AN INTRODUCTION TO STINMOD:
A Static
Microsimulation Model

Simon Lambert, Richard Percival,
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Abstract

This paper is the first in a series of papers which document and discuss aspects of the development of STINMOD, NATSEM's first static microsimulation model. The reasons underlying the approach taken with STINMOD's design and development are examined. Issues that arose in the development process are described, as are the solutions adopted. The major components of STINMOD are summarised and the features that distinguish it from other static microsimulation models are also discussed. While much has been achieved already, there is ample scope for future enhancement and the paper concludes with a discussion of the likely direction of the future development of STINMOD.

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Contents

1. Introduction

The National Centre for Social and Economic Modelling (NATSEM) was established at the University of Canberra in January 1993 to develop microsimulation models and microdata techniques. These models and techniques are to be used by both NATSEM and others who are interested in social and economic policy in Australia – public servants, politicians, lobbyists, academics, welfare groups, private sector peak bodies, the media and students.

This technical paper provides an introduction to NATSEM's first static microsimulation model, STINMOD (**St**atic **In**comes **Mod**el). STINMOD was under development at NATSEM for a year and a half. During this time, a user-friendly version of STINMOD (STINMOD/94A) was completed and is now publicly available for purchase. The STINMOD database provides a synthetic 1994 income distribution; it has already been used to undertake analysis of poverty in Australia (Harding, 1994) and could be used by other analysts interested in income distribution, poverty and inequality in the 1990's. The STINMOD database has also been augmented to provide NATSEM's core funding department, the Department of Human Services and Health, with data to undertake distributional analysis of health and housing expenditure.

While there are a number of other static microsimulation models in Australia, none of these are both broad in coverage and widely accessible. STINMOD has been designed to meet both these criteria and to provide a user-friendly tool for all those interested in social and economic policy in Australia. By providing a model which does not require any programming ability or access to a powerful mainframe computer, STINMOD will satisfy an unmet need for quantitative analysis which has, until now, only been available to those inside government and a few academics.

Section Two briefly describes what microsimulation is and provides an overview of the characteristics of a static microsimulation model. This is followed by a brief overview of Australian static microsimulation models and a discussion of why these models have been inaccessible and how NATSEM aims to improve this situation.

Section Three examines the objectives which guided STINMOD's development and the strategies adopted to ensure these aims were met. A discussion of the issues that arose during STINMOD's development – and how these issues were resolved – is also included.

Section Four summarises the government programs which are currently modelled in STINMOD and the methodology used in their simulation. More detail on how these programs are modelled can be obtained from separate technical papers [1].

Section Five describes the validation strategy used to evaluate STINMOD's results

Section Six examines the issues involved in maintaining and archiving STINMOD.

Section Seven discusses likely directions for the future development of STINMOD.

2. Microsimulation

2.1 Definition

Microsimulation is a means of modelling socio-economic systems by simulating individual units within the system. It is a technique which is particularly suitable for systems where the decision-making occurs at the level of the individual unit and where the interactions within the system are so complex that it is not possible to find an exact solution. The major advantage of microsimulation models for social and economic policy analysis is that they produce results which can be analysed at the individual level [2]. Thus, the distributional impact of a policy measure

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1 See Cox and Paul (1994); Lambert (1994); Percival (1994a; 1994b).

2 Some microsimulation models use the firm as the decision-making unit (Van Tongeren, 1993; Eliasson, 1985), rather than the individual or families.

across different types of families or different geographical regions can be assessed. At the same time, estimates of the aggregate outcomes can still be derived easily, by summing the individual results. It is these features which led a recent exhaustive review of microsimulation in the United States to conclude "... that no other type of model can match microsimulation in its potential for flexible, fine-grained analysis of proposed policy changes ..." (Citro and Hanushek, 1991, p.115).

The idea of applying microsimulation techniques to socio-economic modelling was pioneered by Guy Orcutt in the United States in the late 50's and early 60's (Orcutt, 1957; Orcutt *et al.*, 1961). However, until relatively recently, the enormous cost of the computing resources required by such models and the lack of appropriate microdata had made their development and use for policy formation in Australia of questionable value. Only with the development of increasingly powerful computer hardware and the greater availability of individual unit record data has microsimulation modelling become a cost-effective and accessible option (Harding, 1993b, p.1).

The starting point for most static microsimulation models is a unit record file, which provides comprehensive information on such things as earnings, family characteristics, labour force status, education, and housing status for every individual on the file. Typically, adjustments will need to be made to this base data file to ensure that it reflects, as fully as possible, the population which is being modelled and includes all of the variables which will be needed. Percival (1994a) provides a detailed description of the process of preparing the base population data set for use in STINMOD.

Microsimulation models can be static or dynamic (see Harding, 1993a, p.13-28). *Static* models usually take a cross-section of the population at a specified point in time and apply program rules to the individual units to measure the instantaneous or 'morning after' effects of policy changes. Such models thus usually, although not always, show the 'first-round' effects of policy changes, before individuals have had time to adjust their behaviour to the changes. Generally, these models will allow the analyst to vary the rules of eligibility or liability, and produce output showing the gains or losses (both to individuals and in aggregate) from the policy change.

The distinguishing feature of *dynamic* models is the ageing of the original unit records on the basis of probabilities of different real life events occurring. This allows the original population to be projected forward in time, while maintaining detailed information on the individuals within the simulation.

During the past decade, static microsimulation models have become an important tool in the development of tax/transfer policy in most industrialised countries [3] – and have sometimes played a decisive role in determining whether or not a proposed new policy measure is implemented (Harding, 1993a, p.13). In the United States, for example, Congress will not consider any social security or tax legislation without closely examining the distributional outcomes predicted by microsimulation models (Citro and Hanushek, 1991, p.1).

While many static microsimulation models provide an extremely useful tool for assessing the first-round distributional effects of change, they still suffer from many limitations. They typically abstract from behavioural effects even when, as is often the case, a policy change is intended to prompt changes in behaviour (eg. the increases in labour supply which may result from a cut in marginal tax rates). Some recent modelling initiatives have attempted to incorporate such behavioural change (Bækgaard, 1992; Klevmarken *et al.*, 1992; Warren and Symons, 1992). In the future, such initiatives will no doubt become more common, and this will help to answer the criticism that such models may generate a myopic cast to policy debate, by abstracting from important behavioural effects.

2.2 Static Microsimulation in Australia

Static microsimulation based on comprehensive microdata began in Australia in the mid-1980's, with the release by the Australian Bureau of Statistics (ABS) of unit record data from the 1981-82 Survey of Income and Housing. The ABS has subsequently released unit record data from two subsequent Income Surveys, and two Household Expenditure Surveys. The release of these datasets, coupled with improvements in information technology, provided the opportunity for those interested in

[3] See Harding (1993a, p.381) for a comprehensive list of references.

social and economic policy in Australia to construct models and undertake analysis that would utilise the richness of the information collected by the ABS.

Static microsimulation models based on these datasets were constructed inside the federal government, by academics and by policy / research institutes (Bradbury, 1990). Some were linked with macro-economic models, while another included utility functions and the modelling of labour supply (see Gallagher, 1990 for a review of the development of Australian microsimulation models). Those developed inside the federal government were used to undertake analysis of issues that could not be adequately examined by administrative databases, either because of the comprehensive nature of the policy issue or because of the proposed inclusion of a new population. Those developed outside government were generally used to examine a particular research or policy issue and utilised data which overcame the inaccessibility of administrative databases (eg. Bradbury and Doyle, 1992).

