The Revenue Elasticity of Taxes in the UK*

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Abstract

This paper provides new estimates of the revenue elasticity of income taxes in the UK over the period 1989-2000. It shows that changes in fiscal structure, including changes to income-related deductions, substantially affect these elasticities. Using new analytical expressions, estimates of consumption tax revenue elasticities for VAT and the main UK excises are also obtained. Changes in consumption patterns over time are found to be important for the magnitude of these consumption tax elasticities. A particular merit of the approach used here is that elasticity estimates can be obtained from information on relatively few parameters, almost all of which are available from published sources.

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*This paper is a substantially revised, shorter and less technical version of Creedy and Gemmell (2001a) (available at http://www.nottingham.ac.uk/~lezng), while including additional results in places. This research was supported by an ARC Small Grant, an ESRC grant, a Nuffield Foundation grant, and a University of Melbourne Faculty of Economics and Commerce Visiting Scholar grant.

1 Introduction

This paper provides new estimates of the revenue elasticity of income taxes in the UK over the period 1989-2000. These estimates allow for recent changes in the form of income-related tax deductions such as mortgages and pension contributions. It also shows how far changes in income tax revenue elasticities are due to inflation, real income growth, changes in fiscal structure, and changes in the dispersion of incomes in the UK. Comparable tax revenue elasticities for consumption taxes (VAT and the main UK excises) are estimated, allowing for changes in consumption patterns over time. Values at individual and aggregate levels are reported.

Revenue elasticities are useful for tax planning and for evaluating tax changes over a specified period. In particular, it is useful to separate observed changes in tax revenues into those which result directly from the government's discretionary fiscal changes from those which arise automatically from the revenue responsiveness properties of the tax system.[1] Revenue elasticities measure these automatic revenue changes with respect to changes in income.

The most recent estimates of income tax revenue elasticities for the UK were provided by Johnson and Lambert (1989), for the period 1980-84. From the mid-1980s, major changes have taken place to the income tax structure involving a simplification of tax rates and allowances, the reduction and elimination of mortgage tax relief and, more recently, the extension of allowances/deductions for pension contributions, savings and families. Together with a shift in the tax system away from direct taxes and towards consumption taxes such as VAT, these represent major fiscal policy changes which are likely to have affected tax revenue elasticities.

Section 2 begins with some evidence on recent changes in UK tax revenues. Section 3 provides estimates of UK income tax revenue elasticities. Corresponding estimates of consumption tax revenue elasticities are reported

[1] For a review of analytical expressions and concepts, and references to alternative estimation methods, see Creedy and Gemmell (2001).

Table 1: Tax Revenue and Buoyancy

		Tax revenue (millions)		
Year	Total income	Income tax	Income and wealth tax	Consumption tax
1979	102000	18500	29480	24313
1984	157000	30900	54920	43023
1989	333000	53400	84927	64344
1999	531550	92500	145413	124409
2000	556000	97000		
Period			Buoyancy	
1979-1984		1.189	1.443	1.323
1984-1989		0.728	0.580	0.535
1989-1999		1.175	1.150	1.410
1989-2000		1.164	-	-

in section 4. These estimates are of aggregate revenue elasticities. Results at the individual level are presented in section . Conclusions are in section 6.

2 Tax Buoyancy

Fiscal authorities typically change fiscal parameters and structures from year to year. This affects 'revenue buoyancy', defined as the ratio of the observed increase in revenues to the observed increase in incomes. Buoyancy therefore includes both automatic and discretionary changes in revenues; see Gemmell (1987, p.275).[2] Comparing revenue buoyancy and elasticity gives an indication of the magnitude of discretionary fiscal changes on revenues.

Table 1 provides some evidence on the buoyancy of income and consumption taxes in the UK. Two different data sources are used. The data on total income and income tax revenue in columns two and three are taken from Inland Revenue Statistics and the final two columns are from ONS, *Economic Trends*.[3] These indicate both the relatively low buoyancy of income taxes

[2]This contrasts with its use by Robinson (1987), who used the term buoyancy to signify a revenue elasticity greater than unity.

[3]The ONS uses the term 'production taxes' to refer to VAT, excise and other indirect taxes which are referred to in this paper as consumption taxes.

throughout and the much higher buoyancy of consumption taxes over the post-1989 period.

Buoyancy of all taxes was particularly low during the cyclical upturn in 1984-89, when income growth was temporarily high. Measured over several years, income tax revenues have generally risen only around 15-20 per cent faster than incomes. Consumption tax revenues, by contrast, have been fairly buoyant over the last decade, increasing as much as 40 per cent faster than incomes. Further insight into these changes is given by revenue elasticities reported in the following sections.

3 UK Income Tax Revenue Elasticities

This section presents estimates of income tax revenue elasticities. The basic expressions needed are in subsection 3.1. Subsection 3.2 provides details of the changing income tax structure and the income distribution over the period. Subsection 3.3 examines the elasticity of effective allowances, an important component of the revenue elasticity. Subsection 3.4 reports alternative estimates of the revenue elasticity and compares them with earlier results. A decomposition analysis is reported in subsection 3.5.

