Bank of England Quarterly Bulletin*, June 1962, March issues 1962-73, December or November issues 1974-98 (figures not given for 1973)

Table 2. Personal tax rates on investment income and annual returns after tax, 1919-98

Date	Tax rate on dividends for individuals	Tax rate on interest for individuals	Tax rate on dividends & interest for life funds	Effective personal tax rate on dividends	Effective personal tax rate on interest	Nominal return on equity after tax	Nominal return on gilts after tax
1919	39.3	As for	3.4	39.3	31.6	8.8	-9.8
1920	41.1	dividends	3.4	41.1	33.0	-23.2	-8.9
1921	40.8	until 1973	3.4	40.8	32.7	-3.6	14.7
1922	35.7		2.8	35.7	28.6	23.6	14.5
1923	33.4		2.5	33.4	26.7	-0.9	3.0
1924	33.4		2.5	33.4	26.8	18.5	6.1
1925	29.1		2.2	29.0	23.3	13.1	-0.6
1926	29.7		2.2	29.5	23.6	5.0	1.8
1927	29.3		2.2	29.0	23.0	6.9	6.2
1928	29.7		2.2	29.4	23.2	15.1	4.8
1929	31.6		2.2	31.3	24.4	-16.3	-2.7
1930	35.0		2.5	34.6	26.8	-6.1	11.9
1931	37.0		2.8	36.5	28.2	-21.8	-1.6
1932	37.0		2.8	36.4	27.9	31.3	38.9
1933	37.1		2.8	36.5	27.8	23.1	2.3
1934	35.0		2.5	34.3	25.9	12.2	26.9
1935	35.3		2.5	34.5	25.9	12.3	-3.8
1936	36.9		2.6	36.1	26.8	17.5	-0.5
1937	37.7		2.8	36.8	27.1	-14.4	-10.0
1938	42.3		3.1	41.3	30.2	-12.4	-3.1
1939	51.2		4.1	49.9	36.3	-0.6	-0.3
1940	58.7		2.1	57.2	40.5	-8.0	14.5
1941	66.3		-1.6	64.3	44.3	18.8	9.2
1942	66.3		-1.6	64.3	43.1	14.4	1.4
1943	66.3		-1.6	64.2	41.9	8.5	-1.7
1944	66.5		-1.6	64.2	40.9	9.7	4.4
1945	65.7		-1.6	63.1	39.2	3.2	13.7
1946	61.3		0.9	58.8	35.7	15.3	9.8
1947	76.5		0.9	73.1	43.4	-5.6	-15.4
1948	59.9		0.9	57.0	35.3	-6.4	-0.4
1949	59.9		0.9	56.8	35.2	-8.7	-10.0
1950	59.3		0.9	55.9	34.7	7.5	2.8
1951	62.3		-0.3	58.5	36.2	4.9	-10.9
1952	61.9		-0.3	56.6	35.6	-3.8	-2.2
1953	59.9		0.9	53.5	34.2	20.4	12.5
1954	59.5		0.9	51.6	33.6	45.0	4.8
1955	57.5		2.1	48.6	32.2	8.0	-11.3
1956	57.5		-8.6	46.5	31.3	-11.7	-4.5
1957	58.1		-8.6	45.6	31.1	-4.2	-7.7
1958	58.3		-8.6	45.3	31.9	44.4	15.3
1959	54.9		-6.7	42.4	29.7	52.1	-0.5
1960	55.9		-6.7	42.7	30.0	-0.5	-8.6
1961	56.3		-6.7	42.6	30.4	-0.7	-9.7
1962	56.7		-6.7	42.4	30.9	-2.1	22.7
1963	56.9		-6.7	42.1	31.1	17.7	2.0
1964	57.9		-6.7	42.1	31.4	-7.6	-4.0
1965	66.9		-7.9	47.9	35.0	8.6	2.3
1966	59.6		-7.9	41.9	31.0	-6.4	2.3
1967	60.2		-7.9	41.6	31.6	31.8	0.5
1968	60.6		-4.4	41.5	31.0	46.0	-4.5