Static microsimulation models based on *administrative databases* have also been used to examine policy issues in several federal government departments, including the Department of Social Security (DSS) and the Australian Taxation Office (ATO). Such models are particularly suited to policy options which only affect those who are currently part of the particular government program and that do not have interactions with other government programs. They are less useful when these criteria are not met. Administrative databases also have the limitation that they only capture the information needed to administer the program. Only those family relationships relevant to eligibility and entitlement to a program are recorded. Therefore, if a program change was being considered that was affected by other family relationships, the administrative database would be inadequate.

Another common type of microsimulation model has been one based on *hypothetical data*. These models generate synthetic microdata based on typical family types. Such models have been used to explore trends in disposable incomes and to calculate effective marginal tax rates (eg. Harding and Landt, 1992; Moore and Whiteford, 1986). They can also provide a quick guide to the likely impact of a policy option. Their major drawback is that they do not provide a distributional analysis – numbers and characteristics – of the policy impact, as this depends on the number of different individual or family types affected. There is also always a question mark over how representative the 'typical' families actually are (Atkinson, 1988).

The main academic models currently in use are those of Warren (1991), the Social Policy Research Centre (Bradbury and Doyle, 1992) and the National Institute of Economic and Industry Research (King *et al.*, 1990). The main Government models are PEM (Gallagher and McDiarmid, 1993), PRISMOD (Henry and Wright, 1992) and RIM (Gallagher and Preston, 1993). The power of such models to affect public debate was demonstrated in 1992 and 1993, when the Opposition parties proposed a package of sweeping tax and transfer changes (Liberal and National Parties, 1991). The immediate distributional impact of this policy shock was estimated by both the Opposition and the Government using two different static microsimulation models.

STINMOD represents a departure from other microsimulation models developed in Australia in that it has been specifically designed for public use. This has resulted in a wide range of payments and services being modelled, to give a more comprehensive picture of the impact of Government spending and taxes and be of use to a broader group of users. In addition, considerable attention has been given to the development of a user-friendly interface, which facilitates the use of the model by those who have no experience of microsimulation models or computer programming.

In providing a publicly available static microsimulation model, NATSEM is following the trail-blazing path of the Canadian SPSD/M model (developed by the Canadian Statistical office (Bordt *et al.*, 1990)) and the British TAXMOD model (Atkinson and Sutherland, 1988b).

2.3 Access to Microsimulation

Microsimulation models have been both relatively scarce and inaccessible for technical, financial and political reasons. Microsimulation models constructed within government are generally unavailable because they are based on confidential administrative data and/or have been constructed for internal government debate over policy options. Those constructed outside government are usually created to provide an academic or financial return for their owners, who can maximise their return by limiting access.

Technical Barriers

The creation of a microsimulation model is a complex and expensive undertaking. Until recently, microsimulation models required the power of a mainframe computer to undertake simulations in a reasonable time-frame. With the enormous improvements in the power of CPUs, this is no longer the case (STINMOD/94A runs in as little as four and a half minutes on the current state-of-the-art PC). Within a year this time is almost certain to be at least halved and a PC static microsimulation model running in less than a minute is no longer a pipe-dream.

Financial Barriers

The construction of a static microsimulation model requires a considerable investment in resources, assuming that suitable resources are available. There is also a considerable lead time before a model starts to produce results. Many organisations are unable to afford the dedication of resources to such a project. Moreover, the resource commitment does not end with the construction of the model. The frequent change which has become the hallmark of modern government means that a significant ongoing investment in maintenance (including comprehensive documentation) is also required. While many organisations may have an interest in microsimulation outcomes, their interest is insufficient to justify such expense.

Even when a government department has a microsimulation model, access to that model is not guaranteed. The time between initial specification and receipt of simulation results can be considerable and the volume of requests inevitably means that prioritising is required and that requests are often not met. When they are provided, it is not unusual for insufficient time to be allowed for validation and documentation of the simulation results.

Political Barriers

Microsimulation models constructed inside government have not been accessible to those outside government and often not to other departments within government. Their connection with the confidential world of Cabinet deliberation on policy options, whether Government or Opposition, creates a natural resistance to their being made available to outside individuals or organisations.

Exclusive access to a microsimulation model provides a clear advantage in policy debates both within and outside government. For some policy issues, these models provide the only source of distributional analysis and estimates of cost. Typically, the underlying assumptions and the model's computer code are not available for scrutiny outside the department that has the model, which makes it difficult to challenge the model outcomes. Such models are also invariably constructed and maintained in a 'pressure cooker' atmosphere and often little allowance is made for the time and resources required to structure and document the process.

Static microsimulation models constructed outside government are also not generally accessible to others. Those constructed in academia are typically purpose-built for some particular research project(s) and not comprehensive in their coverage of government programs. Once constructed, they become part of the intellectual property of their creators. Even if they were made available to others they are unlikely to be used successfully, because they have not been designed for external use.

NATSEM's Approach

One of NATSEM's key objectives is to improve access to microsimulation and it has a number of strategies to achieve this. The provision of a user interface to STINMOD means that no programming knowledge is required to run microsimulations. For a modest price, anyone can undertake microsimulation on their own PC and produce estimates of the distributional impact and cost of a particular policy change.

NATSEM is coordinating a Static Microsimulation Interest Group (SMIG) which meets regularly to exchange information and ideas on microsimulation. In the past, modellers have tended to work in isolation and this often leads to duplication of effort and slow progress. Users, as well as modellers, attend these meetings and it gives the former group a chance to understand and question the assumptions underlying microsimulation models. The STINMOD Technical Paper series provides a useful addition to this process, as each paper documents, in detail, the structure of STINMOD's components and relevant benchmark results.

Shortly, NATSEM will provide the STINMOD source code to government departments. This will enable them to use STINMOD to model structural change to government programs. (At the moment, the user-friendly version of STINMOD is provided in a compiled form only and allows the user to change only the existing parameters of government programs. Modelling a completely new program, for example, is a structural change which requires changing the computer code outside the interface.) The provision of this source code will provide the facility for government departments to share a common 'standardised' model and therefore have the same starting point for modelling structural change. NATSEM will be able to keep the 'standard' model (and its documentation) up to date, to incorporate feedback from government departments on corrections and enhancements to the model and to provide whatever user support is required (this is likely to be intensive when the source code is first released).

STINMOD will also be used by academics and students to undertake cooperative research with NATSEM. STINMOD/94A is already in use as a teaching tool and this will increase the profile of microsimulation in Australia.

3. Development of STINMOD

3.1 Lessons from Overseas and Australia

Although NATSEM was building a static microsimulation model from scratch, it had the clear advantage of being able to learn from the documented experience of others who had been down the same path (eg. Sutherland, 1991). This sort of guidance from experienced practitioners provided invaluable reference points as issues emerged.

Early in STINMOD's development, the findings and recommendations of an inquiry into microsimulation by an evaluation panel of experts, convened by the National Research Council in the United States, were published (Citro and Hanushek, 1991). The findings of that inquiry confirmed the importance of some of the priorities and strategies that had been adopted for STINMOD's development. Some of these findings were (that microsimulation had been characterised by):

- a lack of regular and systematic model validation;
- inadequate documentation and archiving; and
- a disregard of the basic principles of model design (such as modularity) and implementation (such as prototyping).

NATSEM has also gained from the experience of those who have built microsimulation models in Australia. This experience is particularly relevant because of their use of the same microdata used by NATSEM. Articles by King (1987) and Hellwig (1991) were particularly useful when strategies for statically ageing the microdata were being developed.

3.2 Objectives and Strategies

STINMOD has been developed with clear objectives in mind. These are that the model should be broad in scope, accurate, easily maintained, widely used and efficient.

Coverage

STINMOD aims to cover as many government programs as the available microdata permit. This is not always the case with static microsimulation models, which are often purpose-built for some research or policy purpose or as a supplement to a microsimulation model based on administrative microdata. There are two important reasons for this breadth of scope. First, it provides a more comprehensive picture of the way government programs interact with individuals and families. Second, it improves the ability of the model to capture interactions between government programs.

