The Distributional Consequences of Environmental Taxes

by

Paul Johnson
Steve McKay
Stephen Smith

The Institute for Fiscal Studies
180/182 Tottenham Court Road
London W1P 9LE

071 – 636 3784

July 1990

Published by

The Institute for Fiscal Studies
180/182 Tottenham Court Road
London W1P 9LE

(Tel. 071 – 636 3784)
(Fax 071 – 323 4780)

ISBN 0 – 902992 – 95 – 3

Printed by

The Chameleon Press Ltd
5 – 25 Burr Road, Wandsworth, London SW18 4SG

Preface

This Commentary forms part of a programme of research at the Institute for Fiscal Studies supported by Friends of the Earth and the Inland Revenue Staff Federation. Its preparation has been aided not only by the financial resources provided by FoE and IRSF, but by the detailed advice and comments of people from both organisations.

We acknowledge the help of a number of IFS colleagues. We are grateful to Paul Baker and Mark Pearson for their comments on various drafts of the report.

The views expressed in this Commentary are the responsibility of the authors, and not necessarily those of FoE nor the IRSF, nor IFS which has no corporate views.

Data from the Family Expenditure Survey are used by permission of the Department of Employment. We alone are responsible for their analysis and interpretation in this publication.

Stephen Smith is Director of the Public Sector Programme, and Paul Johnson and Steve McKay are Research Officers, at the Institute for Fiscal Studies.

Contents

1 Introduction

The possibility that the tax system could be used as an instrument of environmental policy has recently attracted much attention. Some of the attractions of using taxes and charges to control pollution, rather than the conventional regulatory approaches, have been noted in policy discussions from different ends of the political spectrum (Ridley, 1989; Institute for Public Policy Research, 1990). A recent report from the Organisation for Economic Cooperation and Development on the use of "economic instruments" for environmental protection has catalogued the growing use of taxes and charges in the environmental policies of the major industrial countries (OECD, 1989).

Taxes are seen as having two principal advantages over direct regulation. Firstly taxes encourage the greatest reductions in pollution in areas where the costs to industries and consumers of reducing pollution are least, something that regulation could achieve only with implausibly detailed access to information about individual circumstances. A second advantage is that taxes are "technology-forcing" – in other words, they provide a continuous incentive to develop less-polluting products and processes, rather than merely encouraging the minimum compliance necessary. However, the tax approach also has drawbacks. One is that the effect on pollution of a given tax level may be very uncertain, particularly in the short term. Another, raised by Pearson and Smith (1990), is that taxes may have significant distributional and social consequences, not all of which would be encountered with conventional regulation.

The social and distributional consequences of environmental policies pursued either through taxation or through regulation include both effects on the cost of living and effects on employment. Policies to encourage the use of environmentally friendly, but more costly, production processes may increase product prices. The effects of these price rises on the cost of living generally, and the living standards of particular groups of households, may be one source of political opposition to environmental policy. The employment effects of environmental policy, in the form of job losses in the most polluting plants and industries, may be a further area of political concern, although the employment problem may, to some extent, be offset by employment opportunities in pollution control industries.

Whilst these issues of the overall social costs and benefits of environmental policies in general need to be addressed, they lie beyond the scope of the present report. This concentrates on the particular issues raised by environmental taxation, in the form of the additional tax burden and its distribution across households. It focuses in particular on the distributional effects of environmental taxation, and the measures that may be used to

offset any undesired effects of environmental taxes on poor and vulnerable households. In particular it addresses two questions: how would the extra tax burden on households resulting from environmental taxes be distributed across different income groups? What means are available to compensate poorer households or other vulnerable groups for the increase in their tax burden?

1.1 Environmental Taxes

Environmental taxes increase the prices faced by economic agents (consumers and producers), encouraging them to switch to less-polluting products through changes in relative prices. Such price changes induce consumers to switch to goods which are not affected by environmental taxes, and which are therefore now relatively cheaper.

Environmental taxes may be levied at several stages of the production process, ranging from taxes on industrial inputs that cause pollution (carbon, sulphur, etc.), to taxes on final consumer goods. Putting taxes on final products will make households worse off in a direct manner, in that more of their spending will be subject to tax. Applying taxes to industrial inputs will make households worse off in an indirect manner, through increasing the prices of outputs that use taxed polluting inputs to the greatest extent in production.

Many of the environmental taxes that are in practice operated in OECD countries are small-scale, applied to products that constitute only a small proportion of household spending (such as plastic bags, or batteries) or applied at a very low level. In these cases the distributional issues that concern us in this report are of little importance, since the limited scope of the taxes and the low rates mean that their effects on the living standards of individual households will be small. Much more important issues arise where the taxes are set at a level that constitutes a major incentive to change spending patterns, and are levied on goods forming a substantial part of the spending of individual households.

In this report we make use of the Simulation Program for Indirect Taxes (SPIT) developed at IFS (see Appendix) to examine the distributional effects of environmental policies in three areas[1] where such policies might be expected to have a significant effect on the prices of household purchases. These are:

---

1 See Pearson and Smith (1990) for more detail on the issues surrounding each of these policy options.

Domestic energy spending – an increase in the price of gas, electricity and coal for domestic uses such as heating, lighting, etc. The 15 per cent rise in prices modelled can be seen as the effect of imposing VAT at the standard rate on such spending, or as the outcome of policies such as a carbon tax on primary fuels, which would feed through into the cost and price of electricity generated.

Petrol – an increase in the duty on petrol of 55 pence per gallon.

Food – Policies to reduce water pollution and encourage less intensive agriculture could increase the price of food. We model the effect of a 5 per cent rise in food prices.

In each case we confine our attention to the effects on household incomes and spending, and do not trace through in the model the process by which prices rise. Except where we are simulating the effects of a change in taxes on consumer spending, the price changes should be taken as illustrative rather than as predictions or estimates.

The analysis extends and develops earlier work at IFS on environmental taxes (Pearson and Smith, 1990) in two principal respects – through a detailed examination of the way that different types of households would be affected by rises in the prices of each of the three categories of goods, and through an extensive discussion in Chapter 5 of the design of policies to compensate for some of the undesired effects on particular groups of households. In subsequent work, to be reported later in the year, we plan to extend the analysis by taking into account the indirect effect of environmental taxes levied on industrial inputs (industrial energy use in particular) and by making a direct link[2] between the Simulation Program for Indirect Taxes and the IFS tax and benefit model, which will allow us to examine in more detail the relationship between individual household spending patterns and the "target effectiveness" of compensation measures.

1.2 Distributional Effects of Environmental Taxes

Distributional issues have been largely ignored by the economic literature on alleviating pollution. Economic theory has been most concerned with the efficiency effects of different environmental policies; in other words, how effective such policies are in ensuring that private sector decisions

2 The present research, including the discussion of compensation in Chapter 5, is based on a link between particular *groups* of households in the two models. Since individual circumstances vary within these groups, it would be desirable to be able to make a direct linkage between the individual representative households underlying each model.

fully reflect environmental considerations. Equity issues – the distribution between households of the costs and benefits of environmental policy – have been given less attention.

It may be argued, in favour of this emphasis on efficiency, that preferences over the distribution of income can be separated from matters of economic efficiency, or that any distributional concerns may be met or offset by compensatory policies. Nevertheless, the mechanics of how this might be done have rarely been described.

The practical importance of the issue is, however, clear. Some of the areas that are likely to be the focus of environmental policies are areas of considerable distributional sensitivity. Food and domestic energy, two examples already identified, are commonly regarded as necessities, in that every household needs to consume a certain amount of each, no matter how low their spending power. Without compensation, the principal losers from policies which increase the prices of these goods are likely to be those on low incomes, or those facing the greatest needs. This is recognised by the UK VAT system which zero-rates food and energy, although this is not the case in most other EC countries.

The distributional effects of environmental policy are potentially much greater where environmental objectives are pursued using tax instruments than where regulatory approaches are used. The costs of changing to more costly production methods, or to products that, initially, appeared to offer poor value for money, are common to both the regulatory and taxation approaches, and the distribution of the costs between households may be similar in both approaches. However, taxation involves further distributional effects, in the form of the pattern of additional tax payments. Concerns that have been expressed about the impact of environmental taxes on the income distribution, or on the living standards of the poor, have to do with how the burden of these extra taxes is distributed across different households.

However, at the same time as the distribution of extra taxes is considered, the use of the tax revenues raised should also be taken into account. This revenue may be redistributed to the groups with which society is most concerned, if they are made worse off by the imposition of higher taxes. Thus, an appropriate evaluation of the use of tax instruments to reduce pollution is a revenue-neutral change – where both the extra tax revenue and the use of the extra tax revenue are considered. A revenue-neutral change may not allow us to return to the pre-reform situation (expressed in utility terms, rather than in money), but may offset the most pressing distributional problems.

Environmental taxes do not just impose costs while delivering no benefits. The point of environmental policy is, on one interpretation, to improve the quality of (human) life. We do not attempt to quantify the environmental benefits of each tax policy. Often these will accrue to the losers from the tax, say in the form of better-quality water or less traffic congestion. However, all or most of such gains may be felt by those who have not paid any extra tax. Whilst in principle these outcomes may affect the appropriate size of any compensation and the identity of the most suitable beneficiaries, problems of measuring benefits preclude their inclusion in the formal analysis.

In addition to this, one caveat to our analysis, of considerable policy significance, needs to be noted. The estimates take a sample of individual households as they currently are, and reflect their current income levels, their present stock of capital assets, and the range of opportunities for consumption currently open to them. Over time, these characteristics may of course change, and these changes could be influenced or accelerated by the environmental policies being operated. For example, higher energy prices may encourage greater investment in a household's "capital stock" of insulation and fuel efficiency, with the result that, over time, the amount of energy spending necessary to secure a given degree of warmth would fall. This capital stock might also be increased directly by complementary policies to provide or encourage insulation and fuel efficiency. Moreover, as we have noted, environmental taxes provide a continuous incentive to innovation, which may encourage the development of new opportunities for conservation and fuel efficiency. Whilst some of these longer-term changes are likely to be reflected in the experience of the 1970s and 1980s which underlies our estimates, a sustained higher energy price would undoubtedly lead to some capital investments and technological changes, not all of which can be fully predicted from the experience of earlier years.

1.3 Plan of the Report

In the following three chapters we examine the effects on households of higher prices for domestic energy, vehicle fuels and food which could result, as we describe, from the introduction of environmental taxes. In each case, the chapter begins with a descriptive analysis of the pattern of household spending on the good in question, followed by a simulation of the effects of higher prices, using the IFS Simulation Program for Indirect Taxes. Whether it is possible to devise policy measures that use some of the revenue from environmental taxes to compensate particular groups of households, such as the poor, or vulnerable groups, such as the elderly, is examined using the IFS tax and benefit model in Chapter 5. Chapter 6 draws some conclusions.

2 Energy

The energy sector is implicated in a number of environmental problems, two of particular importance. First, the burning of fossil fuels is an important contributor to emissions of greenhouse gases such as carbon dioxide. Second, fossil fuels are responsible for emissions of sulphur dioxide which are believed to cause acid rain, with consequent damage to forests and water both in the UK and abroad.

In principle, emissions of these pollutants may be curtailed in a number of ways. We classify the options as follows:

Fuel-switching – converting to fuels and processes which emit lower quantities of pollutants for a given power output.

Energy conservation – reducing the total amount of power consumed.

Emissions cleaning – removing any harmful emissions from waste gases after they have been produced.

Fuel-switching may occur at several stages of the energy supply process. An important measure could be to change the fuel mix of the electricity supply industry, to increase the use of fuel inputs which create less pollution per unit of power output. For example, natural gas produces less carbon dioxide per unit of power produced than does oil, which in turn produces less carbon dioxide than coal. (The ratio is approximately 3:4:5.[3]) Switching away from coal towards either one of these other fuels will therefore reduce carbon dioxide emissions. Burning coal is also the main cause of sulphur dioxide emissions, though some forms of coal have a lower sulphur content than others and using these would reduce the emissions that cause acid rain. Such fuel-switching might be encouraged by taxing fuels according to their content of carbon or sulphur.

An alternative form of fuel-switching is to increase the proportion of power produced by less-polluting types of power generation. Renewable sources of energy, such as wind and wave power, produce only negligible quantities of pollutants.[4]

---

3 See, for example, the Sixth Report of the Select Committee on Energy (1989), p. xxviii.

4 Nuclear power plants produce virtually no carbon dioxide, although there will be substantial amounts emitted by the construction industry in building them. However, nuclear power may create a number of environmental problems, such as nuclear waste, not to mention the risks of accidents occurring.

There is also scope for reductions in pollution by changing the fuel mix used by the household sector. The most environmentally friendly form of heating in widespread use is gas central heating, though oil and coal heating are still somewhat better than electric central heating. Whilst domestic lighting and the running of appliances need to use electricity, there is the possibility of increased gas cooking and heating.

Reducing the total amount of power consumed may be expected to result in proportionate reductions in the emission of pollutants. Of course, it is not energy itself that households require, but rather the services, such as warmth, lighting and refrigeration, that it provides. Reductions in fuel consumption need not imply reductions in the levels of such services if they are achieved through improvements in efficiency. The evidence suggests that the scope for such improvements is substantial.[5]

An alternative means of reducing fuel consumption would be to increase the price. However, this will lead to concerns regarding the health of less well-off and vulnerable groups, especially during cold winter months. A higher energy price would increase the returns to investments in increasing energy efficiency, and thus might increase the number of such investments made. However, the extent to which this will happen in practice is unclear. Hence the resulting reduction in fuel consumption might imply a reduction in the services, such as heating, that fuel provides.

