



THE ECONOMIC AND SOCIAL RESEARCH INSTITUTE

ON THE DESIGN OF A MODEL FOR
TAX AND TRANSFER POLICY
ANALYSIS

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1. Introduction

At present, the effects of actual or proposed changes in the tax and social security systems are generally assessed by reference to illustrative calculations for a small number of hypothetical, supposedly typical, family types. Because of the diversity of actual family types and circumstances and the complexity of the tax/transfer systems, such calculations are unable to capture the actual effects of changes in the system on the population, and may indeed be quite misleading as to their distributional impact. Similarly the information available about the distributional impact of the current Irish tax/benefit systems at an aggregate level, based on the redistributive analyses carried out by the CSO using the Household Budget Survey (see CSO 1980, 1983 and Murphy 1984), though very valuable in itself, cannot provide an adequate basis for predicting the effects of possible changes in the system in any detail. This provides a powerful impetus to the development of a data-base and methodology which would enable the analysis of tax and transfer changes to be carried out using a random sample of actual families.

The ESRI is conducting a large-scale survey on income distribution, poverty and the usage of state services which was

designed to provide, *inter alia*, a household data base suitable for such analysis. The detailed information being gathered on income from work and property and social security payments will permit the operation of the tax/transfer systems to be explored in detail, and the likely effects of policy changes to be examined. In order to do so, however, it is necessary to model the complex set of rules which make up the tax and transfer systems, as they apply to different household circumstances. Such a model can be further developed to try to take into account behavioural responses to policy changes (for example, changes in decisions about hours worked induced by changes in income tax rates), though a model which accurately reflected the first round or "cash" effects, abstracting from such responses, would in itself represent considerable progress.

One of the major objectives of the current ESAI project is to construct an operational model of the tax/benefit system, for use by researchers and policy-makers on an on-going basis. The present paper discusses some of the issues which arise in the design and implementation of such a model. The paper is structured as follows. The next section sets out in more detail the rationale for a model based on a sample of actual individuals. Section 3 provides a brief description of some models of this type which have been developed in the UK, and points to a number of desirable features in such a model. Section 4 discusses the construction of a model to assess first-round effects, while Section 5 deals with the issues

raised by the estimation and incorporation of behavioural responses. Finally, some major conclusions are brought together.

2 Analysing Tax/Benefit Changes: The Need for a Micro-Data Base

When considering the impact of changes in the tax/benefit system which are actually being introduced or under consideration, recourse is commonly had to illustration of the effects on a typical family or a small number of family types or situations. Budget changes in income tax may be said to cost/save the average taxpayer a certain figure, for example, while the Budget itself shows the effects on eight different family situations¹, with a range of income levels for each. Commonly, a simple single person/married couple distinction is employed or the three cases single/married couple with no children/married couple with two children are used to illustrate the effects of actual or proposed tax and benefit changes.

The limitations of this general approach for many purposes have become increasingly obvious. Indeed, it has become clear that reliance on such hypothetical examples may, in some instances, be positively misleading about the effects of tax/transfer changes. This has been demonstrated most

1. There are six PAYE sector cases - single person, married couple with one earner and no/one/two/three children, and married couple/two earners/no children - and two Schedule D (self-employed) cases - single person and married couple/one earner/no children.

convincingly by analysis based on the UK Family Expenditure Survey, carried out in the course of the ESAC Programme on Taxation, Incentives and the Distribution of Income. An assessment of the representativeness of the eight different family types/situations used by the DHSS to show the effects of taxes and benefits² (in their Tax/Benefit Model Tables), compared with the actual population as revealed by the FES, was made (Atkinson and Sutherland 1983). This showed that the range of hypothetical families failed to capture the circumstances of most actual families, in ways which are not trivial but would rather have significant implications.

The main reasons for this finding merit some discussion. The hypothetical examples, by their nature, must simplify, and the actual set used by the DHSS assume *inter alia* that

- (a) the family head is the only earner;
- (b) there is only one family in the household, i.e., the family and household unit coincide and the family head is a householder;
- (c) the family lives in a council house paying average rent and rates;
- (d) personal allowances are the only income tax allowances;
- (e) the family has no unearned income.