Accuracy of Model Results

The level of accuracy achieved by any policy simulation model is a critical factor in its success or failure. Moreover, for the results of a model to be accepted, it is also important that it be able to demonstrate its accuracy. Users should not simply have to accept its results on trust, as if it were a 'black box' through which simulations are run with little indication of the processes being undertaken.

To achieve an acceptable level of demonstrable accuracy, four goals should be met. First, the microdata used by the model should be representative of the populations affected by the programs included in the model. Second, the rules captured in the computer code of the model should closely match those of the programs they are emulating. Third, the model results should be comprehensively validated (both internally, and against appropriate external administrative benchmarks). Fourth, the model should be kept up-to-date, as government programs change their parameter values and/or their structure.

Ease of Maintenance

The constant change in government programs needs to be accommodated in the structure of a microsimulation model. Changes to parameter values are easily accommodated by a change to the values of some constants in the model. Changes to the structure of government programs present a more significant challenge, as they mean changes to the structure of the computer code in the model. As structural change is a regular occurrence (and has already happened several times in STINMOD's short life), it is essential that the design of the model allow for future structural change to be made as easily as possible.

One of the traditional techniques used by software engineers is modular design, to achieve program reliability and program flexibility. In a modular design, a large programming task is broken down into a series of smaller sub-programs or modules. Each sub-program is self-contained and each handles a discrete element of a larger task. The obvious benefits of a modular approach are that the resulting program will be easier to validate, maintain and modify. A model which contains a set of distinct modules will allow a policy change to be implemented with a minimum amount of disruption to the overall model, as the changes are effectively quarantined to a local area. The changes that need to be made can be made by simply replacing, modifying, or supplementing some of the existing modules. A design corollary is that each module should correspond as closely as possible to the natural divisions that occur in the programs being modelled and that the descriptions of both the modules and the variables they use should allow ready identification with the program's elements.

The essential complement to modular design is comprehensive documentation. This documentation should include the extensive use of comments in the computer code, as well as higher-level documents that capture and explain the key elements of the computer system underlying the model. The combined effects of modularity and documentation should ensure that the model is not dependent on its creators for its survival and is not so daunting to newcomers. In addition, experience-to-date suggests that it is important that the model is written in a language widely used by potential developers and users, as dependency upon highly specialised programmers increases the likelihood that the model will 'die'.

Accessibility

NATSEM is keen to ensure that STINMOD is used widely, both inside and outside government. One method used to achieve this has been the provision of a modern user interface that embodies what has become the current standard for interface design: that is, a visual 'point-and-click' environment, within which all aspects of a model simulation will be handled. A second important method is the modular design of the code and the accompanying documentation, which will facilitate the use of the source code by those who wish to model structural change. A third strategy is the provision of a technical paper series, to assist those using either the user-friendly version or the source code to understand the workings of STINMOD. The fourth method is to actively market

STINMOD, to ensure that all those in Australia who are interested in social and economic policy are aware that they now have access to a static microsimulation model at an affordable price.

Efficiency

Finally STINMOD aims to be efficient in the way it stores and manipulates its microdata. This desire to be efficient has been offset to some extent by the need to ensure that the model is readily accessible to those who use the source code. Subject to this constraint, STINMOD has aimed to remove redundancy in the storage of the microdata and to minimise the time required to run a simulation.

3.3 Issues

A number of key issues emerged in STINMOD's development. Decisions had to be made about the source of microdata, the software to be used, which government programs to include, what time period to use and the unit of analysis.

Microdata

Microdata is fundamental to microsimulation models. In Australia the choice for those outside government is currently rather restricted. The ABS is the only practical source of Australia-wide economic and demographic microdata. Until recently, the ABS has alternated between Income Surveys and Household Expenditure Surveys (HES) (with one of these surveys every two to three years). Both these surveys contain detailed demographic, labour force, education, housing, and income information. The Household Expenditure Survey also contains expenditure data, but contains less detailed income information than the 1990 Survey of Income, Housing Costs, and Amenities (this is commonly known as the Income Distribution Survey or IDS). The ABS also releases unit record data from the Census but it contains substantially less information than either the IDS or the HES. When the development of STINMOD began, the IDS was the most recent of these datasets and, consequently, it was chosen as the base microdata set for STINMOD. No dataset contains all the information needed for a comprehensive microsimulation model and other data items have had to be imputed onto the base dataset. This process will continue as STINMOD extends its coverage.

Software

Model builders have far more choice when it comes to the software used to construct their model (eg. Pascal, FORTRAN, C, Basic, SAS®, SPSS). STINMOD has been written in several SAS® products. SAS® was selected primarily because of:

- the strength of its support for statistical analysis;
- its widespread availability and use within both government and academic communities; and
- its transportability across different computer platforms.

Its use does, however, mean some trade-offs are necessary. First, development using the latest programming paradigm of Object Orientated Programming (OOPS) is not possible in SAS® programming. This meant that it was not possible to explore options such as classifying households, families, income units, and individuals as objects. While SAS® has moved to support OOPS in its products used for building interfaces, the base SAS® language provides no OOPS features. Second, SAS® is not as efficient as some other languages and this means a slower time to run a simulation. Third, those who wish to use STINMOD must have SAS® themselves. This could have provided a cost-barrier to some potential sites for the user-friendly version, but a special low-cost licence agreement was negotiated with SAS® to partially overcome this drawback.

Government Programs

Decisions about which government programs to include in STINMOD were made primarily on the basis of two criteria. The first was whether the microdata contained the necessary information to model a particular program (eg. to model AUSTUDY for a dependent student requires information about the dependant's study status, age and income, the parents' income and the family structure). Sometimes the microdata permitted only a partial modelling of some programs (eg. it was possible to model DSS income tests but not assets tests, because there were no assets data and no available data source that could be used to impute assets information onto the microdata).

The second criterion was whether there were sufficient individuals in the microdata who had the characteristics of those affected by a government program. Low coverage of a program population in the microdata makes any estimates prone to high error. Some comfort can be taken from the fact that low coverage in the microdata usually means that the program is (relatively) small in expenditure terms. However, low fiscal importance does not always mean low political importance. Low coverage is not usually a problem for administrative microdata, which typically are a census of the relevant population.

STINMOD is a *general purpose* microsimulation model, which means that it aims to provide reasonably accurate results across the range of government programs, rather than extremely accurate results for only one or two government programs.

Time Period

The income information gathered by the ABS in the survey used for the STINMOD microdata covers two time periods. *Period income* for individuals refers to their income for the previous financial year (1989-90). *Current income* refers to their weekly income received at the time of the survey (some time in the last quarter of 1990). While some of the current income items are derived from the period figure (eg. income from dividends) most of the current income variables reflect the economic situation of the surveyed individuals at the time of the survey (including any short-term fluctuations). While the use of period income might remove some of these short-term fluctuations in economic status, it presents practical problems for modelling government programs. Many government programs reflect current status and have high flows in and out of the program (eg. a recipient of Job Search Allowance (JSA) might have a high level of period income from wages, but the effect on current entitlement to JSA will depend on what part was earned while in receipt of the payment). The microdata does not contain this information.

Other important variables, such as education status and labour force status, are also not gathered for the period time-frame. As a result, current income has been used in STINMOD as the measure of income for applying program income tests and for determining disposable incomes. Period income has only been used when income tests are specifically based on the previous financial year's income. Those government programs that do not have high flows have, by definition, more stable populations. In such cases, current weekly income would be less prone to fluctuations. Furthermore the ABS has decided to cease collecting period data (apart from previous year's taxable income) in its future Income Surveys, so the use of current income prevents a major maintenance headache and ensures consistency with future versions of STINMOD which will use these Surveys.