The final option we identified is that of cleaning up emissions after the pollutants have been produced. At present there is no viable technology for removing carbon dioxide from power-station and industrial emissions.[6] The situation is somewhat different for emissions of sulphur from the power sector, where there is the possibility of fitting flue gas desulphurisation units (FGDs), which remove harmful sulphur emissions from the waste gases of power-stations.

A detailed investigation into each of these options is required. In this interim report, the effect of reducing energy consumption by means of a price increase is considered. Section 2.2 examines the consequences for national tax revenue, fuel consumption and income distribution of putting VAT on domestic fuel. However, the results will enable some insight into the likely effects of alternative environmental policies in the energy sector. Fitting FGDs, for example, will increase the costs of power

---

5 There is considerable scope for improving the efficiency of power generation, see Select Committee Report 6, vol. II. In the household sector, there are substantial differences in the energy performance of different appliances; see *New Scientist* (14 May 1990) for examples relating to refrigeration technology.

6 Select Committee Report.

generation, thereby increasing the price of fuel. Taxes on fuel inputs containing carbon and sulphur will have a similar effect. Hence, whilst the imposition of VAT on fuel is only one of a range of possible options, the results that emerge will be of relevance to some of the other policies mentioned.

2.1 Household Energy Spending

In this section a number of empirical findings concerning fuel spending are presented. For example, the differences between households with and without retired persons, and at different levels of the income distribution, will be described. These provide the basis for analysing the distributional effects of any policy changes within the fuel sector. The data for this enquiry come from the 1986 Family Expenditure Survey (FES), an annual survey in which some 7,000 households provide details of their demographic characteristics and spending behaviour.[7] For example, household members provide details of their ages, occupational and marital status, earnings, and so on, and keep a diary record of all items of spending over a two-week period. The expenditure information is supplemented by a questionnaire requesting details of larger items of spending over a longer time period.

Since we are interested, here, in the distributional impact of possible policies, we begin with an analysis of fuel spending at different levels of household income. Table 2.1.1 gives details of fuel and total spending, by income deciles.[8] It is clear that richer households spend, on average, more on energy. However, spending on fuel increases at a less rapid rate than total spending: for example, the highest decile spends about eight times as much in total as the lowest decile, but only just over twice as much on domestic fuel. The final column indicates that domestic heat and light takes up a greater proportion of the budget of the poor than it does for the rich. This suggests that taxing fuel is likely to have a "regressive" impact upon the distribution of income, in that the increases in tax paid by poorer households will be a higher proportion of their budget than the increases in tax paid by richer households.

---

7 The advantages and disadvantages of this survey for the work discussed are summarised in the Appendix.

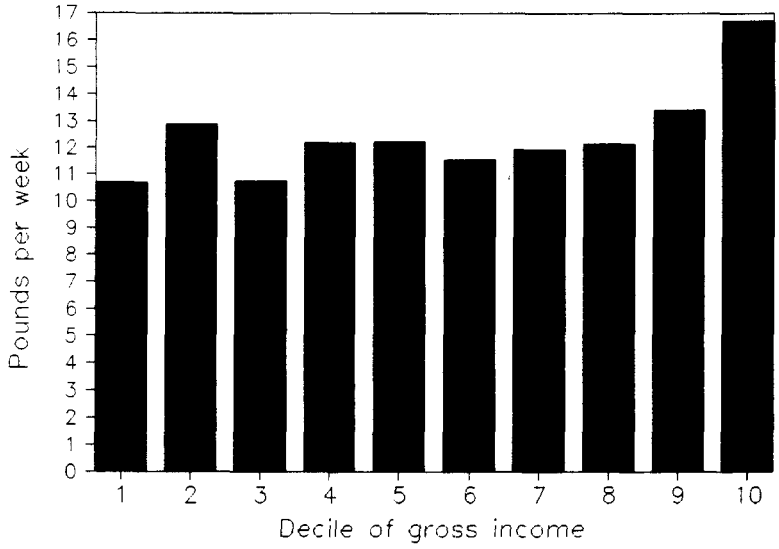
8 Income deciles divide households up into 10 groups of equal size. The bottom decile are the poorest 10 per cent of households, the second decile are the next poorest 10 per cent, and so on.

Table 2.1.1
Fuel spending, by decile of gross income

Decile of gross income	Average income	Average spending (£ per week)	Fuel spending (£ per week)	Budget share (as % of spending)
Lowest	41.62	60.00	7.95	13.25
2	65.75	88.13	10.05	11.40
3	93.71	121.80	10.38	8.53
4	131.31	160.13	11.19	6.99
5	173.56	201.10	11.46	5.70
6	218.19	213.75	11.21	5.25
7	265.61	252.90	12.30	4.86
8	317.09	289.18	12.64	4.37
9	394.15	349.69	13.69	3.92
Highest	644.07	488.99	16.92	3.46
Average	234.51	222.57	11.78	5.29

Concealed within the table, however, are differences in household composition. Households containing more people tend to have more income and to spend more. If we disaggregate the population we find that expenditure on domestic energy is even less affected by income when households of similar composition are compared. Figure 2.1.1, for example, shows the position for two-adult households.

Figure 2.1.1: Fuel spending by two-adult households



Whilst fuel spending still tends to increase with income level, the relationship is far weaker than Table 2.1.1 suggests. For any particular type of household, an increase in income is associated with, at most,

small increases in fuel spending. This suggests that fuel taxes affect the living standards of poorer households much more than those of richer households.

The amount of fuel spending needed to achieve any given level of heating will be affected by the fuel efficiency of heating apparatus, and by investments in energy-saving measures. Table 2.1.2 shows that more affluent households are more likely to have central heating. Moreover richer households are relatively more likely to have gas central heating than heating of other types: in the lowest decile, gas outnumbers other types of central heating by 1.5 to 1, whereas the corresponding figure for the highest decile is 4.5 to 1. Electric central heating is most common amongst poorer households.[9]

Thus a pollution tax which differentiated between electricity and gas, with a higher rate for electricity, would have consequences more regressive than the across-the-board increase that is considered in this paper.[10] Such a tax might aim to encourage households to switch from one type of domestic heating to another. However, Table 2.1.2 suggests that it is the poorest who, on environmental grounds, most need to change their type of fuel. These households are the most likely to face income constraints and limits on the amount they can borrow which make such a switch impracticable without assistance of one form or another.

Table 2.1.2
Types of central heating, by decile of gross income

Decile of gross income	Electric central heating (%)	Gas central heating (%)	Other central heating (%)	No central heating (%)
Lowest	10.7	30.0	11.5	47.9
2	12.3	32.6	9.6	45.4
3	11.9	38.5	10.5	39.0
4	11.9	38.1	12.1	37.9
5	8.9	44.7	10.4	36.0
6	6.8	52.5	12.6	28.1
7	7.7	58.7	9.9	23.7
8	6.8	61.3	12.9	19.0
9	6.3	68.0	11.5	14.2
Highest	4.2	74.2	12.7	8.8
Average	8.8	49.9	11.4	30.0

9 In this instance, although richer households tend to consume *quantitatively* more than poorer households, the poor's consumption is generally *qualitatively* worse from the point of view of the environment.

10 Note that the direct use of coal and oil by households creates less carbon dioxide than the use of electric central heating, although more than gas central heating.

Table 2.1.3 presents results for different types of housing tenure. Housing tenure has some importance in the fuel sector. Not only does it provide some measure of relative wealth, it may be an important variable for decisions made about type of heating and degree of energy efficiency. Where a household is in rented accommodation, either such decisions will be left to the landlord or the likely short length of stay precludes long-term energy efficiency investments. Thus, encouraging more efficient forms of heating may not be effective if the least efficient methods are presently concentrated among those who are renting. The available evidence suggests that this is the case: Table 2.1.3 reveals that households in rented accommodation are the least likely to have central heating.[11]

Those owner-occupiers paying mortgages have the highest spending levels, and spend the most on fuel in money terms, but as a percentage of their total spending this amount is amongst the lowest. However, this relationship between expenditure level and fuel spending does not hold across all tenure types. For example, households in local authority accommodation pay almost the same on fuel as households in rented unfurnished dwellings, despite their lower total spending. Again this may conceal a problem of varying household composition.

Table 2.1.3
Fuel spending, by housing tenure

Tenure type	Percentage of sample	Average spending (£ per week)	Fuel spending (£ per week)	Budget share (as % of spending)	Percentage with central heating
Local authority	27.0	130.06	10.67	8.21	58.9
Housing association	2.0	120.19	9.07	7.54	75.0
Other rented, unfurnished	4.9	162.51	10.56	6.50	33.0
Rented, furnished	2.9	183.41	6.44	3.51	48.5
Owned, with mortgage	40.0	310.04	13.12	4.23	83.1
Owned outright	21.4	203.82	11.92	5.85	70.8
Rent-free	1.8	237.01	11.48	4.84	66.9

It was argued, in Section 1.2, that distributional concerns are not limited to the effects of fuel taxes on household *income* levels. Much concern will be concentrated on *groups* considered especially vulnerable to cold weather, in particular elderly people. Table 2.1.4 shows that households that contain retired persons have much higher fuel shares than households

11 The somewhat higher figure for housing associations includes a higher proportion of electric central heating than for any other type of housing tenure.

that do not, despite spending less on fuel in money terms. Ownership of central heating is also less common among households that contain one or more retired persons.

Table 2.1.4
Fuel spending, by number of retired persons in household

Number of retired persons in household	Average spending (£ per week)	Fuel spending (£ per week)	Budget share (as % of spending)	Percentage with central heating
0	260.78	12.45	4.77	73.6
1	125.96	9.69	7.69	60.0
2 or more	158.98	11.50	7.23	66.3

It is possible to tabulate results for a number of household characteristics, such as the number of retired people in the household, the number of children, or the region. This may show, for example, that the greater the number of retired persons, the higher the proportion of spending that is devoted to fuel. However, it is not clear from such tabulations whether the number of retired people has a direct effect on fuel spending. The observed statistical association could arise because retired and non-retired households have different levels of income. The use of a multiple regression model, which is explained in the Appendix in more detail, enables the effects of a number of different household characteristics on fuel spending to be "untangled". The estimated parameters from the fuel demand equations can then be used to show the effects of changes in each of prices, incomes, and a range of household characteristics, on the share of fuel in total (non-durable)[12] spending.

For data covering 1970 to 1986, the econometric model finds an average price elasticity for fuel of about −0.4. In other words, a 10% increase in the price of fuel relative to other goods is associated with a reduction in fuel consumption of about 4%. The quantity of fuel purchased is also found to be somewhat insensitive to changes in total expenditure: an increase of 10% in real income is expected to increase fuel consumption by about 6%, indicating that fuel is a "necessity". This estimate will have important consequences for the effects of compensation. It implies that any increase in (real) income will be spent on a range of products, such that fuel purchases increase by much less than the value of any compensation paid.

12 Non-durable spending excludes spending on durables and housing. The aim of the model is to consider changes in the pattern of spending over relatively short time periods, and it is believed that these items of spending are either somewhat fixed in the short run (housing), or require a different model from the one actually used (durables).

Table 2.1.5
Summary of effect of household characteristics on fuel spending shares
Percentage points (changes)

Characteristic	Effect on budget share
Married couple	+1.89
Single parent	+0.81
Head unemployed	+0.14
Extra woman	+0.38
Extra retired person	+0.20
Extra adult	−0.35
Age of head (effect per 10 years)	+0.82
Presence of children in household	
aged 0−2	+0.94
3−5	+0.64
6−10	+0.42
11−16	+0.35
17−18	+0.18
Time of year	
1st quarter	+5.56
2nd quarter	+1.68
3rd quarter	−4.18
Regions	
North	−0.24
Midlands	−0.38
London	−0.62
Wales	+0.48
Scotland	+0.24
Average share, all households, whole period	10.50

Table 2.1.5 shows the separate effects of different household characteristics on the proportion of non-durable expenditure devoted to fuel. The numbers shown take as the base case a single person aged 16 living in the South-East (but not in London), with no children and no retired, working in the service sector and observed in the fourth quarter of the year, but not at Christmas. The estimates show the effects of changing each of the individual characteristics; for example, if we retain all of these assumptions but instead the household is now a married couple, then the fuel share is on average almost 2 percentage points higher. Relative to the base case, living in Wales is associated with a fuel share 0.48 percentage points higher, and so on.

Each of these effects is independent of all other effects. The regression analysis effectively controls for each variable. For example, the higher fuel share observed in Wales stands after the lower average income level and other factors (average number of children, occupational structure, etc.) have been allowed for.

2.2 Effects of VAT on Energy

This section is based upon results from the Simulation Program for Indirect Taxation (SPIT) developed at IFS.[13] The parameters that form the model are estimated from 17 years of data from the Family Expenditure Survey, and the responses to previous changes in prices, incomes and household characteristics are analysed to explain changes in purchasing decisions. This model enables almost any change to the indirect tax system to be specified, and makes predictions about how each of the households in the 1986 Family Expenditure Survey will respond. By a further step the results for the particular Family Expenditure Survey households are converted into probable results for national tax revenue.

Overall Impact

In this section, the effects of imposing VAT at 15% on domestic fuel are considered. This policy, as explained above, is aimed at reducing the demand for fuel and will reduce emissions of pollutants to the extent that there is a reduction in demand. However, the qualitative nature of the results will apply to a number of other policies aimed at reducing pollution.