3.1 Elasticity Formulae

Consider an individual with gross income of y_i and facing a multi-step income tax function, such that if $0 < y_i \leq a_1$, the tax paid is $T_{y_i} = 0$; if $a_1 < y_i \leq a_2$, $T_{y_i} = t_1 (y_i - a_1)$; if $a_2 < y_i \leq a_3$, $T_{y_i} = t_1 (a_2 - a_1) + t_2 (y_i - a_2)$, and so on. Hence if y_i falls into the kth tax bracket, so that $a_k < y_i \leq a_{k+1}$, and $a_0 = t_0 = 0$, income tax can be expressed for $k \geq 1$ as:

$$\begin{aligned} T_{y_i} &= t_k (y_i - a_k) + \sum_{j=0}^{k-1} t_j (a_{j+1} - a_j) \\ &= t_k (y_i - a'_k) \end{aligned} \tag{1}$$

where $a'_k = \sum_{j=1}^{k} a_j (t_j - t_{j-1}) / t_k$. The function in (1) is equivalent to a single-step tax structure having a marginal rate, t_k, imposed on the individual's income in excess of an effective threshold of a'_k.

Creedy and Gemmell (2001a) show that, for this tax function, the individual elasticity, η_{T_y,y_i}, is:

$$\eta_{T_y,y_i} = 1 + \left(\frac{a'_k}{y_i - a'_k}\right)\left(1 - \eta_{a'_k,y_i}\right) \tag{2}$$

This shows that the elasticity must exceed unity if the elasticity of effective allowances, $\eta_{a'_k,y_i} < 1$. Letting $T_Y = \sum_{i=1}^{N} T_i$ and $Y = \sum_{i=1}^{N} y_i$, the aggregate income tax revenue elasticity is expressed as:

$$\eta_{T_Y,Y} = \sum_{i=1}^{N}\left(\frac{T_{y_i}}{T_Y}\right)\eta_{T_y,y_i}\eta_{y_i,Y} \tag{3}$$

Evaluation of the aggregate elasticity therefore requires knowledge of the extent to which individuals' incomes change when aggregate income changes, $\eta_{y_i,Y}$. It is often assumed that $\eta_{y_i,Y} = 1$ for all i.

3.2 Income Distributions and Tax Structures

The UK tax structure in recent years has taken a two-step or three-step form. Details for the 1989-2000 period are given in Table 2. These values allow the relevant tax function parameters (t_k, a'_k) to be computed for individual in each year.

Computation of the aggregate revenue elasticity requires information about the distribution of incomes in each year. This section uses annual data on the distribution of taxpayers' incomes from Inland Revenue Statistics (IRS). These data are not available at the individual level, but cover all taxpayers sorted into 15 income groups for most years.[4] The year 1998 is the last for which these income distribution data are currently available. Since the lower income limit in IRS income distribution data for each year is that year's single person's allowance, this is also used to measure the a_js.[5]

[4] In 1992, 1997, and 1998 there were 14 groups, and in 1989 there were 16 income groups.

[5] Using the married person's allowance makes little difference to the revenue elasticity estimates reported below. Furthermore, the declining (tax credit) value and recent withdrawal of the married allowance for almost all married taxpayers means that revenue elasticity estimates for recent years would be unaffected. Age-related allowances have been ignored in the calculations.

Table 2: Income Tax Structures: 1989-2000

	Marginal Rates			Income Thresholds		
year	t_1	t_2	t_3	a_1	a_2	a_3
1989	0.25	0.4	-	2785	23485	-
1990	0.25	0.4	-	3005	23705	-
1991	0.25	0.4	-	3295	26995	-
1992	0.2	0.25	0.4	3445	5445	27145
1993	0.2	0.25	0.4	3445	5945	27145
1994	0.2	0.25	0.4	3445	6445	27145
1995	0.2	0.25	0.4	3525	6725	27825
1996	0.2	0.24	0.4	3765	7665	29265
1997	0.2	0.23	0.4	4045	8145	30145
1998	0.2	0.23	0.4	4195	8495	31295
1999	0.1	0.23	0.4	4335	5835	32335
2000	0.1	0.22	0.4	4385	5905	32785

The IRS data are used to obtain the mean and variance of the income distribution for each year, and these values are used to parameterise a simulated lognormal income distribution. Table 3 provides estimates of the mean and variance of log-income in each year 1989-2000 used in simulations.[6] Each revenue elasticity was obtained using a simulated population of 20,000 individuals, drawn at random from the appropriate lognormal distribution.