In the actual population, however, working wives, owner-occupation, multiple tax unit households (e.g., nuclear families with children of working age), unearned income, and other tax allowances are extremely important. Even actual

2. These family types are single person with no/1/2 children and married couple with no/1/2/3/4 children respectively.

family composition shows wider diversity. The result is that most of the actual families in the population differ in one or more significant respects from the closest hypothetical case. Clearly a wider range of hypothetical cases could increase the coverage of the examples - to take owner-occupation into account, for example. This would quickly become unwieldy, however, and could not cope with the essential problem, which is that there is a very wide range of actual family situations in the population, in terms of variables relevant to the tax/benefit system. No manageable range of hypothetical calculations can take into account the combination of possibilities representing substantial numbers in the population.

The analysis of hypothetical examples could not in any case answer many of the most important questions which arise when considering tax/benefit changes, such as the impact on those actually at the bottom/top of the income distribution, the variation in impact within that group, the overall redistributive effect, etc. Since hypothetical examples cannot answer these questions and cannot generate results which are representative of the population, the alternative is clearly to use information on a sample of actual households. Survey information on such a sample can be used as the base for a model of the tax/benefit system which will allow the redistributive effects of tax/benefit changes to be analysed, and related to the population as a whole. It is, of course,

important that the reliability of the survey information should be checked against external information, such as numbers of recipients of various social welfare schemes, the distribution of taxable income and so on. These control totals provide a test of the validity of the survey data, and can be used to correct for the under-representation of certain groups in the population due to differential non-response. The work on validation and re-weighting of our sample results to adjust for non-response bias will be described in detail at a later date.

Modelling the operation of the tax/transfer system and looking at the effects of changes using a random sample of actual households opens up the scope for analysis of considerable richness and variety. Among the major advantages are:

- (i) Policy changes can be specified in terms of the policy instruments at the government's disposal, e.g., changes in rates of tax or benefit, changes in tax-free allowances, or changes in some of the conditions governing social welfare schemes;
- (ii) The cash effects of changes on individuals, tax units and households can be calculated. These cash effects can be used to show how prespecified groups are likely to be affected, or to characterise the main differences between those who are likely to gain or lose large or small amounts;
- (iii) When considering the effects of changing one scheme, the consequential effects on other schemes can be taken into account - for example, the impact of changing social welfare benefits on payments under the Supplementary Welfare Allowance scheme could be assessed;
- (iv) The modelling approach allows the analysis of both incremental and more fundamental policy changes;
- (v) It is easy to compare alternative reforms, as well as any given reform and the status quo.

All the advantages described so far can be gained by simply modelling the rules of the income tax and social welfare systems, under the status quo and particular reforms, and applying these to predict the effects of reforms on a sample of households and individuals. Such calculations are usually referred to as 'cash gain' or 'first-round' effects. A further advantage of the modelling approach is that it can go beyond this, in attempting to take into account individuals' and households' behavioural responses to policy changes. Calculations which ignore such responses tend to overestimate losses and underestimate gains, relative to 'second round' estimates allowing for behavioural reactions. Cash gain calculations may therefore have a bias in favour of the status quo (see King 1983b for an illustration of the possible extent of this bias).³

In the tax/transfer area, labour supply responses are perhaps of the most obvious importance, and efforts have been made to incorporate such elements into a micro-data based model of the tax/transfer system. As discussed in some detail in Section 4 below, the specification of such behavioural elements in a way which is both satisfactory from a theoretical point of view and suitable for incorporation in a tax/benefit simulation

3. King (1983b) estimated the effects of change in the tax treatment of housing in the UK, both without and with behavioural responses, using a model based on FES data. Cash gain calculations suggest that 56% of households would gain from the change, but calculations based on the 'equivalent gain' which takes behavioural responses and the utility function which underlies them into account, suggested that 83% would benefit. While changes in the demand for housing due to the policy change are allowed for, however, any consequential changes in house prices following this demand shift are not - a general point to be taken into account in the comparison of first and second-round effects discussed here.

model is a complex undertaking. Only limited progress has so far been achieved in this area internationally and the estimation of responses on Irish data involves a great deal more than simple replication of work done elsewhere. Simply modelling the rules of the Irish income tax and social security systems, as they are currently and as they would be under various proposed reforms, would represent a considerable improvement on the analysis current possible here, and is therefore our immediate goal. Clearly, though, working towards the incorporation of behavioural responses must be the next step, and while developing in that direction the sensitivity of estimated first-round effects to likely reactions will have to be indicated. This could be done, for example, by comparing the simple first-round effects with those where a particular labour supply response - an hour's work more/less per week for married women, for example - was imposed. Thus the consideration of the sensitivity of the results to behavioural responses does not have to await the full explicit incorporation of estimated responses into the model.

We now look at the models of the tax/transfer system which are currently being developed in the UK, and draw some lessons for the desirable features of such models.