The expected change in national tax revenue attributable to consumers, from putting VAT on domestic fuel, is £1.7 billion. The reduction in fuel consumption is around 4 per cent.

This comparatively small reduction in consumption is indicative of the low price elasticity of fuel found with the model. Much higher price increases are, therefore, required if the Toronto recommendation of a 20% reduction in carbon dioxide emissions[14] is to be met, or alternative policies will have to be tried. An increase in the price of fuel by 75%

---

13 See Baker et al. (1990) for a summary of the methodology, and the demand analysis underlying the project.

14 A meeting of scientists, economists, Ministers and other experts from 46 countries in June 1988, having considered the evidence on global warming, recommended a cut in carbon dioxide emissions of 20% by the year 2005.

would be needed, according to the simulation model, in order to reduce consumption by around 20%. Predicted responses to various increases in the price of domestic fuel are shown in Table 2.2.1.

Table 2.2.1
Changes in the price of fuel and its consumption

Price increase (%)	Change in consumption (%)
0	0.0
15	-4.1
30	-8.3
50	-13.6
75	-19.6
100	-24.9

Distributional Effects

Table 2.2.2 shows the effect of the change in fuel consumption and tax paid for each income decile. The increase in tax paid by the poorest decile is about a pound per week, compared with £1.52 on average across all households, and £2 by the richest decile. As a proportion of spending, the extra tax declines steadily with income. In addition, the lower deciles reduce their fuel consumption by, proportionately, greater amounts: whilst the average reduction in fuel consumption is some 4 per cent, the two poorest deciles reduce their consumption of fuel by about 10%. Thus at this first round the impact is regressive. Not only are the poorest most affected financially (relative to their ability to finance higher tax payments), but our model predicts that they are likely to reduce their fuel consumption by greater amounts. For the sake of comparison, the third column in the table shows what the effect would have been had we assumed no behavioural response. If we do not use the simulation model, but instead assume that households continue to purchase the same amount of fuel as before the reform, then the increases in tax paid would be somewhat larger, with an average of £1.77 per week.[15]

15 This places an upper limit on the money value of the welfare loss resulting from the imposition of the tax (see Chapter 5).

Table 2.2.2
Change in fuel consumption, by decile of gross income

Decile of gross income	Change in fuel consumption fuel (%)	Change in tax pre-response (£ per week)	Change in tax paid (£ per week)	Change in tax paid (as % of spending)
Lowest	-9.61	1.19	1.08	1.80
2	-9.50	1.51	1.36	1.54
3	-8.26	1.56	1.41	1.16
4	-6.83	1.68	1.49	0.93
5	-4.84	1.72	1.49	0.74
6	-4.11	1.68	1.44	0.67
7	-3.43	1.85	1.57	0.62
8	-1.97	1.90	1.59	0.55
9	-0.06	2.06	1.69	0.48
Highest	+1.09*	2.53	2.05	0.42
Average	-4.12	1.77	1.52	0.68

* This result is surprising. There are few goods where one would expect a price rise to result in more being bought, although this is quite possible within standard economic theory (if there is an income effect sufficiently large to offset the negative substitution effect). Within the model this result arises because, holding all other factors constant, fuel spending falls in the last few percentiles of the distribution compared with slightly lower levels of spending. The tax increase is, apparently, sufficient to move such households into lower income levels where fuel spending is higher.

Social concerns about increasing the price of domestic fuel focus particularly on the situation of the elderly and other vulnerable groups. Table 2.2.3 shows that the percentage cut in fuel consumption is much higher among households containing retired persons than for the population as a whole. The retired also face a much higher increase in tax paid as a proportion of total spending than do the rest of the population. Given the vulnerability of many elderly people to hypothermia and cold-related illnesses, these results give some cause for concern on grounds of public health.

Table 2.2.3
Change in fuel consumption, by number of retired people

Number of retired persons	Change in fuel consumption (%)	Change in tax pre-response (£ per week)	Change in tax paid (£ per week)	Change in tax paid (as % of spending)
0	-2.9	1.87	1.58	0.61
1	-7.4	1.45	1.30	1.03
2 or more	-7.5	1.72	1.54	0.97

Whilst the type of central heating is not a variable in the simulation model, it is interesting to consider the results split by type of heating. Table 2.2.4 shows that it is those households with no central heating that reduce fuel consumption by the greatest amount, compared with other modes of domestic heating. Those with gas central heating reduce

consumption the least. On environmental grounds this is advantageous, but given that it is the poor who use the other forms of heating, it is not desirable on distributional grounds.

Table 2.2.4
Change in fuel consumption, by type of central heating

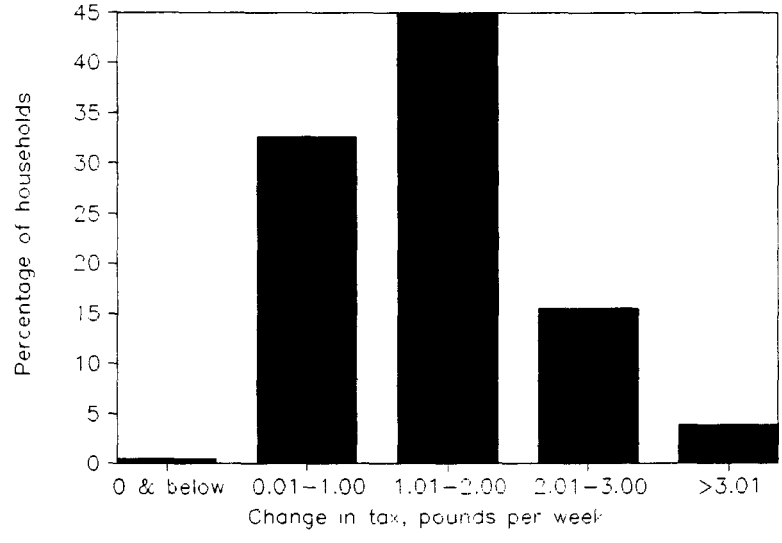
Type of central heating	Change in fuel consumption (%)	Change in tax pre-response (£ per week)	Change in tax paid (£ per week)	Change in tax paid (as % of spending)
None	-6.13	1.55	1.36	0.85
Electric	-4.84	1.52	1.33	0.73
Gas	-2.93	1.87	1.59	0.60
Other	-4.46	2.07	1.75	0.72

Distribution of Tax Payments

The tables above refer to the average increase in tax paid by various groups. However, for issues of compensation it is important to know the spread of values. If the distribution of losses due to tax is sufficiently tight, then paying compensation on the basis of the average loss will mean that few households will be made worse off by the tax change. However, where the values are more widely spread, paying compensation simply on the basis of the average will make a number of households somewhat worse off than they were before the reform.

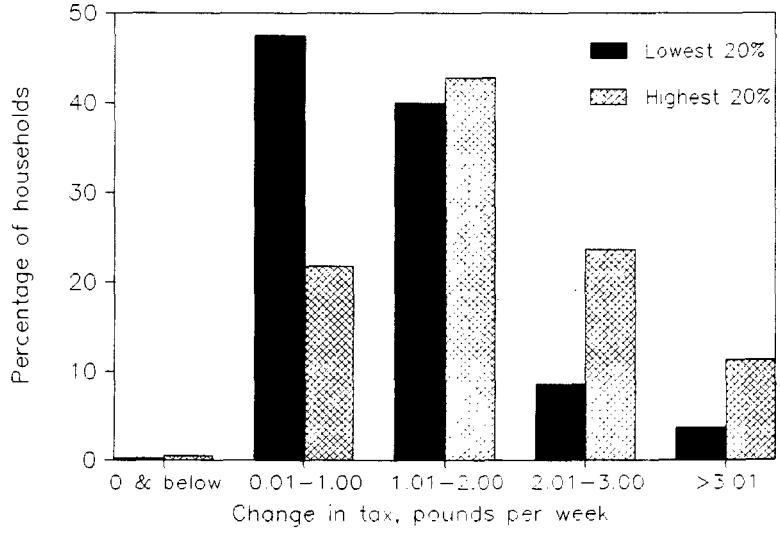
Figures 2.2.1 to 2.2.3 plot the range of tax losses for a number of groups, presenting the percentage of each group that lose a certain amount, in pounds per week, from the tax change.

Figure 2.2.1: Increase in tax paid, all households



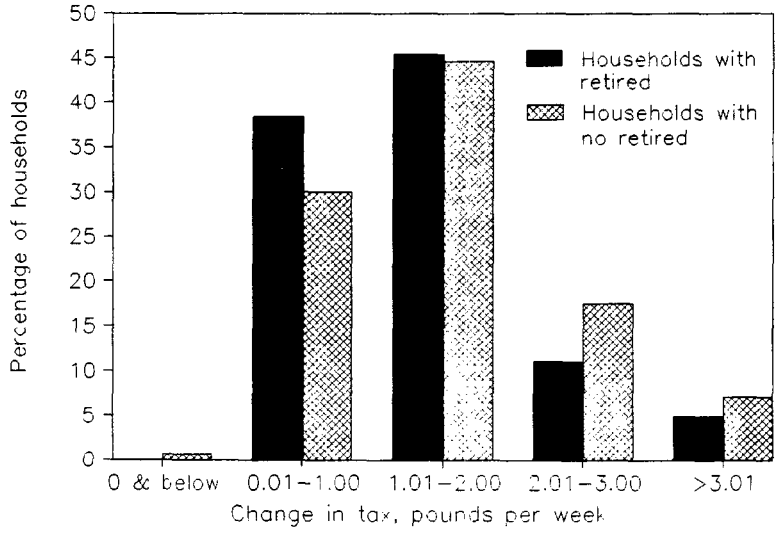
The average increase in tax paid under this reform is £1.52, but this includes a range of figures: some households are predicted to pay little or no extra tax after the reform, whilst there are a number of households where the increase in tax paid is above £3 per week. To some extent, the groups losing the most from this reform are those households observed to have a large fuel expenditure during the period of the diary record, in particular because of infrequent purchases of coal, and would therefore not lose that much every week.

Figure 2.2.2: Increase in tax paid, highest and lowest quintiles of gross income



The increase in tax is greater, on average, the richer the household. Figure 2.2.2 presents the different ranges of figures for the bottom and top quintiles of gross income. For those households in the lowest 20% of income, the most frequent loss is in the range of nothing to £1. For the households in the uppermost quintile, results cluster around the £1 – £2 level. Many more households in the top quintile lose more than £2 per week in tax than in the lowest quintile.

Figure 2.2.3: Increase in tax paid, households with and without retired persons



The average increase in tax for pensioner households is slightly below the average, at least when expressed in cash terms. Given that pensioner households are on generally lower incomes than the rest of the population, their extra tax payments represent a more important deduction from the household budget.

3 Transport

Road transport is a major source of carbon dioxide, carbon monoxide, gaseous hydrocarbons and nitrogen oxides. All of these are greenhouse gases, while nitrogen oxides contribute towards acid rain, and both nitrogen oxides and hydrocarbons result in ozone creation at low altitudes. This has been implicated in the formation of acid mist and acidification of soil. Lead from cars is another pollutant which has received a great deal of attention. Further concerns include the destruction of countryside through road-building, deaths and injuries from road accidents, congestion, smoke and noise.

Reductions in environmental pollution may be achieved through a combination of reducing final demand and changing the combustion technology. The best mix of the two will depend on the particular pollutant.

Technology exists which can control the emission of some of the above-mentioned pollutants. Emissions of hydrocarbons and carbon monoxide may be reduced by the use of oxidation catalysts, while three-way catalysts will enforce stricter controls on both these pollutants *and* reduce emissions of nitrogen oxides.

However, emissions of carbon dioxide are directly proportional to the number of gallons burnt: there are no practicable "end of pipe" technologies for their removal from exhaust gases. A reduction in carbon dioxide emissions requires a reduction in petrol use, either through greater fuel efficiency (i.e. fewer gallons used per mile travelled) or through a reduction in fuel purchases (i.e. fewer miles travelled in total).

The problem of lead emissions has been diminishing over time. Even before the introduction of a tax differential in favour of unleaded petrol which has increased its use, successive reductions in the lead content of petrol have meant that total emissions have been falling. However, it is still important to ensure the widespread *availability* of unleaded petrol because it is required for the use of catalytic converters.

The main focus of this section will be on using the tax system to reduce fuel consumption and thereby reduce emissions of the various gases. By contrast with the energy sector, a number of taxes already exist within the transport sector. The most important of these are VAT and excise duty on petrol; the duty on petrol is currently 102.3 pence, which is reduced by 13.6 pence for unleaded. Vehicle excise duty (VED) is a

lump sum £100 on each private car.[16] In other words, there are taxes both on owning a car and on running it. A lower level of duty applies to road fuel for diesel-engined vehicles (DERV). As Pearson and Smith (1990) observe, an increase in petrol duty by 55 pence per gallon would restore petrol prices to their peak level of 1975, but would still leave the UK with lower petrol prices than Italy. If, at the same time, VED were abolished, the incentive to reduce fuel use would be enhanced sharply, without any great increase in the overall tax burden on private motoring.

Increased taxes on motor fuels will have both direct and indirect effects. Extra tax on petrol will have a predominantly direct impact upon household wlefares, since around two-thirds of petrol is consumed by personal rather than non-domestic users. By contrast, increases in the tax on diesel fuel will mainly affect business users, and will affect private households only indirectly through the effects of higher business costs on product prices.

Policies in the transport sector need not be restricted to measures aimed directly at car-users. Policies towards other modes of transport (coaches, railways, etc.) may have important consequences for the use of cars and hence for environmental pollution. They may also help to offset increases in taxes on road-users.