Unit of analysis

The impact of government programs can be assessed in terms of the individual, the income unit, the family, and the household. The choice of the unit of analysis will determine the perspective from which simulation outcomes are viewed. For example, if the individual is chosen as the unit of analysis, then only low income individuals will appear to benefit from the introduction of a low income rebate, based exclusively on the personal income of the taxpayer. However, if a family income unit is chosen, then there will be plenty of high income units that appear to benefit.

In STINMOD the rules of government programs are applied to individuals. These results can then be aggregated to calculate outcomes for income units, families, or households. This means that STINMOD has complete flexibility in its choice of unit of analysis. The choice of unit in STINMOD will depend upon the purpose of the analysis and assumptions about financial relationships within units (pooling of income, sharing of expenditure).

In STINMOD/94A simulation results are presented in terms of i*ncome units*. The members of an income unit live in the same household and are assumed to share income. There are four types of income unit – single people, sole parents, married couples without dependants and married couples with dependants. Dependants are defined as those aged under 15, and those aged 15 to 24 who are full-time students living with their parent(s).

This income unit is used in STINMOD/94A because it corresponds closely to the definition of the financial unit (who share income and have dependent relationships) used by many of the government programs modelled.

3.4 Development Stages

STINMOD has been developed in an incremental fashion. The construction of a static microsimulation model which also includes a user interface is a major undertaking. Approaching this task in an incremental fashion (instead of trying to build all components of the model simultaneously) has two main advantages. The first is that the model begins to produce results at an earlier stage. This is satisfying for the model builders and also has the effect of providing feedback on the model's outcomes early in the development process. Second, it avoids the risk that the model's size and complexity will overwhelm the model builders and burnout will occur, with the possible outcome that the model is not completed or that quality assurance is not maintained. An incremental approach still requires the master plan to exist, it just breaks that plan down into manageable pieces. This modular approach to project management is complemented by the modular approach to the model's computer code, which facilitates extensions to STINMOD.

There have been six stages in STINMOD's development to date. In the first stage, a methodology was developed to create a base population for STINMOD. This enabled the static ageing of the ABS microdata collected in 1990 to the simulated 1994 world of STINMOD.

In the second stage, the eligibility and entitlement rules of AUSTUDY, Social Security pensions, allowances and family payments, income tax and Medicare were translated into computer code. A prototype interface was also built. This Alpha version of STINMOD was released to three government departments for testing in a mainframe (MVS operating system) environment.

In the third stage, Veterans' payments, take-up of additional family payments, and interaction between family payments and AUSTUDY were all modelled. The interface was substantially enhanced in response to feedback from the test sites. (NATSEM engaged a consultant to develop the interface.) The resultant Beta version of STINMOD, which was by then principally a PC product, was released to six federal government departments and three academic sites for further testing around January 1994.

In the fourth stage, the Beta version was improved to a level suitable for commercial release. This included the provision of a 'typical' Window's style installation package and the negotiation of a special SAS® licence for STINMOD. Around this time, output from STINMOD was first used in conjunction with NATSEM research projects (eg. updated poverty analysis (Harding, 1994)). STINMOD/94A was released publicly during this stage, in June 1994.

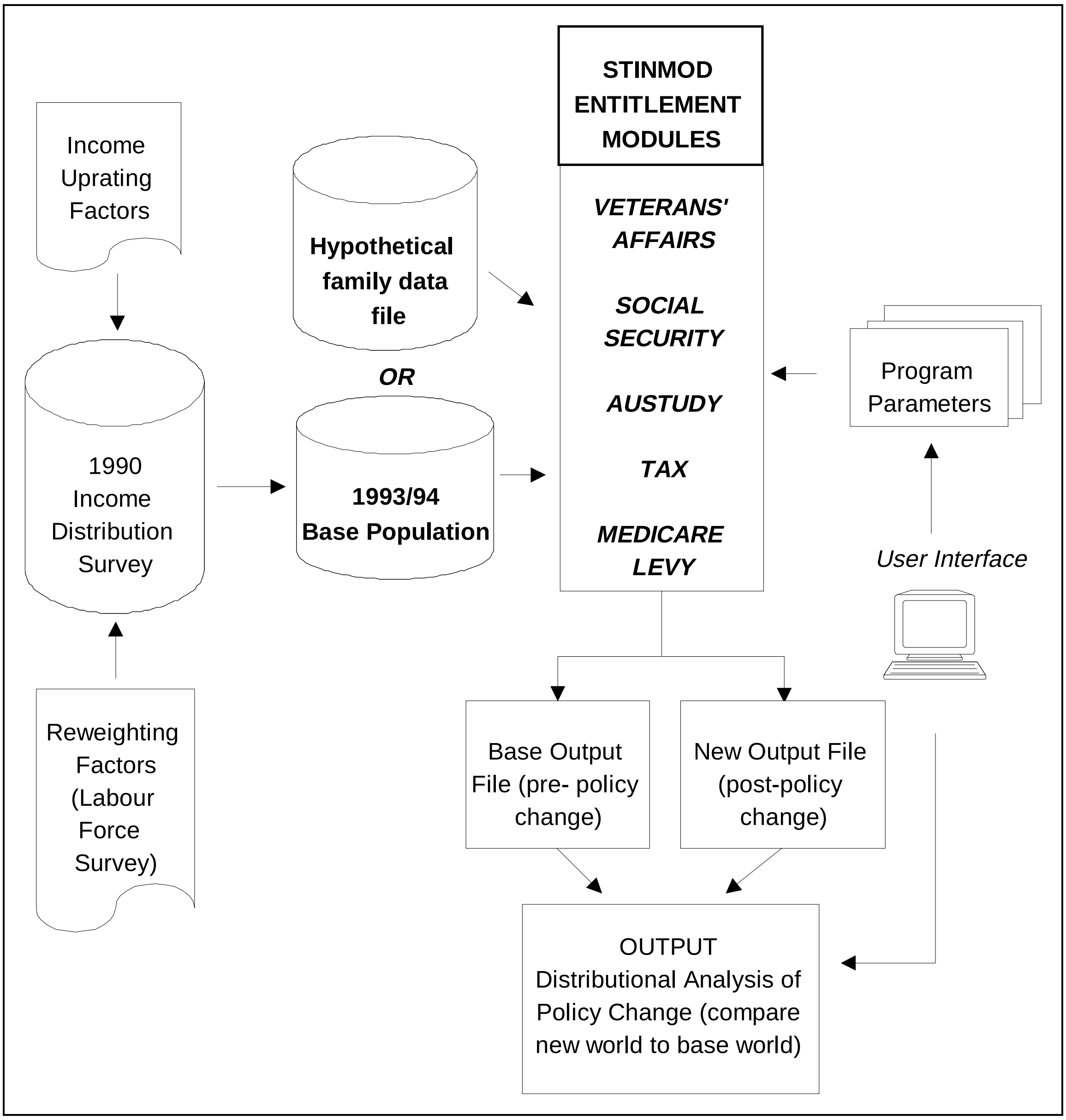
In the fifth stage, estimates of the cash value of subsidies received via public housing and health expenditure were added to the STINMOD database (Landt, 1994; Percival and Schofield, 1994). (These subsidies were not, however, included within the user-friendly interface version of STINMOD.)

In the sixth and current stage, the changes to social security contained in the Government's White Paper on Employment and Growth (Commonwealth Government, 1994) are being modelled. The incidence of child care is being imputed onto the STINMOD microdata, to enable modelling of fee relief and the new child care rebate. STINMOD's interface is also being further improved to provide more options and greater flexibility. Finally, the estimated value of the public education services consumed by individuals is being added to the STINMOD database.