3. Review of UK Models of the Tax/Transfer System

Three main UK models based on micro-data are reviewed here. Two different models have been produced in the course of the ESRC Programme on Taxation, Incentives and the Distribution of Income, and are referred to as TAXMOD and TRAP (Tax Reform Analysis Package) while the third model is being developed by

the Institute for Fiscal Studies. All three represent work in progress, with published analyses often lagging somewhat behind current state of development.

3.1. TAXMOD (*Version 7.1: Nov. 1985*)

The TAXMOD program (described in Atkinson & Sutherland, 1985) is designed to be used directly by policy-makers as well as to be readily available to other researchers. This had a major influence on the construction of the program, which is menu-driven. It is based on a set of tax units drawn from the FES, but the results are grossed up to represent the corresponding national position. The model as presently constructed deals only with those in full-time work, excluding cases where the head of a tax unit is unemployed, retired, a part-time worker (under 30 hours a week), sick or not in the labour force. The total coverage is therefore fifteen million out of the total of twenty-seven million tax units, and the model at present is suitable primarily for the analysis of changes in the income tax systems and related social security benefits for those in work, rather than the wider social security system.

The model does not incorporate possible responses in behaviour, incomes before taxes and transfers being unaffected by the policy change. For any specified reform, the net effect on government revenue is calculated - an alternative provided in other models, of imposing revenue neutrality with the tax rate or a lump-sum subsidy automatically adjusting to provide this outcome, is not available. The data-base is from the 1982 FES sample, but extrapolated to a November 1985 baseline.

In order to assess a particular policy change using the

model, the precise details of the reform must first be specified. The program then calculates the effect which this reform would have on each household by comparison with the baseline, current situation.⁴ The program produces a wide range of indicators of gains and losses, for prespecified groups, overall summary statistics on the change in the distribution, etc.

The range of analysis of first-round effects made possible by the model may be illustrated by the exercise carried out in Atkinson and Sutherland (1983). These assessed the impact of such changes as the integration of income tax and National Insurance contributions, raising the income tax threshold, increasing Child Benefit, altering tax reliefs, and changing the graduated rate structure, in various combinations. As far as social security is concerned the model as presently constructed is particularly suitable for the analysis of child benefit or FIS since these go to those in work - for example, the impact of making FIS taxable, or of increasing the proportion it pays of the deficiency between actual income and the FIS floor level, could be examined.

3.2 TRAP (*Tax Reform Analysis Package: May 1983*)

TRAP, unlike TAXMOD, is designed to take account of behavioural responses to policy changes. It also allows not only cash gains or losses but the effects of reforms on family

4. In order to put the actual tax/transfer regime on the same basis as the reform being analysed, it is necessary to predict the effects on households using the existing rules, as well as the effects of the reform; thus, for example, predicted tax liabilities rather than actual tax payments under the current regime are used in the baseline. Non-take-up of means tested benefits is modelled simply by giving each eligible household or individual a probability of take-up equal to the overall take-up rate.

welfare to be measured, using certain assumptions. Revenue neutrality may also be imposed for any reform, with the tax rate or lump-sum payments automatically adjusting to ensure no net revenue effect. All these features make the model more complex, and it is not menu-driven. It is intended that the user may change the programme directly to meet particular requirements (see King and Ramsay, 1983).

TRAP calculates various measures of welfare change for any reform, based on the concept of equivalent income, a monetary measure of welfare (see King 1983a, b). When any reform is implemented, not only incomes, but prices change: when the tax rate is altered, for example, the price of work versus leisure changes. In order to assess the welfare gain or loss, taking this into account, the income level which is equivalent in terms of the family's welfare to the actual reform, but at pre-reform prices, may be used - that is, the 'equivalent income'. In terms of the example of a change in the income tax rate, this measures how much cash income the family would need at the pre-change net wage in order to be as well off as they are with the tax change. The program calculates the distribution of welfare gains and losses and the results show these by decile groups, or by other prescribed groupings. In order to produce such estimates the user must first specify the functional form of the equivalent income function, representing preferences and the demand functions for the commodities in question. The program will also produce standard errors for the welfare measures given certain other inputs indicating the degree of uncertainty about the estimates of the parameters of the demand function.

The user must also specify various other inputs to

determine the way behavioural responses are to be taken into account and their magnitude. Using TRAP to analyse tax credit schemes taking labour supply responses into account (in Atkinson, King and Sutherland (1983)) for example, a linear labour supply function with a wage elasticity of 0.3 is used, but a larger or smaller effect could be imposed by the user as desired. The way in which revenue neutrality is to be achieved also offers scope for choice by the user.