3.1 The Pattern of Petrol Spending and Car-Ownership[17]

There is a close relationship between affluence and car-ownership. Table 3.1.1 reveals that the richest decile of households are, on average, over eleven times more likely to have the use of a car than households in the poorest decile, in which less than one household in ten has the use of a car. Moreover households in the richer deciles are much more likely to have access to more than one car.

The richer the household, the more money is spent on petrol. Figure 3.1.1 shows the increase in average petrol expenditure that takes place as one considers richer and richer deciles.

---

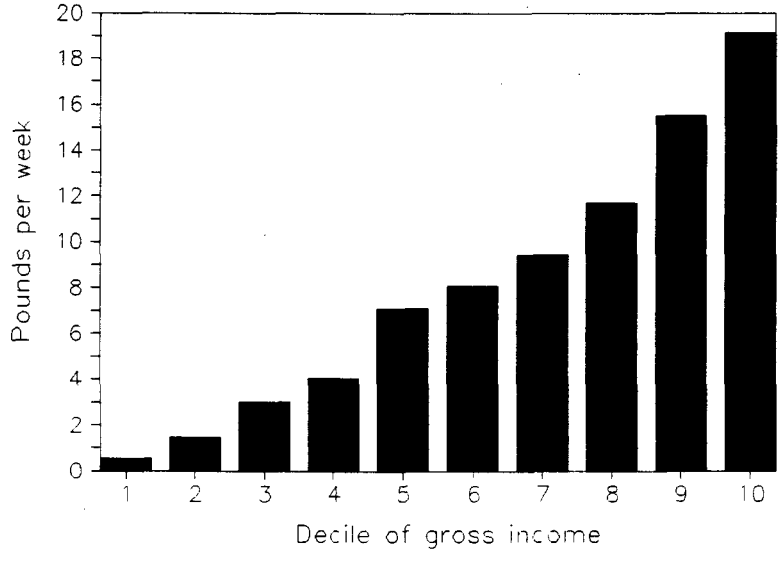
16 In addition, car tax is levied at 10% on five-sixths of the selling price of new cars. The employee benefit of company cars is subject to tax, but the value of the tax paid is less than would apply if the benefit were given purely in cash; see Ashworth and Dilnot (1987). The distortion of the car market created by the company car sector is substantial, and may have important effects on pollution (e.g. company cars are typically more powerful than privately purchased cars).

17 Strictly speaking, the data used in this section refer to the availability of a car, not ownership; this includes company cars.

Table 3.1.1
Car-ownership, by decile of gross income

Decile of gross income	Average number of cars	Percentage who have use of cars
Lowest	0.09	8.5
2	0.21	19.3
3	0.42	40.1
4	0.57	51.6
5	0.75	66.1
6	0.93	76.7
7	1.05	83.2
8	1.19	89.4
9	1.45	93.9
Highest	1.80	96.2
Average	0.84	62.5

Figure 3.1.1: Petrol spending, all households



To some extent, Figure 3.1.1 represents the effect of increasing rates of car-ownership as income increases. The reason richer deciles spend more on petrol is that many more of them have the use of cars. Figure 3.1.1, as it stands, is consistent with each car-owning household spending the same amount on petrol. In fact, this is not the case because rates of car-ownership do not rise as rapidly as the increase in petrol spending. This is brought out more clearly if we consider only the car-owners within each income range. Figure 3.1.2 plots petrol spending by decile of income, taking only the car-owners in each decile. Clearly, the richer the household, the higher the petrol spending; the lowest decile spends about £6 per week on petrol, whereas the equivalent figure for the richest decile is £20.

Figure 3.1.2: Petrol spending by car-owners

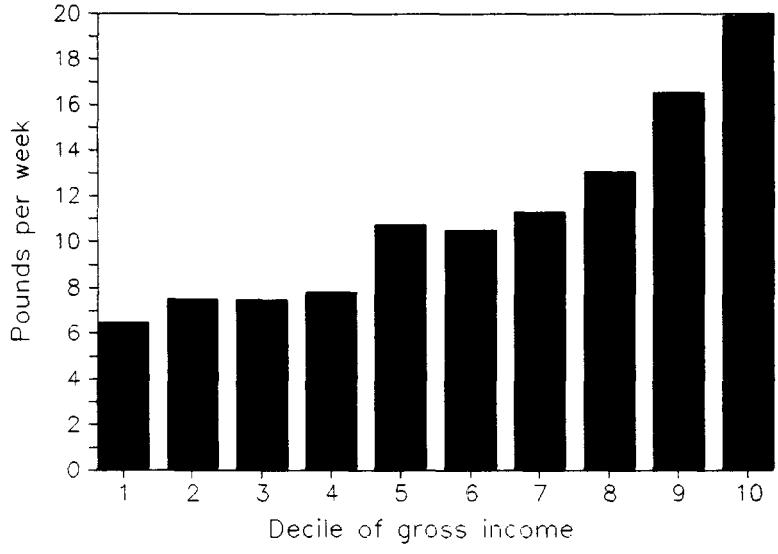
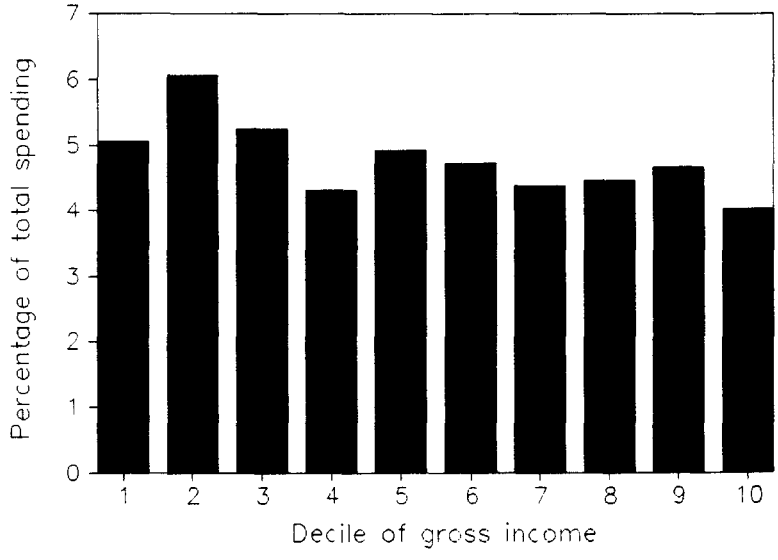


Figure 3.1.2 shows results in terms of money spending. This does not tell us the relative importance of petrol spending within the budget of each household, which may be measured by the percentage of total spending for which that on petrol accounts. Figure 3.1.3 shows that the poorer the car-owner, the greater the percentage of total spending that goes on petrol. Broadly speaking, petrol constitutes 4 – 5 per cent of the total spending of car-owners in all income groups, with a small tendency for the petrol share to be lower in higher income groups.

Figure 3.1.3: Petrol shares of car-owners



This breakdown of petrol spending by deciles indicates that increasing the duty on petrol is likely to be regressive if we consider only car-owners, but is clearly progressive across the whole sample.

As in the case of domestic energy, however, petrol spending varies according to a number of other factors in addition to household income. Table 3.1.2 presents results by standard region. There is the expected correlation between car-ownership and relative affluence: for example, car-ownership is much higher in the South-East than in the North. However, there also appear to be important regional differences. Whilst households in Greater London spend appreciably more per week than households in Wales and the South-West, car-ownership is higher in those latter areas which are less well-served by public transport.

Table 3.1.2
Petrol spending and car-ownership, by region

Region	Average spending (£ per week)	Petrol spending (£ per week)	Budget share (as % of spending)	Percentage of households with cars
Northern	190.78	5.85	3.07	50.8
Yorks & Humb	186.28	6.63	3.56	56.9
North-West	206.45	7.31	3.54	58.7
East Midlands	208.99	8.21	3.93	65.0
West Midlands	207.97	7.32	3.52	60.5
East Anglia	226.33	9.23	4.08	76.7
Greater London	266.05	7.37	2.77	57.1
South-East	270.66	10.53	3.89	74.8
South-West	217.91	8.12	3.72	70.7
Wales	193.78	8.74	4.51	63.2
Scotland	197.85	6.77	3.42	50.2

Region is, however, a rather broad measure of transport needs. A better-focused variable available to us in the data is administrative area, which splits the population broadly according to population density. Five areas are identified:
(1) Greater London, which comprises 11.26% of the FES sample;
(2) Metropolitan Districts and Central Clydeside Conurbation (24.32%);
(3) population density of 3.2 or more persons per acre (23.02%);
(4) population density of 0.9 but less than 3.2 persons per acre (20.13%);
(5) population density of less than 0.9 persons per acre (21.28%).

Hence, this population characteristic splits the population into Greater London plus four roughly equal groups. Table 3.1.3 presents transport details for each area. For the three rural districts, the lower the population density, the greater the percentage of households with cars. Moreover car-ownership in the rural areas is somewhat higher than in the more urban areas.

Table 3.1.3
Petrol spending and car-ownership, by population density

Administrative area	Average spending (£ per week)	Petrol spending (£ per week)	Budget share (as % of spending)	Percentage of households with cars
1 London	267.12	7.49	2.80	58.5
2 Other metropolitan	193.27	6.37	3.30	52.0
3 Rural, high density	215.75	7.65	3.55	62.1
4 Rural, mid density	243.28	9.46	3.89	69.4
5 Rural, low density	220.73	9.09	4.12	70.6

If there is a concern about the effects of extra petrol duty on those needing cars, it will presumably relate to poor rural households. Whilst Table 3.1.3 shows that car-ownership tended to increase as the rural population density decreased, it is not clear to what extent differences in income are a cause of this. In Table 3.1.4 the density of car-ownership is described for each administrative area, looking only at households in the lowest 30% of the income range.[18]

Table 3.1.4
Car-ownership in the bottom 30% of income, by population density

Area	Car-ownership (%)	Ratio to average	
		Bottom 30%	All sample
1 London	18.7	0.83	0.94
2 Other metropolitan	14.4	0.64	0.83
3 Rural, high density	23.2	1.03	0.99
4 Rural, mid density	23.8	1.05	1.11
5 Rural, low density	34.4	1.52	1.13
Average	22.6	1.00	1.00

A number of features stand out. The spread of car-ownership is similar in the bottom three deciles to that of the whole population, but the figures are more dispersed. The last area now seems quite different from the more dense rural areas, and has an appreciably higher frequency of car-ownership. However, in no case is the frequency of car-ownership much greater than one in three. Whilst there will be important differences in transport characteristics within each area, it seems that two-thirds and more of the rural poor manage (or have to manage) without the use of a car.

18 It may be argued that households in the bottom 30% of the income distribution are "better off" in rural than in urban areas, because of generally lower prices.

Again, the various factors interact. The estimated regression model helps to disentangle the separate effects of each characteristic. Table 3.1.5 presents the estimated effects of various household characteristics on the average petrol budget share. The figures relate to car-owning households, and have the same interpretation as Table 2.1.5.

Table 3.1.5
Summary of effect of household characteristics
on petrol spending shares
Percentage points (changes)

Characteristic	Effect on budget share
Married couple	−0.12
Single parent	−0.53
Head unemployed	−0.08
Extra woman	−1.09
Extra retired person	−0.08
Extra adult	+0.67
Age of head (effect per 10 years)	−0.50
Presence of children in household	
aged 0 − 2	−0.28
3 − 5	−0.18
6 − 10	−0.20
11 − 16	−0.29
17 − 18	−0.22
Regions	
North	−0.01
Midlands	−0.08
London	−1.04
Wales	+0.15
Scotland	−0.60
Average share, all households, whole period	6.4

3.2 Effects of Higher Petrol Duty

As stated above, we consider a reform which aims to reduce the demand for petrol. This will reduce emissions of the various polluting gases identified and alleviate a number of the other concerns about road transport in general. The specific reform we consider is that of putting 55 pence on petrol duty. To some extent this figure is arbitrary, but it is significant in that it takes the price of petrol up to the highest real level it has attained over recent decades.

The effect of adding 55 pence to petrol duty is to increase the tax revenue attributable to consumers by £2.3 billion. In addition, this extra tax may be expected to raise substantial sums of money from the company sector, where it is likely that the quantity of petrol purchased is less responsive to price increases than it is for households. We do not consider any indirect effects that arise from increasing the duty on petrol.

Table 3.2.1 reveals that the greatest reductions in petrol consumption are made by car-owners in the worse-off groups: those in the bottom decile reduce their petrol consumption by around 10%, whereas the figure for the top decile is less than this at 7%. Averaging over the *whole* sample, the tax increase is progressive: the higher the spending, the greater the increase in tax paid expressed as a percentage of total spending. Moreover the tax increases are small, typically less than 1% of total spending (the average is 0.89%). However, if we consider only the car-owners in each decile, it is typically the poorer car-driving households which are worst hit.

Table 3.2.1
Increase in tax paid, by decile of gross income

Decile of gross income	Change in petrol consumption (%)	Change in tax paid (£ per week)		Change in tax paid (as % of spending)	
		Households with cars	All households	Households with cars	All households
Lowest	-10.32	1.52	0.13	1.19	0.22
2	-12.05	1.63	0.32	1.32	0.36
3	-11.99	1.65	0.66	1.16	0.54
4	-8.72	1.96	1.01	1.08	0.63
5	-10.38	2.54	1.68	1.17	0.84
6	-10.16	2.50	1.92	1.12	0.90
7	-9.06	2.82	2.34	1.09	0.93
8	-9.58	3.19	2.86	1.09	0.99
9	-9.53	4.03	3.79	1.14	1.08
Highest	-7.58	5.27	5.07	1.07	1.04
Average	-9.31	3.16	1.98	1.11	0.89

Table 3.2.2 shows the changes in petrol consumption and taxation for each region. There is limited evidence that the less densely populated regions (East Anglia, South-West, Wales) pay relatively more in extra tax than the areas better served by urban transport systems such as London.