3.3 Effective Allowance Elasticities

Equation (2) shows that when there are income-related deductions, their income elasticity, $\eta_{a'_k,y_i}$, can have an important effect on the elasticity of tax revenues. Annual estimates of $\eta_{a'_k,y_i}$ were obtained from IRS data on allowances and deductions, by income group, using regressions of the form:

$$\log a'_{kj} = \alpha + \beta \log y_j \tag{4}$$

[6]Though IRS income distribution data decomposed into 15 income groups are unavailable after 1998, a more limited decomposition is available for 2000, allowing an income growth rate of 2.27 per cent per annum to be estimated (for a consistent definition of income). From this the values of μ for 1999 and 2000 can be obtained. The values of σ^2 for these years are simply taken as being the same as in 1998.

Table 3: Mean and Variance of Log-income and Revenue Elasticities

year	μ	σ^2	$\eta_{a'_k,y_i}$	$\eta_{T_Y,Y}$ $(\eta_{a'_k,y_i}=0)$	$\eta_{T_Y,Y}$ $(\eta_{a'_k,y_i}>0)$
1989	9.323	0.472	0.450	1.380	1.209
1990	9.246	0.438	0.379	1.418	1.260
1991	9.308	0.434	0.370	1.418	1.263
1992	9.336	0.431	0.331	1.468	1.313
1993	9.356	0.433	0.275	1.471	1.341
1994	9.375	0.438	0.212	1.473	1.373
1995	9.403	0.446	0.214	1.472	1.371
1996	9.459	0.448	0.265	1.487	1.358
1997	9.509	0.445	0.250	1.501	1.376
1998	9.555	0.456	0.264	1.497	1.366
1999	9.583	0.456	0.264	1.529	1.389
2000	9.611	0.456	0.264	1.538	1.396

where there are $j = 1, ..., n$ income groups. Estimates of the coefficient β provide estimates of the required $\eta_{a'_k,y_i}$ values. Since a'_{kj} takes discrete jumps at income levels where higher marginal income tax rates apply, up to two dummy variables were added to these regressions to allow for these discrete changes. The use of a double-log specification is similar to that followed by Johnson and Lambert (1989) who used Family Expenditure Survey (FES) data for a single year. In view of the considerable changes to the form of income-related deductions from the early 1990s, new annual estimates of $\eta_{a'_k,y_i}$ are required.[7]

Table 3 confirms the empirical importance of obtaining annual estimates. The elasticity of allowances with respect to income declined sharply from 0.45 in 1989 to around 0.2 in 1994, thereafter stabilising and rising slightly to around 0.25 in 1998, the last year for which IRS deductions data are available. Data on the composition of deductions reveals that the declining

[7] Johnson and Lambert's (1989) estimate of 0.58 for the income elasticity of deductions is not directly comparable with that obtained here since they use the 'subpopulation of deduction takers' (rather than all income recipients) as the basis for their regression estimates. FES data are also likely to produce rather different outcomes to those obtained from IRS data.

value of $\eta_{a'_k,y_i}$ to 1994 largely reflects the falling real value of mortgage interest tax relief. Further falls thereafter are masked by the introduction of MIRAS in 1993 and 1994 such that mortgage interest tax relief dropped out of the deductions data from 1994.

However, the change in the data coverage does not account fully for the change in trend in $\eta_{a'_k,y_i}$ from 1994. Firstly, under MIRAS, successive budgetary changes reduced mortgage interest tax relief (to zero by 2000), so that if mortgage deductions were included in later data, they would have a declining effect to 1999 and none thereafter. Secondly, responses to the increasing tax deductibility of occupational and private pensions caused these components to rise substantially from the middle 1990s. Since such pensions are predominantly held by higher income earners this has contributed to the rising value of $\eta_{a'_k,y_i}$ in recent years, a trend which seems likely to continue.

3.4 Income Tax Revenue Elasticities

Table 3 also shows income tax revenue elasticities over the period 1989-2000, assuming equi-proportional income changes, whereby $\eta_{y_i,Y} = 1$ for all i.[8] Two values of $\eta_{T_Y,Y}$ are reported. The first uses the simplifying assumption that personal allowances and deductions are unrelated to income, so that $\eta_{a'_k,y_i} = 0$ for all individuals. The second series of elasticities uses the estimates of $\eta_{a'_k,y_i}$ reported in Table 3.

The table shows clearly that the inclusion of income-related deductions has an important effect on the revenue elasticity of income taxes. Assuming $\eta_{a'_k,y_i} = 0$ suggests a revenue elasticity of 1.38 in 1989, rising to 1.54 in 2000. However, allowing for income-related deductions lowers the revenue elasticity estimates to 1.21 in 1989, rising to 1.40 by 2000.

These values may be compared with earlier results. Using rough estimates of aggregate effective average and marginal tax rates of approximately 17 and 27 per cent respectively, Robinson (1987) suggested that the aggregate income tax revenue elasticity was around 1.6 during the early 1980s. Johnson and Lambert (1989) confirmed estimates in the region of 1.5 to 1.64 for 1980-

[8] Creedy and Gemmell (2001) show that disequalising non-equiproportional income changes are expected to raise the revenue elasticity.

84. With the decline in the marginal tax rate faced by most taxpayers since that period, and the rise in real incomes relative to tax thresholds, it is not surprising that the income tax revenue elasticity has subsequently fallen, though of importance are *relative* changes in marginal and average tax rates. The evidence presented here suggests that income tax revenue elasticities since 1989 have been well below the earlier estimates, but appear to be rising.