In addition to the analysis of income tax, other areas to which TRAP has been applied include changes in the tax treatment of housing and their impact on family welfare. King (1982) looked at the effect of taxing the imputed rental income of owner occupiers,⁵ while King (1983b) analysed the effects of abolishing mortgage interest tax relief and raising local authority rents.

3.3 *The IFS Tax/Benefit Model (1985)*

The Institute for Fiscal Studies has developed a model of the UK tax/benefit system for implementation, like TAXMOD and TRAP, with the sample of actual households gathered in the FES. The basic model is based on the tax unit but can aggregate these into households to produce household-based output. While the model is made available to policy makers and other researchers, it has also been the base for more specialised development and applied by IFS researchers to the analysis of labour supply behaviour in some depth (as discussed in Section 5 below).

The model's coverage is impressive, applying to up to

5. Unlike most such analysis, this allows for "feedback effects" where policy changes leading to behavioural responses produce in turn price changes - here, in the housing market.

97.5% of the households in the FES. _ It has primarily been used to examine possible reforms of the tax/benefit system, including the fundamental reforms suggested by Dilnot, Kay and Morris (1984), and to explore replacement ratios, marginal tax rates, and incentive effects. It has also been used to analyse the impact of the changes actually introduced in successive Budgets, for example the restructuring of the National Insurance contribution system in the 1985 Budget (see Davis and Dilnot (1985)). While focused very deliberately on the analysis of concrete policy proposals/actions taken and intended as a tool for policy-making, it can also be used as the starting point for sophisticated behavioural analysis. The extent to which such behavioural responses have been fully incorporated so that external users can readily take them into account is, however, not apparent.

3.4 *Desirable Features of a Tax/Transfer Model*

This review of UK models suggest a number of desirable features one would aim for in a tax/transfer model:

- (i) Breadth of coverage: In evaluating reforms of the income tax and social welfare systems, it is clearly desirable to predict the effects for *all* households. Experience in the UK suggests that certain areas are particularly difficult to model adequately. Thus the self-employed have only recently been included in TAXMOD, while both this model and TRAP have so far concentrated on the working population, excluding tax units where the head is unemployed, sick, retired, working part-time or not in the labour force. The high proportion of self-employed farmers and relatives assisting on family farms may pose additional problems in the Irish case.
- (2) Ability to cope with a variety of reforms: The available data imposes certain limitations on the type of reform which can be modelled. Further limitations will be imposed by the fact that the programming cannot anticipate all the reforms which will be of interest. These secondary limitations are not insurmountable, and can be reduced by a flexible program. There would, however, be considerable

difficulties in modelling reforms which made major unanticipated changes to the definition of tax or benefit units, as discussed in Section 4.2 below.

- (3) Incorporation of the government revenue constraint: There would appear to be a role for two distinct types of simulation: an unrestricted simulation producing an estimate of the net revenue effect of the policy change (as in TAXMOD), and a restricted simulation which would be revenue neutral or yield a specified net revenue (as in TRAP). Ways to achieve the latter are discussed further in Section 4.
- (4) Ease of updating: Inevitably the household data base available will lag behind developments, and for some purposes it may be important to update the data for changes in incomes and the tax/benefit system to bring it fully up to date. Merz (1986) suggests that updating to take income changes into account can be treated in the same way as the adjustment to contemporaneous control totals, a possible approach which will be discussed elsewhere in the general context of reweighting and validation of the survey.
- (5) Ease with which behavioural responses may be incorporated: It is clear that the development of a model which incorporates behavioural responses will follow the first stage of modelling adequately the cash effects of the tax/benefit system. It is, however, essential that this first stage be implemented in such a way as to facilitate the incorporation of behavioural responses as much as possible. The issues involved in the further stage of estimating and incorporating these responses in the model are discussed in Section 5.
- (6) Calculation of cash gains and welfare gains: In addition to the calculation of cash effects on families/households (whether with or without behavioural responses), the inclusion of welfare measures when behavioural responses are taken into account, and the calculation of standard errors for these measures, is desirable.
- (7) Statistics for evaluation of reforms: Given the complexity of the system and the diversity of the effects of changes on different households, a wide range of statistics on the impact of a particular reform is required. These are discussed in detail in the next section.
- (8) Relevance and availability to policy makers: The more readily available the tax/benefit model is to other researchers and policy makers, the easier it will be to gain acceptance for the results and for the usefulness of evaluating reforms through such a household-based model. There may be some trade-off between sophistication of modelling, particularly of behavioural relationships, and accessibility of the

model to others. However, if accessibility is seen as a major objective from the beginning it will influence the way in which the model is structured and programmed, and will be easier to achieve.