Table 3.2.2
Change in petrol consumption, by region

Region	Change in petrol consumption (%)	Change in tax pre-response (£ per week)	Change in tax paid (£ per week)	Change in tax paid (as % of spending)
Northern	-8.2	1.97	1.52	0.80
Yorks & Humb	-9.9	2.24	1.60	0.86
North-West	-9.4	2.46	1.83	0.89
East Midlands	-10.1	2.77	1.99	0.95
West Midlands	-9.5	2.47	1.81	0.87
East Anglia	-9.7	3.11	2.26	1.00
Greater London	-7.0	2.48	1.99	0.75
South-East	-9.6	3.55	2.57	0.95
South-West	-8.9	2.74	2.04	0.94
Wales	-11.8	2.95	1.98	1.02
Scotland	-10.0	2.28	1.64	0.83

This conclusion is emphasised if the results are broken down by population density. In Greater London, the cut in petrol consumption is the lowest, while there are figures of around 10% for each of the other areas. Moreover, the less dense the population, the greater the increase in tax paid when expressed as a percentage of total spending.

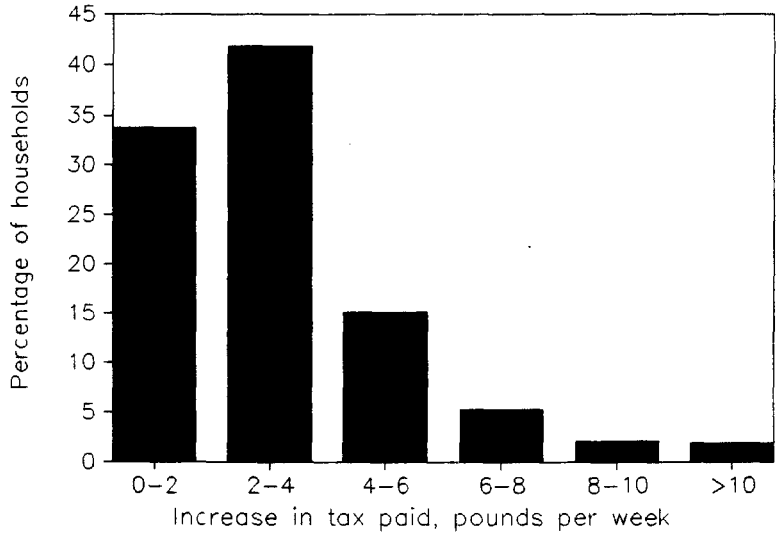
Table 3.2.3
Change in petrol consumption, by population density

Administrative area	Change in petrol consumption (%)	Change in tax pre-response (£ per week)	Change in tax paid (£ per week)	Change in tax paid (as % of spending)
1 London	-6.97	2.52	2.02	0.76
2 Other metropolitan	-9.22	2.15	1.58	0.82
3 Rural, high density	-9.20	2.58	1.90	0.88
4 Rural, mid density	-9.45	3.19	2.33	0.96
5 Rural, low density	-10.41	3.06	2.16	0.98

Distribution of Tax Increases

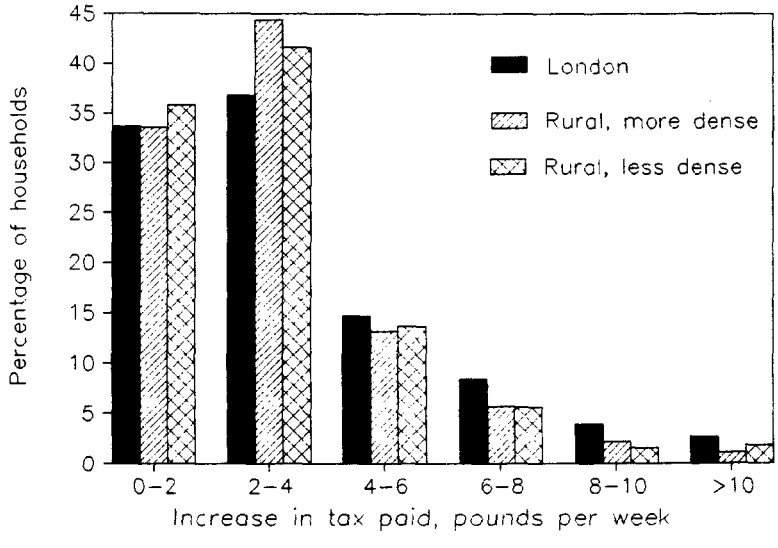
Those households without the use of a car will not be directly affected by this reform and therefore may be excluded from the analysis of tax changes. Figure 3.2.1 shows the range of extra tax payments made by car-owners. As was the case for household energy taxes, many of the outlying figures will be unrepresentative of the consumption of that household, given the snapshot nature of the diary record approach.

Figure 3.2.1: Change in tax paid by car-owners



Given that rural car-owners have been identified as the groups meriting concern (Pearson and Smith (1990)), it is important to consider the tax increases for households living in different population densities. Figure 3.2.2 presents details of tax paid by households (with cars) in administrative areas 1, 3 and 5. It is noticeable that it is the households in Greater London who pay the greatest amounts more: there are fewer outliers for the two rural regions considered. Indeed few of the rural households are worse off by more than around £6 per week as a result of the tax increase.

Figure 3.2.2: Change in tax paid by car-owners, selected population densities



4 Food

In recent times, agricultural practices have been associated with a number of environmental and health problems. There have been, for example, concerns that the treatment of livestock is either unjustifiable in moral terms, or potentially harmful to the safety of the final product to humans. Attention has also been focused on the use of pesticides and chemical fertilisers which may cause harm to the surrounding soil and water.

These problems prompt the use of a range of policies, by no means all of them agricultural. For example, nitrate concentrations in drinking water may be reduced by preventing nitrates from entering the water system, by changes in farming methods, or by treating the water supply to reduce their level. However, the "polluter pays principle", an important tenet of government environmental policy, suggests that measures designed to change agricultural practices, or, at least, make farmers pay for the costs of any resulting damage, will be important.

Whilst environmental measures in the agricultural sector will generate important benefits, they will also tend to increase the costs of agricultural production, and thus may be expected to place upward pressure on the price of food in a competitive market. However, the UK food market is far from being competitive. Prices are determined by the workings of the Common Agricultural Policy (CAP) at an EC-wide level. Following any increase in agricultural costs, prices to consumers *may* be increased in line with the extra costs. If, however, the prices paid to farmers are not increased to compensate, then any effects may fall on farm incomes, agricultural employment and the price of farming land, rather than on prices.

In this chapter, we briefly outline the distributional implications of an increase in the price of food. Empirical evidence, which we present below, suggests that households on low incomes, and especially those with children, spend a larger slice of their budget on food than do other groups of the population. These groups are therefore likely to be the most affected by any increase in the price of food.

4.1 Household Food Spending

Table 4.1.1 demonstrates the expected relationship between total spending, the amount spent on food, and the percentage of the household budget allocated to food spending. That is, richer households spend a greater amount on food than do poorer households, whilst the percentage of their total spending accounted for by food tends to be lower.

Table 4.1.1
Food spending, by decile of gross income

Decile of gross income	Food spending (£ per week)	Budget share (as % of spending)
Lowest	16.37	27.3
2	21.29	24.2
3	27.91	22.9
4	33.99	21.2
5	39.28	19.5
6	41.58	19.5
7	47.06	18.6
8	51.34	17.8
9	56.85	16.3
Highest	74.35	15.2
Average	41.01	18.4

The presence of children, and their number, tends to increase the share of food in total spending. The figures in Table 4.1.2 show that households with three or more children spend almost twice as much on food as households without children, while their total spending is only around 50% higher. This may reflect the influence of age both on income and the decision to have children: younger households are likely to have fewer children and to be less well off. For an attempt to unravel a number of such joint influences, see Table 4.1.4.

Table 4.1.2
Food spending, by number of children

Number of children	Average spending (£ per week)	Food spending (£ per week)	Budget share (as % of spending)
0	195.76	34.00	17.4
1	258.07	48.44	18.8
2	273.58	54.50	19.9
3 or more	290.59	62.05	21.4

Table 4.1.3 presents a similar breakdown of spending, but by number of retired. The food shares of retired households are around 21% of total spending, compared with 18% for households not containing retired persons.

Following the presentation of earlier sections, Table 4.1.4 contains a summary of the effects of certain household characteristics on the share of food in non-durable spending. The results suggest that the presence of children in the household has an extremely important upward influence

Table 4.1.3
Food spending, by number of retired persons

Number of retired persons	Food spending (£ per week)	Budget share (as % of spending)
0	46.74	17.92
1	25.91	20.57
2 or more	32.74	20.59

Table 4.1.4
Summary of effect of household characteristics on food spending shares
Percentage points (changes)

Characteristic	Effect on budget share
Married couple	+0.34
Single parent	+5.64
Head unemployed	−0.74
Extra woman	−0.52
Extra retired person	−0.11
Extra adult	+9.4
Age of head (effect per 10 years)	+0.54
Presence of children in household	+1.84
aged 0 − 2	+2.45
3 − 5	+3.05
6 − 10	+3.19
11 − 16	+2.46
17 − 18	
Time of year	−1.03
1st quarter	+0.54
2nd quarter	+4.70
3rd quarter	
Regions	+0.23
North	+0.06
Midlands	+2.43
London	+0.66
Wales	+0.55
Scotland	
Average share, all households, whole period	29.7

on the share of food,[19] with a separate large impact for single-parent households. Thus we would expect any increase in the price of food to have the greatest impact upon households that contain children.

4.2 Effects of a Rise in the Price of Food

The simulation model used in the above reforms is designed to consider changes in taxes which fall on the final prices of consumer goods. However, it seems that environmental polices within the agricultural sector are likely to increase food prices indirectly. We simulate the results that emerge from a general 5% increase in the price of all food. However, it is important to stress that the figure of 5% is purely for the purposes of illustration; it is not a prediction of the effects of any environmental policy.

Table 4.2.1 presents results by decile of gross income. The most important feature of this table is the consistency of results across the different income groups. The reductions in food spending are all about 4%, whilst the average increase in tax paid[20] represents 0.3% of total spending.

Table 4.2.1
Change in tax and food consumption, by decile of gross income

Decile of gross income	Change in food consumption (%)	Increase in tax pre-response (£ per week)	Change in tax paid (£ per week)	Change in tax paid (as % of spending)
Lowest	-3.94	0.82	0.19	0.31
2	-3.97	1.06	0.24	0.27
3	-4.00	1.40	0.32	0.26
4	-4.00	1.70	0.44	0.27
5	-3.97	1.96	0.54	0.27
6	-4.02	2.08	0.59	0.28
7	-4.00	2.35	0.68	0.27
8	-4.02	2.57	0.78	0.27
9	-3.97	2.84	0.89	0.26
Highest	-3.97	3.72	1.33	0.27
Average	-3.99	2.05	0.60	0.27

19 This is independent of the higher income levels of families with children.

20 Of course, consumers are not paying any extra tax: they simply face a price rise. Given that the effects on households of a 5% price rise are equivalent to a 5% tax on food, we use "tax paid" as shorthand.

The uniformity of response, in terms of the change in food consumption and the relative tax increase, is echoed in the results by number of children reported in Table 4.2.2. However, the money value of the tax increase does increase in line with the number of children.

Table 4.2.2
Change in tax and food consumption, by number of children

Number of children	Change in food consumption (%)	Increase in tax pre-response (£ per week)	Change in tax paid (£ per week)	Change in tax paid (as % of spending)
0	-3.97	1.70	0.51	0.26
1	-3.98	2.42	0.73	0.28
2	-4.03	2.73	0.78	0.29
3 or more	-4.05	3.10	0.83	0.28

Table 4.2.3 shows similar reductions in food consumption for households that do and do not contain retired persons. The money value of tax increases predicted are somewhat lower for households that do include retired persons, but are broadly equal when expressed as a percentage of total spending.

Table 4.2.3
Change in tax and food consumption, by number of retired persons

Number of retired persons	Change in food consumption (%)	Increase in tax pre-response (£ per week)	Change in tax paid (£ per week)	Change in tax paid (as % of spending)
0	-3.99	2.34	0.71	0.27
1	-4.01	1.30	0.32	0.26
2 or more	-4.10	1.64	0.38	0.24

One surprising feature in each table is the large difference between the simulated and "behaviour-neutral" figure for the value of the tax increase. Whereas in previous sections the figure from the simulation model was somewhat smaller than the pre-response figure, in this case the simulated figure is significantly less than one-third of the tax figure assuming no change in the quantity of food purchased. The reason for this is as follows. Under the behaviour-neutral model, the quantity of food purchased does not change, so an increase in the price of food by 5% leads to a

5% increase in food expenditure,[21] with the result that the extra "tax" paid is substantial. However, the model-estimated price elasticity of food is around −1: a 5% increase in the price of food is estimated to reduce food consumption by around 5%, *other things equal*. Hence, total spending on food will vary only marginally with changes in its price. Given roughly constant expenditure on food, the amount of extra tax paid on food will be somewhat less than in the neutral behaviour case.[22]

By contrast, the own-price elasticities for fuel and petrol are closer to zero than is the case for food, and therefore the "no behaviour change" calculation is not quite so unrealistic for changes in their price. Moreover, there may be important cross-price effects operating as well.