3.5 Decomposing the Revenue Elasticity

Though revenue elasticities capture the effects of automatic revenue changes, as equation (2) makes clear these elasticities are also affected discretionary changes in the tax structure. Indeed, changes in the revenue elasticity can be decomposed into changes due to the growth of nominal incomes, alterations to tax rates and thresholds, and changes in the deduction-income relationship, caused by fiscal decisions and endogenous responses by taxpayers. In addition, since the Rooker-Wise amendment ensures that tax thresholds are indexed to prices in the absence of alternative fiscal decisions, it is useful to decompose the first effect further into changes due to real income growth and changes due to the hypothetical indexation of tax thresholds to inflation.

These decompositions are illustrated in Figure 1. This shows that the observed change in the revenue elasticity is substantially due to fiscal decisions which changed the deductions-income elasticity and which altered tax rates and allowances. The revenue elasticity has been only modestly reduced by real income growth, and only slightly increased by inflation. In 1999 and 2000, the Labour government's income tax reforms (over-indexing thresholds and reducing the 'standard' and 'lower' tax rates), had the effect of increasing the income tax system's revenue responsiveness. That is, the apparent sacrifice of some income tax revenues immediately after the budgetary change was compensated by a faster subsequent automatic growth in revenues as a direct result of these budgetary changes.

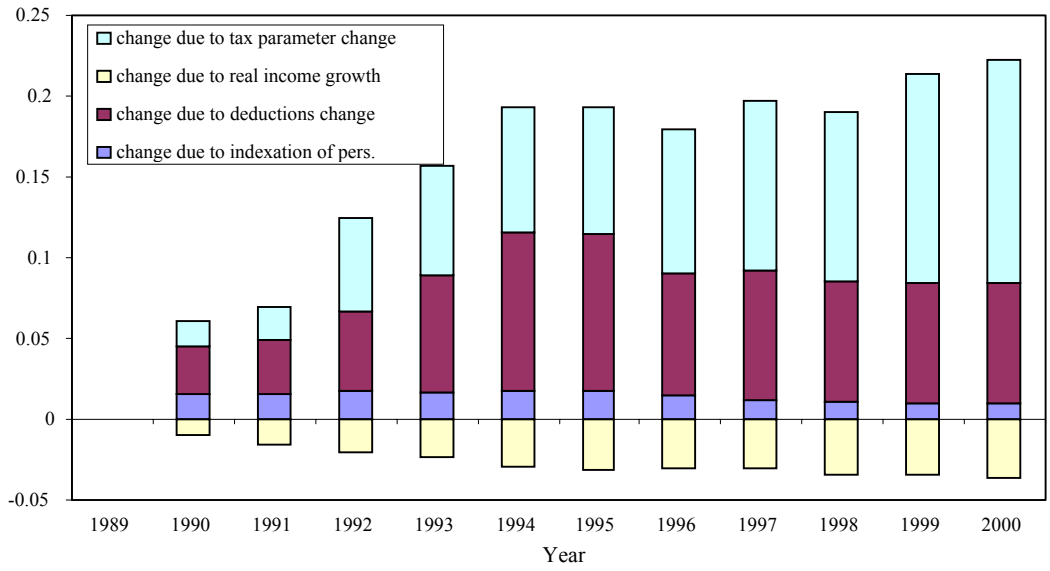

Figure 1: Decomposition of Income Tax Revenue Elasticities 1989-2000

4 Consumption Tax Revenue Elasticities

This section presents estimates of the consumption tax revenue elasticity over the period 1989-2000. Consumption tax revenue elasticities depend both on the extent to which net income changes as gross income changes and on the way in which consumption expenditure responds to changes in net income. In addition, they depend on the precise structure of consumption taxes. The basic formulae are in subsection 4.1. Subsection 4.2 describes the tax structure and budget share data used, and elasticity estimates are reported in subsection 4.3. Since the budget shares of different expenditure items are not constant over time, subsection 4.4 shows how this affects consumption tax elasticities.

4.1 Basic Formulae

Define z_i as individual i's net income, so that:

$$z_i = a_k' t_k + y_i \left(1 - t_k\right) \tag{5}$$

Suppose a proportion, γ_i, of z_i is consumed, so that total consumption expenditure, m_i, is $\gamma_i z_i$. In general, γ_i can vary with z_i and hence with y_i, as discussed below.