4. Modelling the Cash Effects of Changes in the Tax/Transfer System

4.1 Introduction

The development of a fully articulated model including behavioural responses is a long-term project. The evaluation of alternative specifications of labour supply responses, for example, is a major task in itself, as the experience elsewhere (discussed in Section 5 below) has illustrated. Furthermore, there is no intrinsic limit to the refinement of models of behavioural responses; by their nature they are subject to continual revision and reassessment. The first stage in the process, simply setting up a model which mirrors the operation of the tax/benefit system and calculates the cash effects of changes, is in itself extremely valuable. It will represent a significant advance on the type of analysis of policy changes which is currently possible.

It is a major objective of the ESRI project to produce such a model, based on the survey currently being carried out, as soon as possible. It is intended to construct the 'cash gain' model and carry out a range of analyses of that type while the work on behavioural responses is being developed. This does not mean that possible responses will have to be completely ignored in the meantime: information is being gathered in the survey on such areas as the perceived availability of extra hours of work or a second job, for example, which can be applied to the assessment of the

sensitivity of cash gain calculations to responses.

4.2 *Steps in Constructing a Model of the Cash Effects of Changes in the Irish Tax/Transfer System*

(1) Specifying the Current Income Tax Regime: The first element of this task is to group individuals in tax units for income tax purposes. Some flexibility is needed to cope with possible future reforms or the analysis of past changes in the income tax code. If, for example, one wanted to analyse the effects of the change from income tax allowances for dependent children to an increased child benefit (children's allowance), it would be necessary to identify dependent children. The basic unit of analysis which seems to cope best with the present position and possible variants is an individual or married couple, with dependent children, if any. Many changes in the tax treatment of husbands and wives can be considered within this framework. Major changes in the definition of tax units do pose practical problems. It may be necessary to re-process the raw data. Furthermore, comparisons are rendered more complex by substantial changes in the unit.

The next stage would be to classify individuals according to the Schedule under which they pay income tax, and define the rules governing tax allowances, deductions, rate bands and rates.

Income for tax purposes would need to be estimated for each tax unit. Data on current income, and data for the estimation of 12 month income have been collected. For income tax purposes, it is the latter figure which is of more relevance. Then the income tax liability of each tax unit would be calculated.

Some comparison with actual tax outcomes would probably be desirable. A close fit between actual tax payments and predicted tax liabilities on a current income basis would not be expected. A closer fit between the two might be expected if estimated annual income was the basis. The main reasons for a lack of fit would then be discrepancies between income as reported for tax purposes and income as reported in the survey; differences between allowances claimed and predicted allowances; and differences arising from the fact that income in the last 12 months was not the same as income in the year on which tax is currently being paid.

(2) Specification of Existing Cash Transfers: This is an even more complex task than the calculation of tax liabilities. It is necessary to define the full set of eligibility conditions for the various means tested Social Welfare schemes, and model the complex workings of the various means tests. It may be noted that this is also exactly what is needed in order to analyse take-up of these schemes, which is also a priority area for our research. The set of existing payment rates must also be built into the calculation of entitlements to income maintenance transfers; this brings us most of the way to a full specification of the existing tax/transfer regime, although the lack of information on the PRSI contribution records of respondents means that entitlement to contributory benefits cannot be fully modelled.

Various treatments of the non-take-up of means tested benefits are possible. It is envisaged that a simple treatment will be used in the earliest work on the model e.g. randomly assigning eligible households to take-up or non-take-up categories using a probability equal to the overall take-up

rate for the scheme, as is done in TAXMOD. Analysis of the determinants of non-take-up (such as demographic characteristics, and the amount of benefit entitlement) can be incorporated as it becomes available.

(3) Specifying a Reformed Tax/Transfer Regime: The existing tax/transfer regime is very complex, partly because it has been built up by piecemeal decisions over the years. Specifying policy reforms will probably be somewhat simpler than describing the existing system. Policy reforms which continue the piecemeal trend usually involve only a small number of changes to the system. More radical proposals, such as the Commission on Taxation's Report on Direct Taxation, often involve considerable simplifications of the tax/benefit structure and rules.