The Pattern of Extra Tax Payments

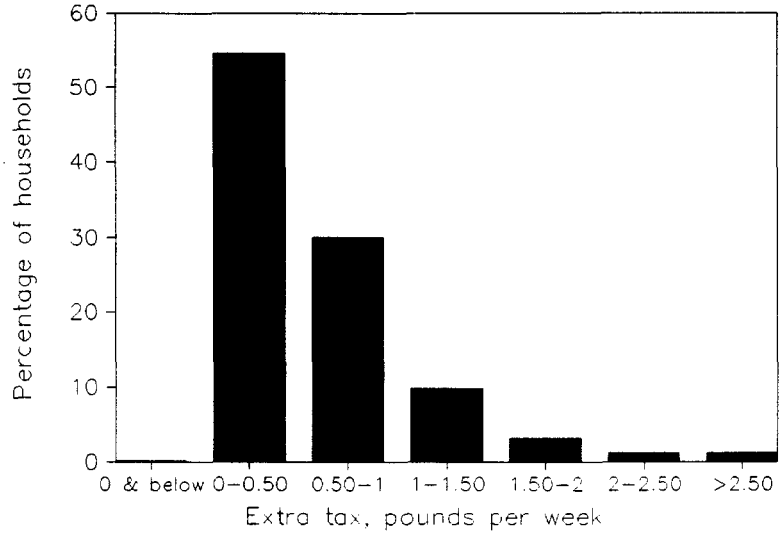
As we have stressed, the average loss resulting from a tax reform may disguise very different changes for particular households. Figure 4.2.1 shows that there are a large number of losses which are somewhat less than the average of sixty pence, but there is a "tail" extending beyond £2 per week.

---

21 Note that this may be said to violate the "adding-up constraint": many households will not be able to afford to purchase this extra quantity of food. It is also somewhat unrealistic, because even if households could purchase their original amount of food, given that the relative price of food has increased they may prefer to increase their purchases of other goods. The simulation model constrains the sum of the amounts people spend on each good after the reform to match the total of their current spending, and allows them to change the amounts of different goods that they buy.

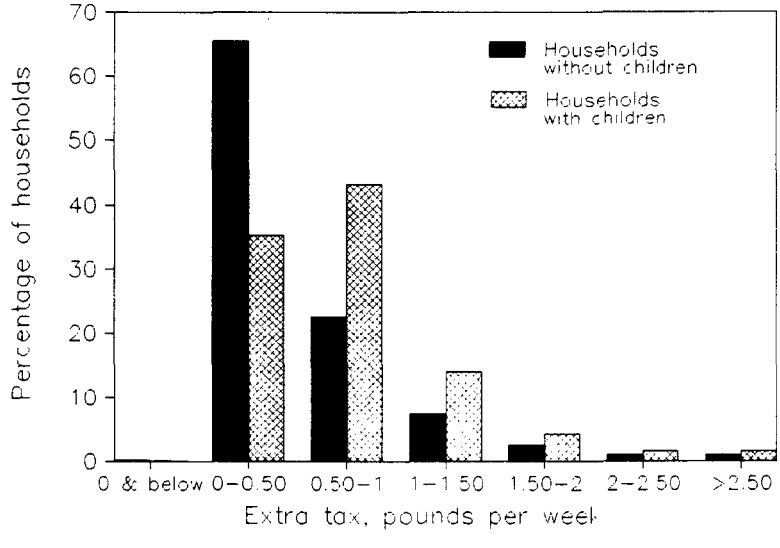
22 The simulation model does allow households to pay extra tax as a result of switching to other goods. However, in this case the effects are not important: the cross-price elasticities for food are around zero, meaning that increases in the price of food induce relatively little substitution into other goods.

Figure 4.2.1: Increase in tax paid, all households



There are important differences between households with and without children. For those households containing children, there is a much higher frequency of larger tax losses, as is clear from Figure 4.2.2.

Figure 4.2.2: Increase in tax paid, households with and without children



5 The Design of Compensation Policies

5.1 Introduction

Using the tax system to promote environmental ends may, as we have described in earlier chapters, conflict with another important policy objective – that of ensuring the well-being of the less well-off. In this chapter we consider how this conflict might be reconciled – how the price of goods can be raised without the poor suffering.

Policies to achieve this aim might involve direct subsidies to people on low incomes who lose from these price increases, or compensation through the present structures of the tax and benefit system. But whatever route is taken, although it should prove relatively simple to compensate any broadly specified group, such as pensioners, *on average*, it would be extremely difficult if not impossible to leave every individual as well off as they would have been before the change. Exactly tailoring the lump-sum compensation to each individual's circumstances so that each person was exactly compensated would be impossible from a practical point of view. Whilst various easily identified characteristics of households account for some of the variation in spending on fuel, for example, (as Chapter 2 showed) there remains considerable variation in household spending which cannot be related to observed household characteristics.

The task is made easier if we wish to concentrate on compensating just a small part of the affected population such as the poor. Money raised from an extra tax paid by the population as a whole would then be used to compensate a smaller group. The smaller group as a whole could then be made better off because we have more money to spend on them than they lost through paying the extra tax. Thus, some "wastage" could be afforded in terms of money given to some who do not need any compensation.

Two things follow. Firstly, the smaller the group about whom we are concerned, the easier it will be to ensure there are no losers among that group. Secondly, the better targeted any compensation is on people who lost out from the original change, the fewer losers there will be. The first point suffers from the problem that the smaller the group towards whom we target help, the larger will be the number of losers in other groups; the second from the fact that targeting is difficult and expensive and the help targeted often does not reach those for whom it is intended – particularly a problem in the benefit system with low take-up of means-tested benefits such as family credit.

A good place to start in designing possible compensation measures is the tax and social security system as it now stands. It would be easier both practically and politically if the main part of any compensation could be provided through pre-existing structures. It would seem that the most direct and appropriate method of compensation might be through a full expenditure-specific benefit operating in a similar manner to housing benefit. Housing benefit works by relating amount of benefit received directly to housing costs in the form of rent and rates (now Community Charge), to income and to household characteristics. There are two features of housing costs, however, which are not shared by expenditures on energy, petrol or food, and it is these features which make housing costs particularly suitable for such treatment. The first is that for any individual they are frequently difficult to vary; the second is that they vary widely across the country. These facts are particularly important in understanding why housing is suited to this type of benefit. If costs are difficult to vary for an individual then it is difficult to take advantage of the system by consuming more housing and having the extra paid for by the social security system. Furthermore, the fact that the cost of housing varies so dramatically across the country makes it unsuitable for a standard amount to be allocated. An amount which might be quite adequate in the North would probably be wholly inadequate for a household in London. Conversely, expenditure on energy or food is easily varied by individuals but costs are much less variable across the country. The possible exception is petrol which may be more necessary in rural areas.

There are few specific benefits within the present system which deal with the expenditures at which we are looking, and those that do exist are small and peripheral to the system. Therefore using the structures of the present tax and benefit system to compensate losers from these increases in indirect taxes will inevitably be problematic. It is a relatively blunt instrument and any combined change will inevitably result in some losers as well as some gainers among those with whom we are concerned. It is, however, the most accessible means of compensation and the most likely to be used. It is also already designed to help those whom we may be concerned to compensate – the old, the poor, families with children, etc.

Before going on to look at the specific changes and specific compensation measures, it is important to be clear exactly what compensation means. Suppose we say that we want to leave people as well off after as before the change in the prices of the goods which they purchase. To be as well off they need to have the same utility, in other words the same overall standard of living. This is not the same as being given back the extra money spent in tax following the tax increase and consequent behavioural response. Suppose the price of a good increases because a tax is put on it. Two things occur. The consumer's real income is reduced

because prices have increased, and the relative prices faced by the consumer have changed. Even if the extra tax paid is returned to each consumer, they will still face different relative prices and if the extra tax caused them to buy less of the newly taxed good then they would still be unable to buy as much of all goods as before.

Suppose, for example, in the initial state somebody buys 10 units of a good at £1 per unit, at a total cost of £10. Following the imposition of a 10% tax they buy 9 units at £1.10 each thus paying 90p in tax. If they are given 90p to compensate them they will still be unable to buy the original 10 units, which now cost £11, without making an overall loss of 10p. Because of the change in relative prices, however, this is not necessarily what they now want to buy. If, on the other hand, we look at what would happen if there had been no behavioural change and compensate, in this example, assuming that they continue to buy 10 units of the good, we would give them £1. However, the new set of relative prices means they would probably actually prefer to buy fewer than the original 10 units and more of other goods. In choosing to do this they would increase their welfare.

Giving people enough to leave them as well off in money terms after their behavioural change is, therefore, likely to be inadequate for maintaining their welfare; but giving them enough to ensure that they are as well off in money terms assuming no behavioural change is likely to over-compensate them. The evidence indicates (see, for example, Table 2.2.2) that the differences pre- and post-behavioural response are small, particularly for those on low incomes. Since the compensation measures proposed are imprecise in not seeking exactly to compensate people but rather to ensure that some groups are no worse off, the exact formulation of our meaning of compensation is not vital. Nevertheless the issues raised are important.

In the sections that follow, use will be made of the IFS tax–benefit model to examine the effects of changes in the tax and social security systems on people's incomes. The model runs on a full year's Family Expenditure Survey data and models the whole of the direct tax and benefit system, capturing the interdependencies between various taxes and benefits, and is capable of producing detailed information on the effects of changes on particular individuals and on the population as a whole.[23]

---

23 For a detailed description see Johnson, Stark and Webb (1990).

5.2 Energy

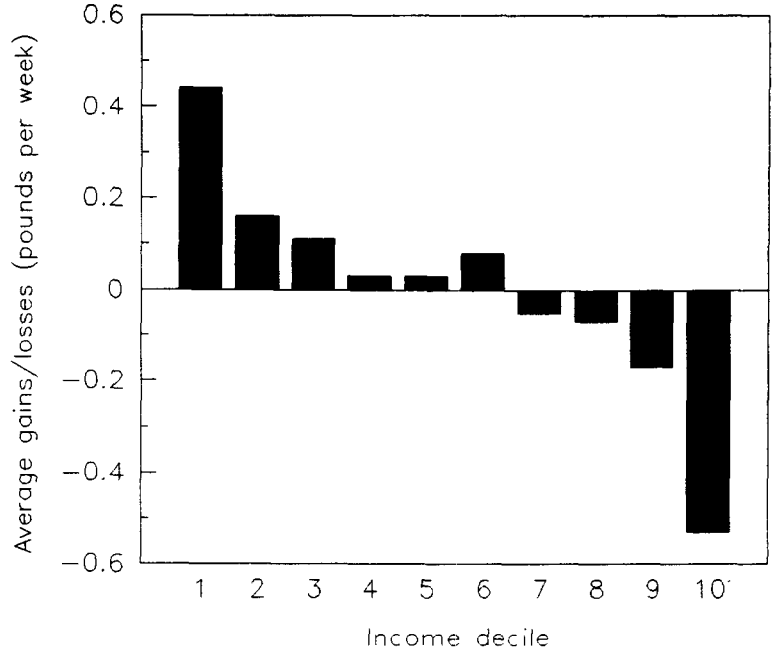
The results of the simulation described in Chapter 2 suggest that tax losses increase only gradually with income and that the average loss among the poorest deciles is over £1 per week. This average conceals a range of between nothing and over £3 in the bottom quintile alone, although only a very small number lose more than £3 and most of these larger recorded losses result from "lumpy" expenditure on fuel such as coal, as described earlier. It is unlikely that any reasonable policies would be able to compensate this small latter group fully. They would, however, obviously benefit from measures designed to help losers as a whole.

Putting VAT on energy would merely bring its treatment into line with that of most other goods and services purchased by households. Its present treatment results in a loss of £1.7 billion to the exchequer when compared with a system in which VAT was charged. This loss can be seen as a tax expenditure. Its present treatment results from worries about the cost to the poor of putting VAT on energy. However, it is a badly targeted tax expenditure. The rich benefit from it more than the poor in monetary terms. Imposing VAT and increasing benefits would actually allow the expenditure to be better targeted.

Our focus in devising compensating policies will be on the most vulnerable – notably the poor, the old and the young. Energy differs somewhat from motor fuel and food in that there are certain groups among the population whose use of it one might want to encourage, and pensioners are prime among this group. It is well known that in severe weather many elderly people may die from hypothermia, but there is also a general increase in the number of deaths during very cold weather. There were 578 hypothermia-related deaths in the first quarter of 1986, and over 6,000 more deaths than would have been expected during the five very cold weeks of February and early March of that year.

Perhaps the most immediately attractive means of compensation would be a lump-sum payment of £1.52 per week (the average loss caused by putting VAT on energy) to every household. This would be a broadly redistributive measure since richer households pay more than the average on energy, poorer households less than the average. As a whole, then, poorer households would be over-compensated, richer households under-compensated. Figure 5.2.1 shows the distribution of average gains and losses by decile from combining the imposition of VAT on energy with such a lump-sum compensation.

Figure 5.2.1: Average gains/losses with lump-sum compensation



This general pattern, however, conceals variations within the deciles. Twenty per cent of the bottom decile lose. A third of the poorest half lose. And although pensioners gain on average, a third of them lose overall. A lump-sum payment such as this is clearly inadequate to compensate a large enough proportion of the groups with which we are concerned. There may in practice also be substantial administrative costs and difficulties in giving a lump sum to every household in the country.