If the tax-exclusive indirect tax rate imposed on the ℓth good (for $\ell = 1, ..., n$) is v_ℓ, the equivalent tax-inclusive rate is $v'_\ell = v_\ell / (1 + v_\ell)$. Define $w_{i\ell}$ as person i's budget share of the ℓth good. The consumption tax paid on all goods, T_{v_i}, is given by:

$$T_{v_i} = m_i \sum_{\ell=1}^{n} v'_\ell w_{i\ell} \tag{6}$$

Let $e_{i\ell}$ denote the total expenditure elasticity of demand for the ℓth good by person i. It can be shown that the individual consumption tax revenue elasticity, η_{T_v,y_i}, is given by:

$$\eta_{T_v,y_i} = \left(\eta_{\gamma_i,y_i} + \eta_{z_i,y_i}\right) \left\{\sum_{\ell=1}^{n} \left(\frac{T_{i\ell}}{T_{v_i}}\right) e_{i\ell}\right\} \tag{7}$$

where:

$$\eta_{z_i,y_i} = \left(1 - \frac{T_{y_i}}{y_i}\right)^{-1} \left(1 - \frac{T_{y_i}}{y_i}\eta_{T_y,y_i}\right) \tag{8}$$

Furthermore, suppose that:

$$m_i = a\left(z_i + b\right) \tag{9}$$

This allows for the non-proportionality in the relationship between expenditure and net income often observed in practice, for example, because of transfers received by those on low incomes. Creedy and Gemmell (2001a) show that:

$$\eta_{\gamma_i,y_i} = \frac{b}{y_i - T_{y_i} + b} \left(1 - \frac{T_{y_i}}{y_i}\right)^{-1} \left(1 - \frac{T_{y_i}}{y_i}\eta_{T,y_i}\right) \tag{10}$$

which may be substituted into (7). With suitable values of a and b, estimates of the individual revenue elasticity, η_{T_v,y_i} are readily obtained.[9] The aggregate consumption tax elasticity can then be calculated, following (3), using:

$$\eta_{T_V,Y} = \sum_{i=1}^{N} \left(\frac{T_{v_i}}{T_V}\right) \eta_{T_v,y_i}\eta_{y_i,Y} \tag{11}$$

[9] Alternative specifications of the relationship between income and expenditure can be used but the linear form in (10) appears to work well.

where T_V is aggregate consumption tax revenue. Furthermore, if $T = T_Y + T_V$, the elasticity of total revenue with respect to aggregate income can be found as a tax-share weighted average of the income and consumption tax revenue elasticities.

4.2 Tax and Budget Share Data

Inspection of equation (7) reveals that estimation of the elasticity, η_{T_v,y_i}, requires information on (i) the relevant budget shares and total expenditure elasticities; (ii) how the consumption proportion,γ_i, varies with individuals' incomes and; (iii) data on income and consumption tax parameters. For the purposes of estimating budget shares and expenditure elasticities, it is only necessary to distinguish between goods with different indirect tax rates. For example, all expenditure items subject to VAT at 17.5 per cent, and not liable to other taxes, can be treated as a single item.

With the exception of savings proportions, this information is readily available, by income group, annually in the UK or can be calculated from family expenditure surveys, Inland Revenue, H.M. Treasury and other official sources.[10] Using (11) above, aggregate revenue elasticities for consumption taxes are obtainable from the IRS taxpayer income distribution, as the tax revenue share weighted sum of the revenue elasticities for each income group.

The calculation of budget shares and expenditure elasticities for each of a range of total expenditure groups used published FES data. These can distinguish between 10 groups of consumer goods currently subject to different levels of indirect tax. The categories are: goods subject to VAT at 17.5 per cent, 5 per cent (domestic fuel and power), and 0 per cent; beer; wines; spirits; other alcohol; tobacco; motor fuel; and insurance.[11] Budget shares generally fall as total household expenditure rises across income groups in the cases of VAT-exempt goods, tobacco, and domestic fuel and power.

[10] See http://www.inlandrevenue.gov.uk/stats/ and www.hm-treasury.gov.uk/budget2000/fsbr/contents.htm. Relevant fiscal data are taken from IFS 'fiscal facts' at http://www.ifs.org.uk.

[11] Though domestic fuel and power and insurance were not subject to these tax rates throughout the period, they are examined separately for the entire 1989-2000 period so that each category is composed of the same goods throughout the period.