Date	Tax rate on dividends for individuals	Tax rate on interest for individuals	Tax rate on dividends & interest for life funds	Effective personal tax rate on dividends	Effective personal tax rate on interest	Nominal return on equity after tax	Nominal return on gilts after tax
1969	59.6		-4.4	40.1	29.6	-13.8	-2.1
1970	58.6		-4.4	38.0	26.6	-5.6	1.3
1971	55.9		-3.4	35.0	25.2	44.4	24.9
1972	56.1		-3.4	33.8	25.5	14.6	-6.0
1973	51.2	46.1	-2.9	29.7	21.6	-29.6	-10.9
1974	58.3	54.1	-4.4	32.4	24.6	-52.6	-18.3
1975	61.2	57.0	-5.4	32.5	26.2	144.3	32.1
1976	59.6	55.4	-5.4	30.2	24.6	-0.4	10.2
1977	55.5	53.4	-4.9	26.6	22.4	45.9	41.6
1978	53.3	48.8	-0.4	24.8	21.1	6.3	-4.3
1979	43.4	40.7	-5.2	18.4	16.1	9.4	2.0
1980	45.9	41.6	-4.9	18.4	15.9	32.6	18.5
1981	46.7	41.7	-2.1	18.0	16.0	11.6	-0.5
1982	47.5	41.9	-1.9	18.0	14.1	26.6	49.2
1983	46.0	40.6	-1.6	17.2	13.3	27.0	14.3
1984	40.0	38.5	-0.1	14.9	13.0	30.1	5.5
1985	39.5	37.2	1.4	14.7	12.2	18.8	9.7
1986	39.9	36.7	2.0	14.7	11.1	25.9	9.8
1987	40.2	37.6	3.5	14.8	11.0	7.5	15.1
1988	33.8	28.2	4.9	12.5	9.3	10.4	8.5
1989	34.4	32.1	8.5	13.0	10.9	34.3	4.8
1990	33.0	30.3	9.5	12.3	10.5	-10.7	4.5
1991	32.9	31.0	10.5	12.2	10.1	19.6	17.8
1992	31.8	31.9	11.5	11.9	10.3	18.8	17.4
1993	29.2	31.2	12.5	10.8	10.9	25.8	27.8
1994	29.2	31.5	12.5	11.4	10.9	-6.2	-12.1
1995	31.8	34.1	12.5	11.7	10.5	22.0	18.1
1996	31.7	31.6	12.0	11.4	9.6	14.8	7.0
1997	30.8	34.0	11.5	21.0	9.6	22.3	18.7
1998	30.8	34.0	11.5	20.3	9.0	13.2	24.5

Sources for tax rates:

For individuals:

1919-46: inferred from Orhnia & Foldes (1975)

1947-69: inferred from King (1977)

1970-98: own calculations (see Appendix)

For life funds: own calculations (see Section 4.2)

Table 3. Capital gains on listed shares for various assumed holding periods, 1969-98

Assumed holding period	Mean capital gain before actual CGT paid (% pa)	Mean capital gain after actual CGT paid (% pa)
One year	12.30	12.13
Three years	12.93	12.71
Five years	14.22	13.94
Ten years	20.03	19.53

Table 4. Mean returns on equity and gilts before and after tax

Arithmetic means	Nominal returns (% pa)		Real returns (% pa)	
	1919-98	1949-98	1919-98	1949-98
Equity				
Before tax	13.3	17.1	9.1	10.2
After tax	11.1	15.0	7.0	8.1
Gilts				
Before tax	7.1	8.1	3.4	1.8
After tax	5.6	6.4	1.9	0.2
Geometric means				
Equity				
Before tax	11.0	14.2	6.9	7.5
After tax	8.8	12.0	4.7	5.4
Gilts				
Before tax	6.3	7.2	2.4	0.9
After tax	4.8	5.5	0.9	-0.7
Equity premium				
Arithmetic means				
Before tax	6.2	9.0	5.7	8.4
After tax	5.5	8.5	5.0	7.9
Geometric means				
Before tax	4.7	6.9	4.5	6.5
After tax	4.0	6.4	3.8	6.1

Table A1: Estimation of the effective tax rate for the individuals category, 1970

Taxable income threshold	Tax rate applicable	Total income corresponding with taxable income (estimated)	Total income threshold for inv income¹ (IRS Table 65)	Inv income¹ by total income band (£m) (IRS Table 65)
< £2,500	41.25%	<£4,104	<£4,000	575
£2,500	53.75%	£4,104	£4,000	127
£3,000	58.75%	£4,770	£5,000	92
£4,000	63.75%	£6,048	£6,000	129
£5,000	68.75%	£7,271	£8,000	85
£6,000	73.75%	£8,451	£10,000	289
£8,000	78.75%	£10,716		Total: 1,297
£10,000	83.75%	£12,882		
£12,000	88.75%	£14,973		
£15,000	91.25%	£18,001		

Effective tax rate = $(41.25\% * 575 + 53.75\% * 127 + 58.75\% * 92 + 63.75\% * 65 + 68.75\% * 64 + 73.75\% * 85 + 78.75\% * 48 + 83.75\% * 48 + 88.75\% * 48 + 91.25\% * 145) / 1,297 = 58.6\%$.

1. 'Dividends, interest etc taxed at source'.