There are several other ways in which the problem might be approached. Certain groups such as pensioners could be made exempt from VAT on energy, either by not paying it in the first place or by being provided with a refund on VAT paid when providing proof of their status as a pensioner. A similar system could be extended to those in receipt of family credit, housing benefit and income support. This would mean that pensioners and all those at present protected by the means-tested benefit system should be left no worse off. To implement such a system, however, would be extremely difficult and costly. There are around 10 million people in receipt of retirement pension alone, another 2 million or so non-pensioners on income support, and over 2 million non-pensioner recipients of housing benefit who are not on income support. A system designed specifically to reimburse these 14 million or so people would be extremely costly and unwieldy. Incentive problems would also result. If the cost of energy increases when one stops receiving a benefit then there is an added cost to earning an amount adequate to take one off the benefit. This cost reduces the incentive to earn more. Any change

in this direction would, therefore, not only be very costly and bureaucratic but would have a significant adverse effect on incentives, unless confined to pensioners. From a practical point of view the chances of it being implemented by a government which has been much concerned with the problems of incentives in the social security system would be small.

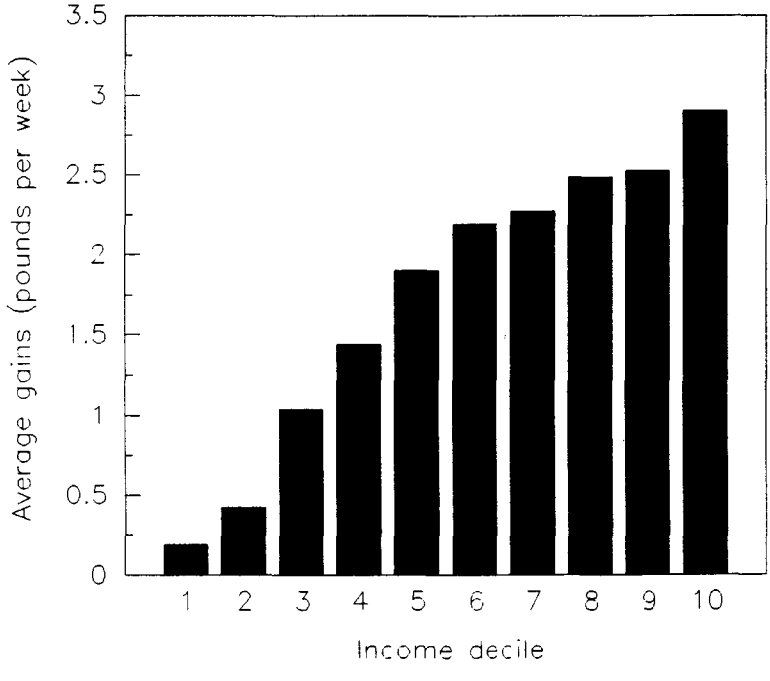
A more promising route to compensation is through adjustments to the existing tax and benefit system. Before going on to look at ways in which this might be changed, however, it is worth looking at what specific measures there have been in the system to deal with energy costs. The present system includes two minor provisions. The first is a home insulation grant. Under this scheme those in receipt of housing benefit, income support or family credit are entitled to grants to insulate loft spaces, of 90% of the cost up to a maximum of £144. The second provision is the cold weather payment. This is available to pensioners, the disabled, and those with a child under 5 who are receiving income support. Five pounds is payable to each of these groups for each week of cold weather. A period of cold weather is defined as a period of seven consecutive days during which the average of the mean daily temperatures for that period is equal to or below 0 degrees Celsius.

In practice neither of these provisions forms an integral part of the income support system. The situation was somewhat different, however, under the old supplementary benefit (SB) system. Additions for heating would be paid if an SB recipient satisfied one of a number of conditions. Help was available to some of those in ill health or disabled, to those living in accommodation that was particularly difficult to heat, to some of those with central heating and to those with a family member aged over 65 or under 5. These special provisions were abolished with the introduction of the income support system in 1988. The new system consolidated some of the heating provisions in enhanced premiums for groups such as the old, the disabled and families, and these premiums might provide one route towards helping particular groups of the poor who lose from the introduction of VAT on energy. Housing benefit works in a similar way with a basic entitlement plus premiums dependent upon family circumstances, and increases here could also be directed towards those whom we particularly wish to help.

The major problem suffered by these routes to compensation is that of non-take-up of means-tested benefits. Not all those entitled to income support or housing benefit receive it, and clearly they would not benefit from any increase. This problem, however, is likely to be a feature of any attempt to target help towards people according to a particular attribute, be it income or expenditure on energy. The alternative route of using the resources on universal benefits such as child benefit, which do not suffer from take-up problems, or on cutting income taxes, however, may be less effective in compensating the poor.

To illustrate this problem we might consider increasing pensions by £2, child benefit by £1 and income tax allowances by 5%. These changes might be expected to be of benefit to at least some of the groups with which we are concerned, namely pensioners, families with children and workers on relatively low incomes. However, as Figure 5.2.2 shows, the benefits from such a reform would accrue to the better-off. The bottom deciles gain little or nothing because what they receive extra in child benefit or pension they lose in means-tested benefits, particularly income support which is withdrawn pound for pound. Pensioners and those with children in the higher deciles get the full benefit of the increases. Those in the bottom couple of deciles pay no income tax and therefore gain nothing from the increases in tax allowances. While the value of these increases is the same for all basic rate taxpayers in money terms, and therefore worth more to the poorer taxpayers in proportionate terms, the value is higher for top rate taxpayers. This is because top rate taxpayers gain 40% of the value of any increase in allowances while basic rate taxpayers gain just 25%. This explains the big gains in the top decile.

Figure 5.2.2: Average gains from untargeted expenditure



Clearly we cannot compensate the poor, within the current tax and benefit system, without using means-tested benefits. Using these and retirement pensions as a vehicle for compensating the poor and elderly, one route to compensation which is broadly revenue-neutral might be the following:

1) Increasing all basic income support and housing benefit allowances by £1.

2) Increasing the income support and housing benefit allowances for children under 11 by £2.

3) Increasing all pensioner premiums for income support and housing benefit by £2.

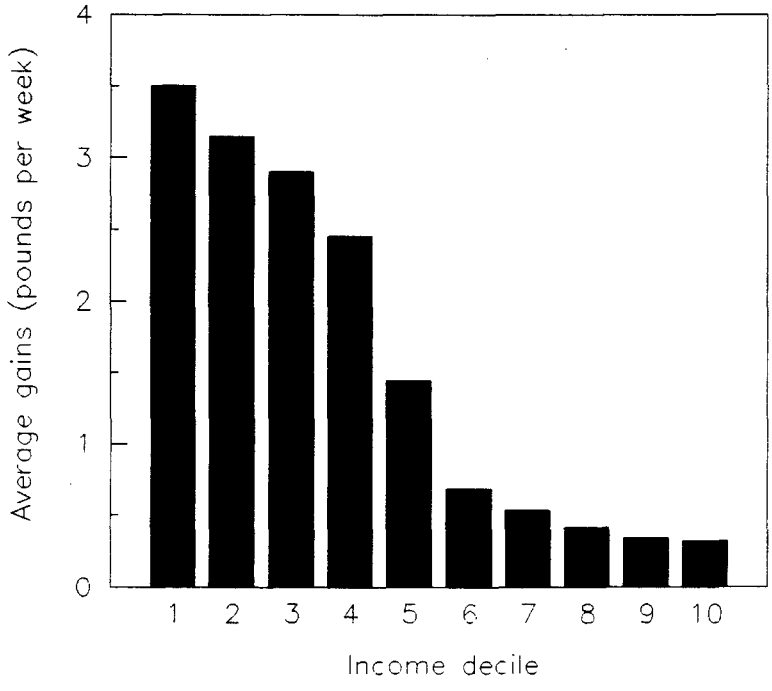
4) Increasing the adult credit for family credit by £1, and the credit for children under 11 by £2.

5) Increasing the basic state pensions by £3.

6) Increasing one-parent benefit by £1.

The fact that this change is well targeted on lower income groups is demonstrated by Figure 5.2.3 showing the lower income deciles to be gaining, on average, more than necessary to compensate for the imposition of VAT on energy, and the higher deciles gaining relatively little. Note, however, that this takes no account of take-up problems.

Figure 5.2.3: Average gains from targeted expenditure



The average gain over all households is £1.57, slightly more than the £1.52 average loss caused by the imposition of VAT. This indicates that the overall package is approximately revenue-neutral.

Under this reform 85% of the bottom two income deciles gain more than the £3 and only 2% gain less than £1. Among the bottom four

deciles 80% gain over £2. By contrast 84% of the top two deciles gain nothing at all. The distribution of average gains by family type is shown in Table 5.2.1.

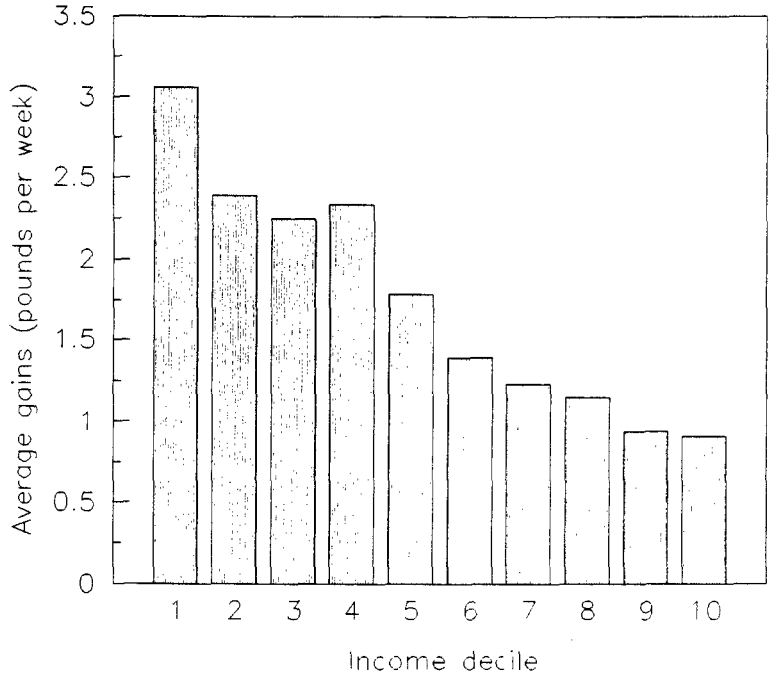
Table 5.2.1
Average gains from targeted expenditure, by family type

Family type	Average gain (£ per week)
Single unemployed	1.10
Single employed	0.13
Single-parent family	3.94
Unemployed couple, no children	1.28
Unemployed couple + children	5.22
Single-earner couple, no children	0.42
Single-earner couple + children	0.65
Two-earner couple, no children	0.04
Two-earner couple + children	0.20
Single pensioner	2.74
Couple pensioner	3.26

It is important to note, however, that these figures assume that everybody takes up the benefits to which they are entitled. To the extent that this is not the case, there will be more among the lowest deciles who gain little. Research indicates that the more benefit to which a family is entitled, the more likely they are to take it up (Fry and Stark (1987)), and thus the very poorest are more likely to receive their entitlement than the slightly less poor. Moreover, to the extent to which benefits are not taken up, the cost will be lower and the money saved could be spent on higher benefits.

Because of the problem of non-take-up, we might want to combine smaller increases in means-tested benefits with an increase in child benefit to ensure the least possible number of losers among families with children. Such a change might also appeal to a wider section of the populace. Increasing child benefit by £1 could be combined with increases in the income support and housing benefit allowances and premiums mentioned above of £1 and a pension increase of £2, a similar increase in family credit and a £2 increase in unemployment benefit. Such a change would have the impact shown in Figure 5.2.4.

Figure 5.2.4: Average gains from combined approach



As might be expected, the poorest deciles do somewhat less well than under the regime shown in Figure 5.2.3, but higher deciles do better. The average gain among each of the bottom five deciles is, however, more than adequate to compensate them. There are now far fewer in the bottom two deciles gaining more than £3 because of the smaller pension increase, but 85% are still gaining more than £2 – enough to compensate the vast majority of losers. The combination of the increases in child benefit and pensions should ensure that help would reach all pensioners and all families with children with no problems regarding take-up. Table 5.2.2 shows the distribution of gains by family type. The clearest contrast with Table 5.2.1 is that families with children do much better than before and pensioners less well.

These simulations can be little more than illustrative as there is an almost infinite number of ways of altering the tax and benefit system. It would also be possible to use some of the revenue in other ways, perhaps combining smaller increases in pensions and means-tested benefits with fiscal incentives or subsidies for more expenditure on domestic insulation programmes.

Table 5.2.2
Average gains from combined approach, by family type

Family type	Average gain (£ per week)
Single unemployed	1.18
Single employed	0.11
Single-parent family	4.30
Unemployed couple, no children	1.18
Unemployed couple + children	5.42
Single-earner couple, no children	0.39
Single-earner couple + children	2.78
Two-earner couple, no children	0.03
Two-earner couple + children	2.04
Single pensioner	1.83
Couple pensioner	2.14

5.3 Transport

The first question to ask when considering compensation for higher taxes on petrol is whether any is required and if so who requires it and why. The arguments for compensation are much less compelling than for energy; in contrast to energy, expenditure on petrol does increase quite rapidly as income increases, indicating that petrol is far from being a necessity for most people.