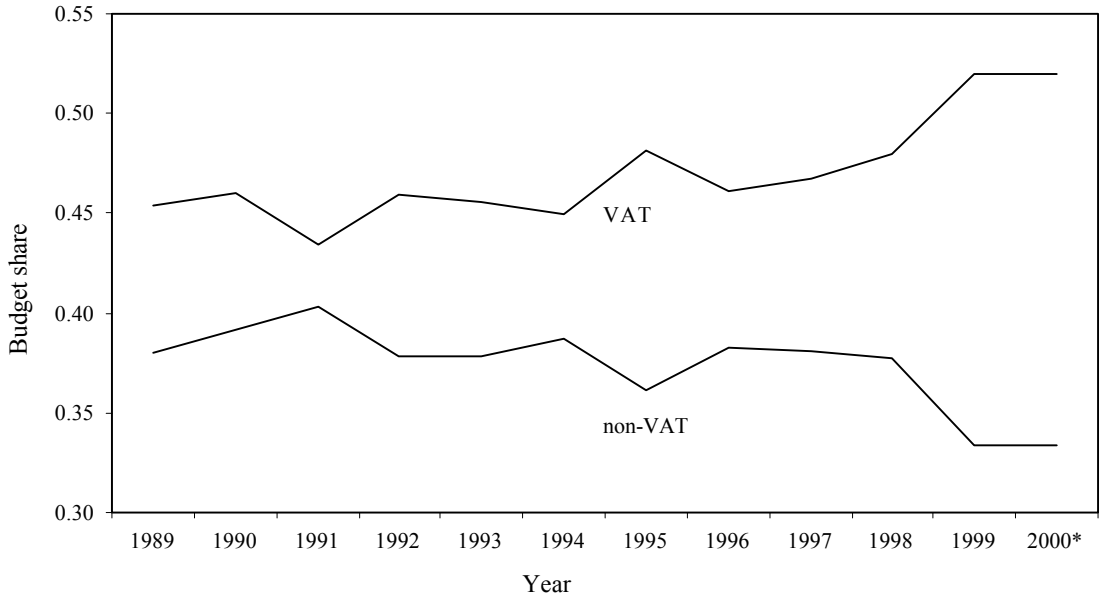

Figure 2: Aggregate Budget Shares 1989-2000

The shares rise in the case of goods at 17.5 per cent VAT, wines, other alcohol and motor fuel. In the cases of beer, spirits and insurance budget shares show a tendency to rise initially before falling in the higher total expenditure groups.

Aggregate budget shares over the period are shown in Figure 2 for standard rate (15 per cent, and 17.5 per cent) and zero rate/exempt (0 per cent) VAT items. This reveals both the general tendency towards greater spending on VAT-liable items over time as real incomes grow and the temporary fall in the share of standard VAT items in 1991, and rise in 1995. While the former change most likely represents a response to the increase in the standard rate of VAT in 1991, the reason for the particularly large rise in the VAT-liable share in 1995 (and subsequent fall) is less clear. The aggregate budget share of domestic fuel and power (not shown in Figure 2) fell steadily from almost 5 per cent in 1994 when 8 per cent VAT was introduced, to around 3 per cent by 2000.

Table 4 gives details of the consumption tax structure over the period 1989

Table 4: Consumption Tax Rates: 1989-2000

year	VAT	insur-ance	beer	wines	spirits	other alcohol	tobacco	petrol	dom fuel
1989	15.0	0	49.25	88.68	194.12	80.44	284.6	156.41	0
1990	15.0	0	47.06	88.68	194.12	79.11	284.6	163.16	0
1991	17.5	0	49.25	92.31	185.71	80.05	316.7	194.12	0
1992	17.5	0	49.25	92.31	194.12	81.31	316.7	203.03	0
1993	17.5	0	49.25	96.08	177.78	79.79	316.7	212.50	0
1994	17.5	5	44.93	100.00	185.71	79.26	316.7	244.83	8
1995	17.5	5	44.93	104.08	203.03	82.84	354.5	284.62	8
1996	17.5	5	44.93	104.08	185.71	80.24	354.5	316.67	8
1997	17.5	5	42.86	96.08	163.16	73.68	376.2	316.67	5
1998	17.5	5	42.86	104.08	170.27	76.66	376.2	376.19	5
1999	17.5	5	47.06	112.77	177.78	82.44	455.6	614.29	5
2000	17.5	5	47.06	117.39	170.27	82.42	614.3	733.33	5

to 2000. Tax rates are in percentage, tax-exclusive, form; that is, they are values of $100v = 100v'/(1-v')$. Rates for alcohol, tobacco and petrol appear precise because these were calculated from tax-inclusive rates published by the IFS, see Chennells *et al.* (2000). For example the rate of $100v = 49.25$ for beer in 1989 is equivalent to $100v' = 33$. The values in Table 4 demonstrate both the wide variety of tax rates across expenditure items and the high rates on expenditures such as tobacco and petrol. Given the wide dispersion in tax rates, the effective average and marginal rates of consumption tax in any given year are far from clear, but are readily obtained below from simulations.

As shown earlier, consumption tax revenue elasticities require values for the parameters a and b. Benchmark values were chosen such that $a = 0.95$, with b calculated such that (for each year) a person with $z_i = 0$ has consumption, $m_i = ab$ equal to the value of the single person's income tax allowance.[12] This provides a convenient benchmark because the single person's allowance is also the minimum income level recorded in the IRS income distribution

[12]The Office of National Statistics, *Economic Trends* provides some data on the average proportion of disposable income consumed, which reveals figures between around 5 per cent and 12 per cent since 1989.

database. However the existence of social transfers could lead to consumption at very low income levels exceeding or falling short of this level. For example, FES data for most years suggest that, for the lowest income decile, average consumption expenditure marginally exceeds the upper income boundary for this group. Benchmark values of b used are shown in Table 5. Sensitivity to these values was also examined and is discussed below.