4. Current Structure

This section provides an overview of the STINMOD/94A modules – what has been done and how it has been done. More detail can be obtained from the separate STINMOD Technical Papers, which are referenced at the end of each module overview. In addition, the STINMOD/94A manual contains a chapter with a detailed description of current government programs and their simulation within STINMOD (NATSEM, 1994). Figure 1 provides an overview of the structure and data flow within the user-friendly version of STINMOD.

Figure 1: Data flow in STINMOD/94A



4.1 Base Population

The base population of STINMOD is generated from the IDS. This survey was undertaken by the Australian Bureau of Statistics and includes demographic, income and other details on some 30,000 persons. (However, stringent measures taken by the ABS ensure that it is not possible to identify any of these individuals.)

As STINMOD will be used to estimate the *immediate* distributional impact of policy changes, the IDS microdata was 'aged', so that the information it contains more closely matches that of the current Australian population. This data ageing is achieved by *reweighting* and *uprating* each record (this process is described briefly below, further details can be found in Percival, 1994a and Landt *et al.*, 1994). The base population of STINMOD will be reweighted and uprated every six months, in May and November.

Reweighting

Each of the 30,000 records on the IDS file has a *weight* attached to it, which represents the likelihood of finding persons with a similar set of characteristics in the Australian population. For example, a person record with a weight of 300 is estimated to represent 300 comparable individuals in the Australian population.

The IDS data is aged in STINMOD by adjusting the weight of each record in line with movements over time in the characteristics of the populations that the record represents. The methodology adopted in reweighting the IDS for STINMOD was to use benchmark data from the monthly ABS Labour Force Survey (LFS). Use of the LFS allows very accurate estimates to be made of the size of many population sub-groups. The reweighting is done by replacing the original IDS weights with weights calculated using LFS tables of population sub-groups. If, for example, it was found that there were 10 persons with a particular set of characteristics on the IDS file (say, single employed females living in Tasmania and aged between 40 and 44 years) and the LFS showed that in Australia there were now a total of 1,000 persons with the same characteristics, each of the 10 original IDS records would be given a weight of 100.

The reweighting process thus captures change in demographic, family, education, and labour force characteristics since 1990 (eg. the increase in unemployment). Reweighting is not a simple task, and the method is described and assessed in Landt *et al.* (1994).

Uprating

The second task in making the 1990 IDS look more like the world of today was to inflate or deflate the private incomes that were recorded in the survey, to account for any changes to income levels that had occurred since the survey was undertaken in November 1990. Housing costs, which included mortgage payments, rate payments, and rent for own dwellings, were also uprated in STINMOD (by movement in the relevant components of the Consumer Price Index).

The inflators used to uprate the IDS incomes were selected from available indices to best capture the economic changes that had occurred – for current weekly income, from November 1990 to November 1993 and, for period income, from 1989-90 to 1992-93.

Wages and salaries were inflated by movements in average weekly earnings by sex. Self-employment and investment income were inflated by movements in the relevant National Account indicators (with the inflator for self-employment income adjusted for changes in the number of self-employed). Maintenance receipts were inflated by changes in average weekly payments made under the Child Support Scheme.

Uprating, however, is not a simple and uncontentious process. For example, average movements in uprated variables often have to be used, because of the absence of longitudinal data which would capture changes in the distribution of uprated variables. Therefore, any distributional change that does occur (eg. a movement away from 'interest' to 'dividend' income by the elderly) will not be captured by the 'average' approach. The method used for STINMOD is described and assessed in Percival (1994a).

Structure of Base Population Data

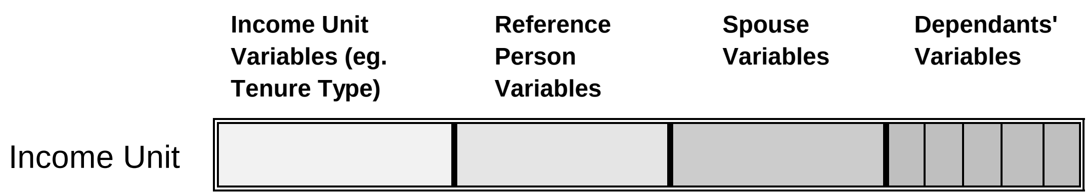
The base population of STINMOD consists of about 18,800 records. Each record represents an income unit and contains a set of variables which describe the income unit and its members. Each income unit record contains between two and eight segments. These segments contain information for:

- the income unit as a whole (eg. locality, housing tenure type);
- the reference person;
- the spouse of the reference person (if present); and
- up to five dependent children between the ages of 15 and 24.

There are no segments for dependants aged between 0 to 14, but the number and ages of such dependants are contained in the income unit segment. Dependent children aged 15 to 24 must be full-time students, otherwise they are given a separate income unit record.

Figure 2 shows the general structure of each income unit record. For more detail on the creation of STINMOD's base population see Percival (1994).

Figure 2: Data Structure of STINMOD Microdata



4.2 Veterans' payments

The Veterans' payments module simulates the service pension (including pharmaceutical allowance, rent assistance and additional pension for veterans' dependent children), war disability pension, and war widows' pension programs. Simulation of Veterans' payments involves determining eligibility and then calculating entitlement. *Eligibility* is established by the receipt of a Veterans' payment in the 1990 IDS base microdata (as there are no other variables that indicate a connection with war service).

Entitlement to service pension is determined by applying an income test to the maximum entitlement applicable (which depends upon marital status, number and ages of dependants, tenure type and housing costs and the receipt of other Veterans' payments). The income test has the same parameters as the DSS pensions income test except that (unlike DSS), payments for dependants are income-tested along with other pension components.

War widow's pension and war disability pension are not income-tested. The amount of war disability pension depends on the level of disability. This was imputed by comparing the level of war disability pension shown in the 1990 IDS base microdata with the rates of pension that applied at the time of the survey.

Payments that have not been included in the DVA module, because of insufficient data, are dental benefits, travel, accommodation and meal allowances, education allowances, and general assistance allowances. For more detail on the modelling of Veterans' programs see Schofield and Paul (1994).

4.3 Social Security Payments

The Social Security module simulates the pensions, allowances and benefits, and family payments programs. All the major pension types are modelled – age pension, sole parent pension, widow pension (Class B), disability support pension, wife pension, and carer pension. The major allowance types are also modelled – new start allowance, job search allowance, sickness allowance, special benefit, partner allowance, and mature age allowance. Basic family payment and additional family payment (including rent assistance and guardian allowance where applicable) and home child care allowance are all included in STINMOD. Insufficient data have prevented a number of programs from being modelled. These are the mobility allowance, remote area allowance, child disability allowance, multiple birth allowance, rehabilitation allowance, double orphans pension, and widowed person allowance programs. However, in total the excluded programs account for only 0.5% of total Social Security payments (Department of Social Security, 1993).

There are four main steps involved in simulating Social Security payments within STINMOD. First, *eligibility* for each major payment is determined, usually on the basis of the type of payment the person received on the 1990 IDS [4]. Direct simulation on the basis of individual characteristics was not possible for many payments, because the necessary information was unavailable. For example, the degree of disability was not recorded in the 1990 IDS and therefore could not be used to directly impute eligibility for Disability Support Pension. This methodology, unfortunately, means that STINMOD does not capture changes in the characteristics of many categories of recipients between 1990 and 1994.

The second step is to establish the rate and components of payments which are potentially payable. This is based on the type of payment, and individual characteristics such as marital status, number of dependants, age, tenure type, and (where applicable) parental income.

Income tests are then applied to all payments, with a separate maintenance income test applying to family payments. The assets tests were not simulated, because of the lack of data on assets in the 1990 IDS.

Finally, the separate components of the entitlement, such as the basic pension or allowance, rent assistance, and pharmaceutical allowance are calculated. It is important to identify these components separately, as they are not all taxable. For more detail on the modelling of Social Security programs see Schofield and Paul (1994).