The Commission on Taxation identified those elements of its proposals for income tax reform which could be put into effect immediately. These "Phase I" proposals formed the basis of the tax reforms recommended by the recent National Economic and Social Council report on A Strategy for Development. The cost, revenue and distributional implications of most of these reforms could be modelled. (The data would not, however, allow a direct simulation of the Commission on Taxation's expenditure tax proposals).

Analysis of the Commission on Social Welfare Report would also be possible. It contains rather more detailed amendments to existing schemes and fewer simplifications than the Commission on Taxation. However, most of its recommendations can be analysed as changing parameters of the existing system. For instance, the proposals to have a uniform basic payment, a set of equivalence scales, and a 10% differential between

"benefit" and "assistance" payments can be analysed in the same framework as the existing system. So too could differential increases in rates of payment favouring the schemes with lower rates, which was the path recommended by the NESO.

The effects of changes in indirect taxes cannot be analysed adequately with the data currently being collected. This might be possible at a later date, using data from the 1987 Household Budget Survey to estimate expenditures on commodities with different tax rates for the households in the ESRI sample.

(4) Net Revenue Effects and the Government Budget Constraint

As already outlined, there would seem to be a role for two main types of simulation:

- (i) an "unrestricted" simulation, where the parameters of the tax/transfer system are directly and exactly specified; the net revenue effect of the changes would be part of the output of this type of simulation.
- (ii) simulations which are "restricted" in order to achieve a given net revenue effect. Revenue neutral changes would be a special case of this type of simulation; a more topical example would be a comparison of different ways of achieving a positive net revenue of some target amount, by combinations of changes to direct taxes and transfers.

The simplest way of imposing the required restriction is to let one variable (say the standard rate of tax, or the level of personal allowances, or a multiplicative constant applying to all social welfare payments) be determined as a residual. A more satisfactory method would be to allow a user to define the balance of the residual financing package e.g., specifying that half of any shortfall be made up from the taxation side, and half from the social welfare side.

Atkinson, King and Sutherland (1983), in their examination of a tax credit scheme remark that "the precise determination

of the tax rate required to finance the scheme may be crucial to its distributional impact". It will be important, therefore, to ensure that the grossed-up survey information reflects the size and composition of the existing income tax base, so that it will be possible to estimate the net revenue effects of alternative reforms adequately.

(5) Evaluation of the Reforms and Presentation of Results

The output of the modelling procedure is the full set of predicted cash or 'second round' effects on households of changes in tax/transfer policies. This is an excellent information base on which to assess policy effects, but one must decide on a range of tables to summarise the information for presentation to policy-makers, other researchers and the public. Some of the measures used by the ESRC and IFS researchers are outlined below:

- a> overall summary statistics on the distribution of net incomes under the alternative policies e.g. Lorenz curves;
- b> overall summary statistics on the distribution of gains and losses;
- c> distribution of gains and losses for households with pre-specified characteristics e.g., the number who gain/lose and average gain/loss for each decile of the income distribution, income range, tenure group, household composition type, stage of the family cycle, or class;
- d> profiles of those with different ranges of gain and loss, in terms of their individual and household characteristics e.g., average income of those who gain more than £2 per week, £0 to £2 per week, lose £0 to £2 per week, or lose £2 per week or more. This helps to answer the question "What distinguishes the gainers from the losers?" TAXMOD also includes an option for a full listing of cases with very large gains or losses;
- e> a graphic illustration of the distribution of gains and losses within income groups can be given. King (1983b) graphs the 10th, 50th and 90th percentiles of gain as well as the mean gain for each decile of income; both the spread and the average gain can be seen quite clearly. A similar picture of the mean gain and the distribution of gains could be drawn for other prespecified groups;
- f> an explicit social welfare function approach provides

another alternative, which will be easier to implement after some work on behavioural responses has provided estimated utility functions. The use of poverty indices can be regarded as an important special case of this approach, where all those above the poverty line receive zero weight in the social welfare function. It will be possible to build in the information necessary to compute summary measures of poverty for various income poverty lines and adult equivalence scales so that the effects of policy changes on these summary measures of poverty can be calculated. Some choice could be given to users in the specification of the poverty line, and, as in TAXMOD, in the specification of equivalence scales;

g> effects on marginal tax rates for husbands and wives: again this can be done for pre-specified groups, or the characteristics of those whose tax rates change by similar ranges can be examined. Several concepts of marginal tax rate may be of interest, ranging from the rates on an hour's extra work by each spouse, to the rate faced by a married woman taking up a paid job;

h> TAXMOD also has an option to calculate the effect of a reform on a hypothetical family specified by the user. This may be useful from several points of view. It is more flexible than the Budget or DHSS tables, which calculate the effects of pre-specified policy changes for a pre-specified and restricted range of family types. It can establish a link between the usual Budget tables approach and the fuller analysis which the model makes possible. It can also help users to understand the consequences of reforms which they specify. It may show that a reform which has exactly the intended consequences for the type of family in which the user is interested may have undesired or unintended consequences for other families.