4.3 Elasticity Estimates for Consumption Taxes

Consumption tax revenue elasticity estimates for each year were based on equation (7) using a simulated distribution of 20,000 taxpayers, as in section 3. The results are shown in Table 5, for all indirect taxes combined.[13] It can be seen from column 3 that the consumption tax revenue elasticity generally fell during the period, from around 1.3 or 1.4 in the early 1990s to about 1.15 by 2000. As expected, comparison with Table 3 reveals a tendency for the consumption tax elasticity to move inversely with the elasticity of income taxes. As (8) and (7) show, the more elastic are income tax revenues (η_{T_y,y_i}), the lower is η_{z_i,y_i} and hence, *ceterus paribus*, the lower is the revenue elasticity of consumption taxes.[14]

Failure to acknowledge the role of savings would have a substantial effect on consumption tax revenue elasticity estimates, as shown in Table 5 (column 4). The allowance for savings reduces the revenue elasticity in each year, though there is a minimal impact on the time-series pattern. However, failure to include a savings effect makes consumption tax revenues appear to be inelastic from the early 1990s.

Table 5 also reveals that, when the income tax structure is relatively flat, as it became after the budget reforms of the middle 1980s, this generates an especially low income tax revenue elasticity, so that it is possible for the elasticity of consumption taxes to exceed that for income taxes. This appears to have happened in the late 1980s and early 1990s.

[13] It would be possible to apply the methods used here to examine tax revenue elasticities for individual consumption expenditures.

[14] The finding that the consumption tax revenue elasticity exceeds that of income taxation for the earlier years is consistent with evidence on indirect tax buoyancy shown below.

Table 5: Consumption Tax Revenue Elasticities

Year	b	Current year shares savings	Current year shares no savings	1993 shares	1989 shares	$\eta_{R,Y}$
1989	2932	1.293	1.078	1.191	1.293	1.238
1990	3163	1.358	1.109	1.224	1.314	1.290
1991	3468	1.411	1.141	1.239	1.329	1.320
1992	3626	1.241	1.020	1.230	1.319	1.286
1993	3626	1.219	1.006	1.219	1.307	1.294
1994	3626	1.154	0.946	1.184	1.269	1.286
1995	3711	1.131	0.924	1.181	1.268	1.275
1996	3963	1.159	0.953	1.191	1.281	1.276
1997	4258	1.182	0.964	1.207	1.303	1.267
1998	4416	1.179	0.971	1.194	1.290	1.290
1999	4563	1.162	0.959	1.188	1.286	1.290
2000	4616	1.158	0.957	1.182	1.280	1.298

Experiments showed that the results in Table 5 appear not to be sensitive to the values of a and b. For example, the benchmark revenue elasticity estimate of 1.162 in 1999 rises by only 1.1 per cent (to 1.175) when b is raised by almost 10 per cent to £5000. Similarly, reducing a by approximately 5 per cent increases the revenue elasticity by about 1.4 per cent.

4.4 The Impact of Budget Share Changes

The changes in the revenue elasticity of consumption taxes in Table 5 arise both from changes to fiscal parameters (income and consumption taxes) and from changes in consumers' budget shares (such as the movement away from zero-rated VAT expenditures and domestic fuel). Some changes in consumers' spending patterns may be partly in response to these fiscal changes. For example, the average budget shares in Figure 2 suggest a temporary reduction in expenditures on VAT-liable items in 1991 when the rate was raised to 17.5 per cent and a longer-term trend towards a lower domestic fuel expenditure share following the introduction of VAT in 1994.

Nevertheless it is interesting to compare the consumption tax revenue elasticity based on contemporary budget shares with those based on un-

changed 1989 and 1993 budget shares; see Table 5.[15] The greater variation shown in column 3, that is using contemporary shares, indicates the importance of allowing for changes in consumption patterns over time. Fiscal changes, most of which relate to income taxation, also appear to have had a significant role, as is evident from changes in the elasticity values in columns 5 and 6 when shares are held constant.

The final column of Table 5 reports the elasticity of the combined income and consumption tax revenue, using current year budget shares and allowing for savings. This indicates that the generally declining values of the consumption tax revenue elasticity over time were almost exactly compensated by the rises in the income tax revenue elasticity. As a result the overall revenue elasticity was fairly constant, at least from 1990, at around 1.29. However, the value has been rising since 1997.

5 Individual Elasticities

Aggregate revenue elasticities are likely to be most useful for tax planning purposes, but individual elasticities can also be important to identify those taxpayers likely to experience the greatest change in tax liabilities as their incomes or fiscal parameters change. This section shows how revenue elasticities, marginal and average tax rates vary across income levels for specified individuals.

Furthermore, the individual tax revenue elasticity can be expressed as:

$$\eta_{T,y_i} = \frac{MTR_i}{ATR_i} \tag{12}$$

where MTR_i and ATR_i are the marginal and average tax rates faced by an individual with income y_i. Hence it is easy to obtain from simulations the implicit tax rates faced by individuals at different income levels. Table 6 shows ATR_i, MTR_i and elasticity values for both income and consumption

[15] From 1993, FES data are arranged by income deciles rather than the 16 income groups used perviously. As a result, from 1993, comparisons using contemporaneous and 1993-based budget shares are likely to be more accurate than those based on 1989 budget shares.