4.4 AUSTUDY

STINMOD models entitlement for each person in the base population who meets the basic AUSTUDY eligibility criteria. STINMOD first determines what type of AUSTUDY a person is entitled to (ie. Independent, Standard, etc.) and then calculates their entitlement, based on their income level, family structure, and parental income (if applicable).

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4 The exceptions to this are sole parents pension, wives and carers pension, family payments, and the home child care allowance. In such cases, the relevant characteristics of the person are used to determine their eligibility.

STINMOD currently models the four main AUSTUDY payments. These are: the Pensioner Education Supplement; Standard AUSTUDY; Away-from-home AUSTUDY; and Independent AUSTUDY (including Dependent Spouse Allowance). (AUSTUDY entitlements not included in STINMOD, due to insufficient data in the base population, are ABSTUDY, Assistance for Isolated Children, and fares allowance.)

The amount of AUSTUDY entitlement each student receives is determined by up to three separate income tests – on the student's own income, the student's family's adjusted income, and the income of the spouse (for married students). As the IDS did not gather information on the income of school students, this has been imputed in STINMOD using information recorded in other surveys. Similarly, details of family composition and parental income have also had to be imputed for away-from-home students.

AUSTUDY payments are subject to both an income and an assets test. STINMOD, however, only applies an income test, as information on assets was not recorded on the IDS. For more detail on the modelling of AUSTUDY see Percival (1994b).

4.5 Income Tax and Medicare Levy

The major components of the income tax and Medicare levy programs are modelled in STINMOD. Determining net income tax requires the calculation of taxable income, gross income tax and entitlement to income tax rebates.

Calculating taxable income has two stages. First, assessable income components are identified and summed. Deductions from that assessable income are then subtracted, to give taxable income. Official tax statistics have been used to impute deductions, by using the average deduction levels in 25 ranges of assessable income (Australian Taxation Office, 1994). Assessable income items not included in STINMOD include capital gains and lump sum payments.

Once taxable income has been calculated, the income tax scale is applied to determine gross income tax. STINMOD has the facility to have as few as one and as many as ten steps in the income tax scale (there are currently five). This gross income tax is then reduced by any income tax rebates to which the individual is entitled.

There are many different rebates, some of which depend on family structure and some of which are income-tested. The rebates included in STINMOD are the sole parent rebate, the dependent spouse rebate, the low income rebate, the dividend imputation rebate, and the pension and allowance rebates. The latter two rebates are implemented as policy-consistent rebates in STINMOD. This means that STINMOD calculates their values, rather than specifying them as constants, to ensure their policy objectives are met [5]. This requires consideration of the parameters of both the income tax, and allowance and pension programs. Rebates not included in STINMOD are the housekeeper, medical expenses, zone and overseas forces, heritage conservation, superannuation contributions, and deposits in the income equalisation deposits scheme rebates. Once rebates have been determined, net income tax can be calculated.

The Medicare levy program is captured fully by STINMOD, as it is based only on taxable income and family structure. The amount of Medicare levy payable is calculated by locating family taxable income in one of the three Medicare ranges of taxable income (these three ranges are: below the threshold for Medicare levy payment; in the 'shade-in' range immediately above the threshold; and above the 'shade-in' range). The different rules for each of these three taxable income ranges are then applied. These rules are very complicated in the case of married couple families whose family incomes are in the shade-in range, but they are replicated in STINMOD.

STINMOD has included the facility for a second step in the Medicare scale. This was an option under consideration when the Medicare module was being developed and may re-emerge as growing health expenditure generates pressure for an increase in revenue from the Medicare levy. For more detail on the modelling of tax programs, see Lambert (1994).

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5 For the pension rebate, the policy objective is to ensure that a full-year maximum rate pensioner does not pay income tax. For the allowance rebate, the policy objective is to ensure that a full-year allowee with no private income does not pay income tax.

4.6 Housing Costs and Subsidies

STINMOD has included the incidence of housing costs faced by the Australian population and also the benefits received by families and individuals from the major forms of government expenditure on housing.

The costs include rent and mortgage payments, water and sewerage rates, and the cost of repairs and maintenance. The government benefits modelled include direct cash assistance in the form of rent assistance paid by the Commonwealth Departments of Social Security (DSS) and Veterans' Affairs (DVA), and indirect assistance in the form of rent subsidies administered by State governments to low-income public housing tenants. The subsidy to public tenants was estimated as the difference between actual rent paid and the rent paid for similar accommodation in the private rental market.

Using the user-friendly STINMOD/94A interface, the user may vary the rules for *direct* cash assistance for housing. Rules for indirect assistance (ie. for public rent subsidies) cannot yet be varied via this interface.

Inclusion of housing costs and subsidies in STINMOD provides up-to-date estimates of housing costs and benefits which may, in conjunction with the current estimates of family incomes produced from STINMOD/94A, provide a comprehensive picture of the housing costs of Australian families. For more detail on the modelling of housing costs, see Landt (1994).

4.7 Health Expenditure

Tax/transfer programs such as AUSTUDY form only part of total government welfare activity. Of equal importance are the effects on families and individuals of non-cash government programs, such as the provision of public health services. The lack of attention given to non-cash programs in welfare studies stems in part from the difficulties of accurately attributing these benefits to different family types – as well as from a frequent failure to appreciate the size of the impact they often make on family welfare.

To address this shortcoming, NATSEM has begun to model the benefits accrued by families from public expenditure on non-cash benefit programs. The first part of this project modelled the incidence of public

health expenditure and added the results to each income unit in the base population of STINMOD. The method adopted was to distribute current Government outlays on public health across the Australian population and, in so doing, to both update and to improve on earlier health incidence studies. Outlays were allocated by age, sex, and state using an *insurance premiums* approach. That is, it was assumed that all persons in each age/sex/state grouping would, over time, receive an equal benefit from public health expenditure, either through direct usage or through having the services available in case of need.
Like indirect housing benefits, these additional health incidence variables have been added to the STINMOD database. The incidence of such benefits cannot currently be modelled or analysed via the user-friendly STINMOD/94A interface. For more detail on the modelling of health expenditure, see Percival and Schofield (1994).

4.8 Interface

STINMOD/94A has a user friendly interface developed in a Windows style. While the interface has been designed in a PC Windows environment, the interface is portable (with minor modifications) to other operating systems. It allows users to simply 'point and click' on a number of menus and option windows to run a simulation that they have specified. The user can then analyse and print the simulation outcomes of interest to them. Users can run their simulation against the entire base population or for one or more synthetically generated hypothetical (ie. 'typical') families.

Internationally recognised user interface design standards were applied to ensure that the interface was functional, flexible, and easy to use. The interface was prototyped with potential users as it was being developed. Prototyping is a particularly useful technique for ensuring that a complex system such as a microsimulation model is easy to understand, meets the user's needs and is simple to use. Figure 3 is an example of a typical STINMOD/94A parameter window and Figure 4 is the first output analysis window seen by the user after a simulation has been run.