5. Allowing for Behavioural Responses

Behavioural responses may have major implications for the distributional - and revenue - effects of many policy changes; indeed policy reforms are frequently designed with the intention of producing precisely such responses. To estimate the relationships involved and incorporate them in a tax/transfer model is, however, a major task, and is by its nature something of an iterative process. Behavioural responses can be used simply to improve positive predictions of the effects of reforms and the money gains/losses they produce.

They can also provide the basis for estimates of welfare gains and losses, which may be measured in a money metric, in the manner of the TRAP model.

The behavioural responses which will be relevant will vary depending on the precise area being analysed. In the context of the income tax and social security systems the most obvious area of importance is labour supply, but clearly the model could also focus on other areas. It could be used to look at changes in the tax treatment of housing, for example, where housing demand responses become relevant and labour supply less so. Here we will concentrate on labour supply and the issues to which it gives rise.

A very substantial literature analysing the determinants of labour supply at the individual (rather than aggregate) level has developed in recent years, as micro-data on individuals and families became more widely available. Beginning with simple linear models, this research has now reached a high level of theoretical and econometric sophistication. (For general reviews of this literature, see for example, Hausman (1985), Killingsworth (1983)). Increasing attention has been paid to issues such as:

- (a) the non-linearities and non-convexities introduced into the budget constraint facing individuals by the way the tax and social security systems operate,
- (b) the interrelationships between the labour supply decisions of different family members.
- (c) the quantity constraints which may restrict individuals' options about labour supply - many jobs offer a choice only between working 40 hours a week or not at all, for example - on which the Stirling

project in the UK have concentrated (see Brown et al (1986));

(d) the importance of fixed costs to working, most obviously travel costs but also such possibilities as child minding expenses influencing married women or single parents' decisions;

(e) the joint determination of labour supply and commodity demands, examined by Atkinson and Stern (1980) and Blundell and Walker (1982);

(f) intertemporal aspects of labour supply, taking into account such elements as the influence of prospective future earnings on current labour supply and life-cycle considerations generally (see, for example, Blundell and Walker (1986)).

As was made clear in our earlier discussions of UK models, progress in incorporating such complex behavioural relationships into an operational model of the tax/benefit system has been rather patchy. It is also the case that there is little previous research based on Irish data on which to build, since suitable cross-section data has not been available. This means that the specification and estimation of labour supply relationships using the data generated by the ESRI survey, itself obviously a major research effort, will have to be undertaken. The data will, however, permit a variety of interesting approaches. Relatively little expenditure data is being gathered, but a variety of information on items such as perceived quantity constraints (through availability of extra hours or second jobs), the marginal wage rate for those who can work extra hours, travel to work and other costs, as well as detailed information on current and usual hours and pay

of each household member is included.

In practice, there may be a trade-off between theoretical elaboration, theory consistency and the coverage of the model. Elaborate models may be developed applying only to particular sub-groups, such as married women with working husbands in single tax-unit households. Also, the more elaborate the theoretical model, the more likely it is that the data will violate the theoretical restrictions: welfare gain calculations for these households will then be meaningless, while dropping them from the sample leads to an unknown bias and narrows the coverage of the model, reducing the policy relevance of the analysis. As Brown *et al.* point out, it is impossible to incorporate simultaneously all the refinements found in the literature into one estimated model: the combined data requirements would exceed what could be expected even from a survey, such as that undertaken for the Stirling/Treasury Project, specifically devoted to labour supply issues.

Both hours worked and participation decisions have to be modelled, either separately or jointly. The data being gathered includes information for those not currently doing paid work on whether they are currently seeking a job, and if not, explores the reasons why, which should help in the modelling of participation. The selection bias inherent in the analysis of hours independently, conditional on participation, argues for a joint analysis, which would also have the advantage of being more suitable for incorporation into the tax/transfer model. Joint analysis is necessarily more complex, however; Stern (1966) emphasises the need for tractable and flexible functional forms, and the importance of forms which allow, for example, for the possibility that leisure is an inferior good

at low levels of labour supply. In analysing hours worked, information will be available on actual hours worked last week/month, and usual hours, with overtime identified, with current and usual gross and net pay. If extra hours of paid work would be available in the main job or second job, then the marginal wage rate for an extra hour is also asked. This should enable the actual budget constraint facing individuals to be identified with more accuracy than in the standard approach, which relies on wage rates obtained by dividing income by hours, assuming the same standard workweek and overtime premia for all workers, and ignoring employer demand constraints.