Table 6: Individual Revenue Elasticities and Tax Rates

Annual Income	η_{T_y,y_i}	MTR_{y_i}	ATR_{y_i}	η_{T_v,y_i}	MTR_{v_i}	ATR_{v_i}	$ATR^*_{v_i} = T_{v_i}/m_i$
5000	5.798	0.075	0.013	1.601	0.405	0.253	0.140
10,000	1.792	0.199	0.111	1.324	0.246	0.186	0.146
15,000	1.389	0.210	0.151	1.233	0.200	0.162	0.148
20,000	1.257	0.214	0.170	1.175	0.175	0.149	0.148
25,000	1.192	0.217	0.182	1.115	0.157	0.141	0.148
30,000	1.154	0.219	0.190	1.083	0.146	0.135	0.148
35,000	1.673	0.350	0.209	0.910	0.117	0.129	0.148
40,000	1.592	0.356	0.233	0.920	0.114	0.124	0.148
45,000	1.435	0.360	0.251	0.910	0.107	0.118	0.146
50,000	1.370	0.364	0.266	0.915	0.104	0.114	0.146

taxes for specified individual income levels from £5,000 to £50,000, using 1999 fiscal parameters and budget shares (the most recent year available).

Table 6 shows the tendency for revenue elasticities to decline as income increases, but with a step increase for income tax and a step decrease for consumption tax when incomes cross the relevant income tax threshold (at £5835 and £32335 in 1999). The MTRs for income taxes are not simply the statutory 0.23 and 0.40 rates. They also reflect the effects of income-related deductions which reduce the effective marginal tax rate below the statutory rate at each income level. For consumption taxes, marginal and average rates both fall as income increases, with the marginal rate falling below the average rate for incomes in excess of £32335. This latter phenomenon reflects the impact of the income tax structure on the marginal rate of consumption tax.

Around mean income levels, approximately £18,200 in 1999, the MTRs and ATRs of consumption taxes as a whole are approximately 18 per cent and 15 per cent respectively. At low income levels, consumption tax rates appear surprisingly high (for example, $MTR_{v_i} = 0.4$ at $y_i = 5000$). However, this reflects the calculation of tax rates from tax payments relative to earned incomes, y_i. Unearned income and proportionately lower income tax payments give a relative boost to expenditures, and consumption tax payments, for such individuals. The more relevant tax base for consumption taxes is

total expenditure. It can be seen from column 8 that average consumption tax rates, $ATR^*_{v_i}$, are much lower at low income levels and are approximately constant across income levels, at around 15 per cent.[16]

6 Conclusions

This paper has examined the revenue responsiveness properties of UK income and consumption taxes since the late 1980s using recently developed expressions for tax revenue elasticities. These allow elasticities to be derived in terms of relatively few parameters for which data are usually readily available. Using annual Inland Revenue income distribution data to estimate the parameters of a lognormal income distribution, which is used to simulate a population, together with data on income tax rates, allowances and deductions, annual income tax revenue elasticity estimates were obtained for 1989-2000.

The results revealed that an important component of the revenue elasticity – the income elasticity of income-related deductions – appears to be variable over time. It fell substantially with the progressive limitation and then the withdrawal of mortgage interest tax relief. But it stabilised in the middle 1990s and has begun to increase again in recent years with the rise in private pension schemes.

Income tax revenue elasticity estimates obtained here, of around 1.3 to 1.4 in the early 1990s, are much lower than those previously estimated for the middle 1980s, reflecting in part the flattening of the income tax structure since that time. They are also more in line with the observed buoyancy of income taxes of around 1.16. This suggests that discretionary tax changes have, *ceterus paribus,* considerably reduced tax revenues, causing the tax elasticity substantially to exceed buoyancy, especially in the late 1990s. In addition, income tax revenue elasticities appear to be rising during the 1990s

[16] It is this latter average tax rate which is relevant for assessing the degree of progression of consumption taxes and these would appear overall to be approximately proportional. Implicitly therefore, the tendency for higher income individuals to spend proportionately more on VAT-liable items is compensated by proportionately smaller expenditures on other taxed goods.

partly in response to the increased deductions referred to above, and the reversal of some of the 1980s tax reforms.

Elasticity estimates for consumption taxes reveal interesting results. Since these taxes are often regarded as only mildly progressive, their elasticity has generally been presumed to be close to unity. However, when the impacts on the consumption tax revenue elasticity of savings rates, the revenue responsiveness of income taxes, and changing consumption patterns towards tax-liable goods are recognised, values for the revenue elasticity of around 1.2 are obtained for recent years. Indeed, in the early 1990s, the revenue elasticity of consumption taxes appears to have been even higher and to have exceeded that for income taxes. With consumption tax buoyancy around 1.4 over this period, discretionary tax changes have tended to raise, rather than reduce, revenues *ceterus paribus*.

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