Figure 3: Income Tax Scale Parameter Window

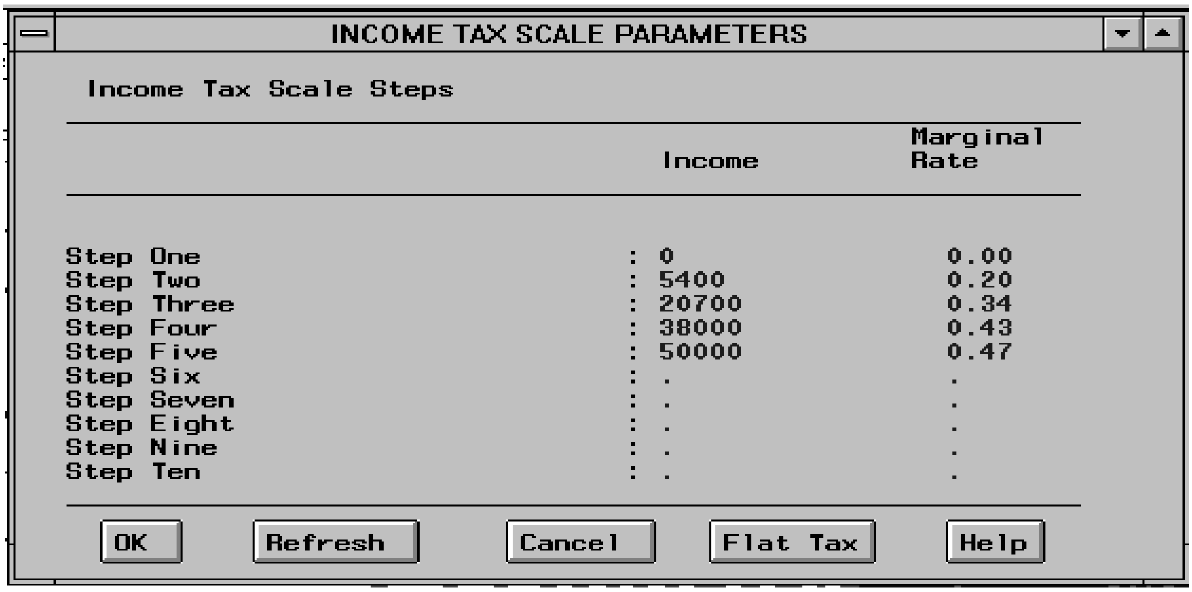
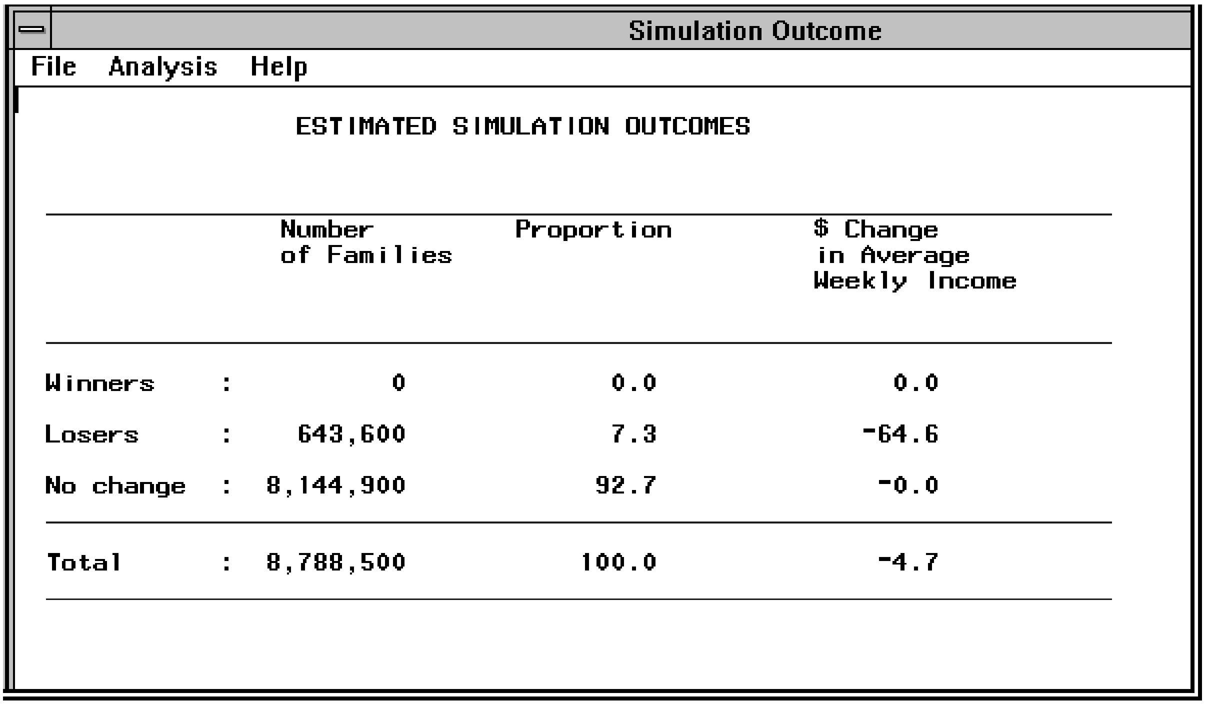


Figure 4: Winners/Losers Simulation Outcome Window



The development of a Windows interface for a comprehensive static microsimulation model complying with current software standards has probably been a world first. The public release of STINMOD with a user interface has made distributional analysis of government policy at the micro-unit level available to a wide range of users who previously would not have had access to this type of model. For more detail on the STINMOD interface, see Schofield (1995).

5. Validation

One of the criticisms of microsimulation mentioned earlier in this paper was that there has been 'a lack of regular and systematic model validation' (Citro and Hanushek, 1991). Two strategies were used in STINMOD's development to address this criticism – internal validation and external validation.

Internal validation ensures that the computer code for a government program accurately reflects program rules and therefore produces the correct outcomes. Individual record testing played an important part in internal validation.

Individual record testing involved the creation of synthetic records (which tested different aspects of the government program), as well as a subset of the base population; both of these were run through the computer code for a particular program (Davis and Fisher, 1979). For each record, the expected program outcome was manually calculated. This outcome was compared with the outcome generated by the computer code. Applying this method on a modular basis (program by program) made debugging more manageable.

This approach was complemented by the standard programming practice of code walk-throughs. This practice allows other programmers to check for errors and ensures that each team member has a thorough knowledge of the whole model and the interactions between each of the modules.

The testing of STINMOD by the government departments who administer the programs modelled in STINMOD, as well as their participation in the Static Microsimulation Interest Group, has been another important factor in ensuring that STINMOD produces valid program outcomes.

The second strategy was external validation – benchmarking the model's outcomes against administrative data. Where possible, this was done at both an aggregated and disaggregated level. While getting the aggregates (numbers, outlays, revenue) right is obviously important, the program profile (eg. age, family status, revenue/expenditure distribution) is equally important. If the program profile is right and the aggregates are wrong, then accurate simulation outcomes can still be obtained by applying a scaling factor to the original outcomes. On the other hand, if the program profile is wrong, then the accuracy of the simulation outcomes from changes to program rules will be affected. If, for example, the distribution of taxable income is incorrect (even though total tax revenue and the number of taxpayers may be correct), the model will not correctly estimate the distributional impact of a change in the income tax scale. This could occur, for example, if STINMOD had too many taxpayers at the upper end of the taxable income range, as the impact of an income tax change that affected this group would be overestimated.

Importantly, NATSEM has published these benchmark outcomes with its release of STINMOD/94A – and this means that those who use STINMOD can be aware of how close STINMOD outcomes are to administrative outcomes (Table 1).