As already mentioned, labour supply is not the only behavioural element which will be relevant to the assessment of the effects of tax/benefit reforms. Depending on the policy reforms involved, the responses of most interest could be in many other areas, e.g., responses in the housing market, or in the utilisation of public services such as health. It may, therefore, be necessary to develop other behavioural relationships and introduce them into the model for particular analyses. Labour supply is the clear priority in this context, however. A broader issue relates to the feedback effects which behavioural changes induced by policy reforms may themselves have on prices and demand: labour supply responses, for example, may lead to changes in wage rates and unemployment, which could only be picked up in a full labour market model. It is unlikely that such effects could be incorporated directly into a tax/benefit model based on individuals and families, though their likely magnitude could perhaps be illustrated by reference to such other work as may be available.

6. Conclusion

The large-scale survey currently being carried out at the ESRI will provide a household data base suitable for the analysis of changes in the tax and transfer system. In order to assess the impact of such changes, it is necessary first to model the complex set of rules which makes up the tax/transfer system as they apply to these households. The first-round or cash effects of actual or proposed changes can then be examined, with a wealth of possible indicators of the distributional implications available. This would allow the policy proposals to be properly assessed in terms of the direct effects on different types of households, on different sections of the distribution, and on the overall shape of the income distribution. Such a model could be made available to policy-makers and others for the analysis of policy on an on-going basis.

Further development to try to take account of behavioural responses which may affect the impact of policy changes would then be desirable. This would be particularly relevant in the area of labour supply, itself entailing a substantial programme of research based on the data being gathered in the survey.

References

- Atkinson, A.B. (1984) "The Costs of Social Dividend and Tax Credit Schemes", ESRC Programme on Taxation, Incentives, and Distribution of Income DP No. 63
- Atkinson, A.B., M.A.King and H.Sutherland (1983) "The Analysis of Personal Taxation and Social Security", National Institute Economic Review, No.106, Nov.
- Atkinson, A.B. and H.Sutherland (1985) TAXMOD User Manual
- Blundell, R. and I.Walker (1986) "A Life-Cycle Consistent Empirical Model of Family Labour Supply Using Cross-Section Data", Review of Economic Studies, Vol. LIII (4), No. 175, Aug.
- Blundell, R., C.Meghir, E.Symons and I.Walker (1986) "A Labour Supply Model for the Simulation of Tax and Benefit Reforms" in R.Blundell and I.Walker (eds) Unemployment, Search and Labour Supply Cambridge: CUP
- Central Statistics Office (1980) Redistributive Effects of State Taxes and Benefits on Household Incomes in 1973, Stationery Office, Prl. 8628
- Central Statistics Office (1983) Redistributive Effects of State Taxes and Benefits on Household Incomes in 1980, Stationery Office, Pl. 1806
- Davis, E. and A. Dilnot (1985) "The Restructuring of National Insurance Contributions in the 1985 Budget", Fiscal Studies, Vol. 6, No. 2, May
- Davis, E., A. Dilnot, G. Stark and S. Webb "The IFS Tax and Benefit Model", IFS Working Paper No. 87/9
- Dilnot, A., J.Key and C.N.Morris (1984) The Reform of Social Security London: IFS
- King, M.A. (1981) "The Distribution of Gains and Losses from Changes in the Tax Treatment of Housing" ESRC Programme on Taxation, Incentives, and Distribution of Income DP No. 20
- King, M.A. and P.Ramsay (1983) "TRAP: Tax Reform Analysis Package" ESRC Programme on Taxation, Incentives, and Distribution of Income DP No. 35
- King, M.A. (1983a) "An Index of Inequality: With Applications to Horizontal Equity and Social Mobility", Econometrica, Vol.51, No.1
- King, M.A. (1983b) "Welfare Analysis of Tax Reforms Using Household Data", Journal of Public Economics, Vol. 21, No. 2
- King M.A. (1983c) "Tax Policy and Family Welfare" ESRC Programme on Taxation, Incentives, and Distribution of Income DP No. 52
- Murphy, D.C. (1984) "The Impact of State Taxes and Benefits on Irish Household Incomes", Journal of the Statistical and Social Inquiry Society of Ireland, Vol. XXV, Part I