The greater car-ownership in more rural areas would, however, indicate an element of need in car use. This is particularly illustrated by the fact that the people in lower income deciles in rural areas are considerably more likely to own cars than those in low income deciles in more heavily populated areas (see Table 3.1.4). To the extent that these cars are needed so that such people are able to get to work and to use various facilities, there may be a concern that higher petrol taxes should not force them to part with them or to be unable to afford to use them. On the other hand higher petrol prices would be more likely to reduce time spent on unnecessary journeys and might encourage people to live nearer to where they work. Someone who chooses to live a long distance from their work imposes a social cost on the community by spending longer travelling on the road, contributing towards pollution and congestion more than those who live close to their places of work.

Using the direct tax and benefit system to bring about any compensation that we might desire is unlikely to be appropriate. The only people to lose from the change would be car-owners; non-car-owners will gain to the extent that the reduction in pollution enhances the quality of their lives. Any compensation through the direct tax and benefit system would

inevitably go both to car-owners and non-car-owners. Differential rates of income tax or income support according to car-ownership would clearly be both impractical and unjust.

Taxation of petrol is, however, not the only way in which car use or ownership is taxed. Vehicle excise duty is raised at a uniform rate, currently £100 per year on all cars. Compensation could be possible by reducing this tax. Indeed enough extra money would be raised by the extra tax on petrol to allow the complete abolition of vehicle excise duty. This would not necessarily be desirable as the knock-on effects encouraging car-ownership and petrol consumption might defeat the object of increasing the price of petrol. One option (suggested in Pearson and Smith (1990)) would be to vary VED according to car engine size. This would not only encourage people to use cars with smaller engines which tend to be more fuel-efficient, but would compensate those with smaller cars, who would tend to be among the poorer car-owners, for the increase in the price of petrol. It may be arguable that some people need to use cars because of poor public transport, etc. but it cannot be arguable that they need to use large cars.

Table 5.3.1
A possible way of relating VED to engine size

Engine size (cc)	VED (£)
<1,000	30
1,001 – 1,200	36
1,201 – 1,500	45
1,501 – 1,800	54
1,801 – 2,000	60
2,001 – 2,500	75
2,501 – 3,000	90
>3,001	120

Source: Based on Department of Transport (1989).

At a cost of about £1 billion, VED could be reduced and related to engine size as shown in Table 5.3.1. This would have the effect of compensating virtually all car-owners to some extent, with a maximum gain of £70 per year for those with the smallest cars. This would be almost enough completely to compensate owners of small cars in the lowest decile on average, but would be gradually less adequate compensation for those with bigger cars and in higher income deciles.

The figures in Table 5.3.1 are based on 3p per cc of the largest engine size in each tax bracket, and thus there is a smooth increase in VED due as engine size increases. Alternatively, we may wish to compensate owners of small cars more than proportionately and penalise owners of large cars more. That might ensure fewer poorer car-owners lose from

the increase in tax on petrol. Simply abolishing VED for cars of less than 1,500cc and leaving it unchanged for larger cars might achieve this also at a cost of around £1 billion.

If either of these routes is taken, over £1 billion of extra revenue will remain. This money might best be used on improving public transport, particularly in rural areas and other regions where its present inadequacy makes car-ownership important. To the extent that this can be achieved, compensation measures may not be necessary at all. If the full £2.3 billion raised from increasing the tax on petrol were used on improving public transport in these areas, services might improve enough to make car-ownership no longer necessary for many. Again a range of possibilities exist and the exact combination of policies will depend upon how concerned we are with poor car-owners and to what extent an expansion of public transport is desired.

5.4 Food

The analysis of the distributional effects of changes in the price of food differs from that in the earlier two sections in that the price rise would be an indirect consequence of policies to change agricultural practices, for example regarding fertiliser use, rather than the direct consequence of a tax on food. A range of policy measures in agriculture might considerably affect the price of food; some, such as taxes on fertilisers, might result in revenue which would be available to compensate some of the effects on farm incomes or consumers, but others might raise no revenue. In the absence of a detailed account of how the changes in farming policies would be achieved, it is difficult to be precise about the scope for compensation. As far as the need for compensation is concerned, however, one factor stands out from the analysis presented in Chapter 4, and that is that it is poor families with children who would be most affected by any increase in food prices. Unfortunately, it is also the case that this is precisely the group which we would least like to see either reducing their food consumption or suffering losses in income.

To a small extent the present benefit system recognises this problem for poor families with children. Children whose families receive income support get free school meals. These should be available for nursery children and to those still in education up to their nineteenth birthday. Although the law says that education authorities must make such provision for meals as "appears to be requisite"[24] in the middle of the day, they have no responsibility to provide a suitable main meal of the day. Unlike

24 See Lakhani and Read (1990).

the old family income supplement, however, family credit no longer entitles children to free school meals, though the higher rates are supposed to compensate for this loss. Clearly one response to a government-induced increase in food prices could be to extend rights to free school meals to children whose parents are receiving family credit, or even to those whose parents receive housing benefit. Furthermore, education authorities could be made responsible for providing a suitable main meal of the day.

The obvious problem with any such move to extend the cover provided by free school meals would be its possible deleterious effect on incentives. It would, however, be relatively simple to arrange such a scheme, given that it already exists for those on income support. Alternatively child premiums for income support, family credit and housing benefit could be increased, possibly with a concentration on premiums for young children (those under 11). As illustrated earlier, increasing these levels would be much more effective in helping the poor than would increasing child benefit. Other possible ways of helping poorer families with children might be to increase child benefit for those with pre-school children or increase child benefit while making it taxable.[25]

Given the differences between the pre- and post-behavioural responses outlined in Chapter 4, more thought would need to be given to exactly what we want to compensate people for than was the case with energy and fuel. Given the way in which the gap between these two measures increases as income increases, it appears, as one might expect, that while most food bought by those in lower deciles is bought as a necessity, an increasing amount is bought as a luxury as income increases.

25 For a detailed analysis of these and other methods of helping poorer families with children through the benefit system, see Johnson, Stark and Webb (1989).

6 Conclusions

The potential for using taxation to encourage industries and individuals to take environmental costs into account when choosing particular products and processes has received a certain amount of attention since the publication of the Pearce Report, *Blueprint for a Green Economy*. The attraction of tax instruments rather than a conventional regulatory approach to the problem of environmental pollution is that they allow firms and individuals to choose to reduce pollution where the costs of doing so are least; moreover, taxes provide a continuous incentive to develop less-polluting products and processes, whereas regulations tend to encourage only minimum compliance.

As with all environmental policies which require changes in the way that businesses and individuals behave, environmental taxes will have costs. The costs of changing to more costly production methods, or to products that, initially, appeared to offer poorer value for money, are common to both the regulatory and taxation approaches.[26] However, taxation involves further costs, in the form of the tax revenues paid by each business or individual. Concerns that have been expressed over the impact of environmental taxes on the income distribution, or on the living standards of the poor, have to do, especially, with the pattern of these extra tax payments. What would be the extra burden on poorer households?

The answer to this question should not, however, focus solely on the pattern of extra tax payments. Such a restricted focus is inappropriate because, in addition to the costs of extra taxation, the tax approach has available the benefits of additional tax revenues. The tax revenues raised by environmental taxes provide the opportunity to compensate poorer households, or other vulnerable groups, for the extra tax they will pay. In evaluating the overall effect of environmental taxes on the income distribution, it is important to consider not only where the additional tax revenue comes from, but also what it is used for.

In this Commentary we have explored the distributional consequences of environmental taxes in three broad areas (domestic energy, petrol and food) where significant distributional issues are likely to arise, and have considered the scope for offsetting compensatory policies for particular groups.

---

26 The optimal environmental policy is one which incurs these costs only when greater environmental benefits result.

The analysis concludes that the area where environmental policy is likely to raise the most important distributional conflicts is in the pricing of domestic energy. Energy conservation could be encouraged by extending VAT to cover domestic energy spending; similar effects might be encountered if domestic energy prices rose as a result of a carbon duty on primary fuels, which would feed through into the cost and price of electricity generated. Energy spending rises with household income, although only slowly, and the proportion of a household's total budget accounted for by spending on energy is much higher amongst poorer households than amongst the better-off. In purely financial terms, and *on average*, poorer households could be adequately compensated by using the revenue to pay a lump sum to each household, although administratively this is likely to be impracticable. Given the variation in individual households' energy needs, however, compensation at the average level is still likely to leave many households worse off. We outline in Chapter 5 possible ways in which the existing tax and benefit system could be used to construct a pattern of compensation which would leave a very substantial proportion of poorer households at least as well off, in financial terms, as with current energy prices.

Public policy may, however, be concerned not only with households' real income, but also, specifically, with the availability of adequate heating, especially among the elderly. The estimates in Chapter 2 show that the reduction in energy use amongst the poorest households is much greater than average; moreover, even if financially compensated for the extra tax, these households are likely to have lower energy spending than before, due to the change in the relative prices of fuel and other goods. Where specific heating objectives form part of the aims of public policy, reliance on higher taxes and income compensation alone is likely to put environmental policy and these other objectives at odds. Policies aiming to encourage insulation and thermal efficiency, especially in poorer households, would then appear a necessary adjunct of policies, such as environmental taxation, which aimed to reduce the overall level of domestic energy use.

Appendix: Data and the SPIT Model

The aim of this Appendix is to describe the tax simulation models used in the above quantitative work, and the data source on which it is based.

The Family Expenditure Survey

Each year, around 7,000 UK households take part in the Family Expenditure Survey. This study aims to uncover average household spending patterns, in order to construct the "basket of goods" that is the basis of the RPI figures. Details of most items of spending are based on a two-week diary kept by each adult member of each household. In addition, interviews generate data about a wide range of household demographic and other characteristics, including the number of household members, the age of each, and their relationship to the head of the household. Income details are also recorded.

Whilst the diary record approach may be expected to give an accurate picture of average spending, for any particular household the snapshot nature of the diary may misrepresent the usual pattern of spending. For example the weeks of the diary may coincide with large occasional items of spending (durable goods such as furniture and kitchen appliances, for example), or with weeks of zero spending on certain items although the household does consume such goods at other times (such as clothing and alcohol).

The Simulation Program for Indirect Taxation (SPIT)

Changes to the structure and levels of indirect taxes give rise to changes in the prices faced by consumers. In order to predict the response of consumers to such price changes, and hence their effect on tax revenues, a model of consumers' expenditure is required. In particular, it is necessary to have precise estimates of how consumers respond to price and income changes.

The model that forms the basis of SPIT is a generalisation of the popular Almost Ideal Demand System of Deaton and Muellbauer (1980). This model attempts to explain the share of spending devoted to a particular good, on the basis of changes in prices and incomes.

Estimates of consumers' price and income responses are often obtained by relating *aggregate* expenditures on particular goods to variations in relative prices. However, the data used in the estimation of the model underlying SPIT are micro-level household data (drawn from the FES). Thus it has been possible to estimate a comprehensive model of the relationship between *household* expenditures and household characteristics, in addition to the usual aggregate variables such as prices. The availability

of FES data from 1970 to 1986 on a consistent basis, a sample of some 116,000 households, allows the econometric analysis to be based on household data and yet have considerable variation in relative prices with which to identify price effects.

One feature of the data which has become clear during the process of the model development is that, although the model described above allows for significant variation in preferences across households, the variation in expenditure patterns and behaviour within the data is sufficiently large that problems of obtaining stable estimates arise when estimation takes place across the full sample of households. In particular there appear to be clear differences in spending behaviour across certain subgroups of households, notably whether the household includes smokers and/or possesses a car has an important effect on preferences. One of the main refinements to the model underlying SPIT has been to split the data into four subgroups according to whether the household records positive spending on tobacco and whether a car is present.

References

Ashworth, M. and Dilnot, A. (1987), "Company cars taxation", *Fiscal Studies*, vol. 8, no. 4.

Baker, P., Blundell, R., McKay, S., Symons, E. and Walker, I. (1990), "A simulation program of consumer expenditure", IFS Working Paper, forthcoming.

Deaton, A. and Muellbauer, J. (1980), "An Almost Ideal Demand System", *American Economic Review*.

Department of Transport (1989), *Transport Statistics Great Britain 1978–1988*, London: HMSO.

Fry, V. and Stark, G. (1987), "The take-up of supplementary benefits: gaps in the safety net?", *Fiscal Studies*, vol. 8, no. 4.

House of Commons Select Committee on Energy (1989), *Energy Policy Implications of the Greenhouse Effect*, 6th Report, London: HMSO.

Institute for Public Policy Research (1990), "Green taxes: a budget memorandum", London: IPPR.

Johnson, P., Stark, G. and Webb, S. (1989), *Alternative Tax and Benefit Policies for Families with Children*, IFS Commentary no. 18.

Johnson, P., Stark, G. and Webb, S. (1990), "TAXBEN2: The new IFS tax benefit model", IFS Working Paper no. W90/4.

Lakhani, B. and Read, J. (1990), *National Welfare Rights Handbook*, London: Child Poverty Action Group.

Organisation for Economic Cooperation and Development (1989), *Economic Instruments for Environmental Protection*, Paris: OECD.

Pearce, D., Markandya, A. and Barbier, E. (1989), *Blueprint for a Green Economy*, London.

Pearson, M. and Smith, S. (1990), *Taxation and Environmental Policy: Some Initial Evidence*, IFS Commentary no. 19.

Ridley, N. (1989), *Policies Against Pollution*, Centre for Policy Studies, Policy Study no. 107.