Table 1: STINMOD/94A Benchmark Results

SOCIAL SECURITY:

	DSS Recipients 30 June '93(1)	STINMOD/94A late-'94	Difference No.	Difference %
Age Pension	1,515,682	1,477,872	-37,810	-2.49
Disability Support Pension	514,919	438,647	-76,272	-14.81
Sickness Allowance	45,280	54,979	9,699	21.42
Newstart Allowance	423,348	389,394	-33,954	-8.02
Job Search Allowance	464,218	487,157	22,939	4.94
Sole Parent Pension	298,444	258,700	-39,726	-13.31
Basic Family Payment	1,933,696	1,743,350	190,346	-9.84
Additional Family Payment	810,219	778,045	-32,174	-3.97
Special Allowance	28,503	13,130	-13,820	-48.49
Widows B Pension	64,568	59,026	-5,542	-8.58
Total	6,098,877	5,700,300	-398,577	-6.54

	DSS Outlays $ million per fortnight 1992-93(1)	STINMOD/94A late-'94	Difference No.	Difference %
Age Pension	425.14	397.45	-27.69	-6.51
Disability Support Pension	149.53	114.22	-35.31	-23.62
Sickness Allowance	14.81	19.99	5.18	34.97
Newstart Allowance	139.94	122.42	-17.52	-12.52
Job Search Allowance	138.22	166.06	27.84	20.14
Sole Parent Pension	89.74	77.73	-12.01	-13.38
Basic Family Payment	80.75	73.13	-7.62	-9.43
Additional Family Payment	128.63	112.4	-16.23	-12.62
Special Allowance	10.00	5.08	-4.92	-49.23
Widows B Pension	20.42	19.21	-1.21	-5.95
Total	1197.18	1107.7	-89.51	-8.08

VETERANS' AFFAIRS:

	DVA Recipients March '94(2)	STINMOD/94A late-'94	Difference No.	Difference %
Service Pension	355,752	431,334	75,582	21.25
War Disability	242,736	146,698	-96,038	-39.56
War Widow	84,434	75,079	-9,355	-11.08

(1) DSS, 1993a, 1993b.

(2) DVA, 1994.

Table 1: STINMOD/94A Benchmark Results (continued)

AUSTUDY:

	DEET Recipients 1993(3)	STINMOD/94A 1993(4)	Difference No.	Difference %
Standard	280,618	248,277	-32,341	-11.54
Independent	95,226	95,273	47	0.05
Away-from Home	62,446	52,837	-9,609	-15.39
Pensioner Education Supplement	23,776	27,673	3,897	16.39
Total	462,066	436,281	-34,109	-5.58

	DEET Outlays $m 1993(3)	STINMOD/94A(4) $m 1993	Difference No.	Difference %
	1,503.61	1,589.34	85.73	5.70

TAXATION:

	Tax Recipients 1992-93(5)	STINMOD/94A late '94	Difference No.	Difference %
Taxpayers	7,661,771	7,767,847	106,076	1.38

	Budget Outlays $m 1993-94(6)	STINMOD/94A late-'94	Difference No.	Difference %
Tax Paid	50,260	49,054.11	-1,205.89	-2.40

(3) DEET, unpublished data.

(4) While STINMOD/94A models the 1994 AUSTUDY program, the validation benchmarks were produced using 1993 AUSTUDY program rules and parameters to allow comparison with available 1993 administrative data. DEET figures are for the calendar year to November 1993, while STINMOD/94A figures are estimated for the month of November 1993, only.

(5) ATO, 1994.

(6) The Treasurer, 1994.

6. Maintenance

Microsimulation models are expensive to build and, once they have been constructed, it is important not to underestimate the resources required to ensure that the model has a long life. A well-defined and supported maintenance strategy is the key to ensuring this.

There are at least six aspects to maintaining a static microsimulation model: keeping the government programs up-to-date; keeping the microdata up-to-date; making enhancements; correcting errors; ensuring the documentation reflects the current model; and, archiving old versions of the model and its documentation to enable historical comparisons to be made.

The constant change in government programs provides a challenge for modellers. NATSEM has a number of strategies in place to cope with this. The most important is maintaining good (personal and information) relationships with the departments whose programs are modelled in STINMOD. This process has been assisted by improvements in the way these departments make information about their programs accessible to 'outsiders' (eg. the provision of such information in software form with built-in aids to navigating the database). STINMOD's modular design also facilitates the implementation of structural change to government programs and the addition of enhancements.

Currently, the microdata is kept up to date by the process of uprating and reweighting discussed in Section 4.1. Four years have elapsed since the time of the survey used as the starting point for STINMOD's microdata. This is not an inconsiderable time period in terms of demographic and economic change and the technique of 'static ageing' starts to be stretched. The ABS have undertaken some internal comparison of the results of statistically ageing their 1986 Income Survey to 1990 with their actual 1990 Income Survey (Hellwig, 1991). When the 1994 Income Survey is released, NATSEM will be able to compare STINMOD/94A with the 'real' data.

The ABS has recently shifted to a continuous (as opposed to periodic) basis for its Income Surveys. Within two to three years, the ABS will be in a position to release, every year, a file of sufficient size to form the basis for static microsimulation. The ABS will have to use ageing techniques to achieve this, but they will always have the benefit of a current sample of around 7000 households as a benchmark dataset.

The widespread use of STINMOD will also be invaluable in detecting errors overlooked by the STINMOD team. There are some 200 parameters in STINMOD and it is impossible to cover all the combinations of these in internal testing. The discovery of errors by external users will be seen as a positive development for the model. This is a very important by-product of providing widespread access to a microsimulation model. One outcome of this will be improved confidence in STINMOD, both by those who use it themselves and those who have to assess the validity of simulation outcomes.

Archiving each version of STINMOD will enable historical analysis of outcomes under the different policy structures that have existed over the life of the model. Those interested in social and economic policy are always attracted to questions such as 'what has happened to … since … ?' and what have been the causes of any change. Archiving will enable the substitution of individual program modules to enable a comparison of the way outcomes have been affected by changes in one component of STINMOD

7. Future Directions

While STINMOD is already a sophisticated model overcoming a number of the limitations of previous models, there is still plenty of scope for further development. STINMOD currently covers the major government cash transfer programs (Social Security and Veterans' payments, AUSTUDY, and taxation) and some non-cash government services (housing and health). Future versions of STINMOD will include additional government programs, such as education and child care. There are also plans to develop a more sophisticated model of public health usage and expenditure and to include private health insurance.

Improvements will be made to the STINMOD microdata in four areas. The first area will be to make the microdata more representative of Australia's current economic and demographic profile. For example, some sources of income (such as child support payments) which have become more widespread since the original survey was undertaken may be updated using more sophisticated and accurate techniques. The second area will be to impute variables which will improve the modelling of programs currently in STINMOD. For example, if assets were imputed, the assets tests for most of the government programs already simulated in STINMOD could be applied.

The third area will be to impute variables which will provide new perspectives for analysis of STINMOD's outcomes. For example, regional information may be imputed to support more fine-grained analysis. The fourth area will be to impute variables which enable the modelling of programs not currently in STINMOD. For example, imputing the incidence of child care will enable the modelling of child care fee relief.

There are also plans for an academic version of STINMOD which could be used to teach economics, sociology, and public policy. This version of STINMOD will have enhancements suggested by those academics who use it as a teaching tool. It is likely to have additional features such as equivalence scales, poverty estimates, Gini co-efficients and Lorenz curves.

Improvements will be made to the interface to STINMOD to provide more flexibility for users in specifying and analysing a simulation. In the future, STINMOD will allow users to view the simulation outcomes as graphs in addition to the current tables. Graphical representation of the outcomes would allow users to quickly identify how the impact of a simulation differs for various sub-populations. Users may be given the option to choose their own variables for distributional analysis. Currently, STINMOD identifies winners and losers, and tabulates average outcomes by family type and various income ranges. Users could be given the opportunity to tabulate the outcome using different variables, such as tenure type, or the age, industry sector, labour force status or study status of the reference person or spouse.

Other possible initiatives include incorporating behavioural response to government policy changes, linking STINMOD with a macroeconomic model, adding consumption and indirect taxes, and linking the STINMOD model with NATSEM's dynamic population model, DYNAMOD (Antcliff, 1993).

These are just some of the possible future directions of STINMOD. Depending on demand, a new version of STINMOD will be released approximately biannually and each new version will be up-to-date and include further enhancements.

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