



National Centre for Social and Economic Modelling
• University of Canberra •

Social Modelling and Public Policy: What is microsimulation modelling and how is it being used?

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About NATSEM

The National Centre for Social and Economic Modelling was established on 1 January 1993, and supports its activities through research grants, commissioned research and longer term contracts for model maintenance and development with the federal departments of Family and Community Services, Health and Aged Care, and Education, Training and Youth Affairs.

NATSEM aims to be a key contributor to social and economic policy debate and analysis by developing models of the highest quality, undertaking independent and impartial research, and supplying valued consultancy services.

Policy changes often have to be made without sufficient information about either the current environment or the consequences of change. NATSEM specialises in analysing data and producing models so that decision makers have the best possible quantitative information on which to base their decisions.

NATSEM has an international reputation as a centre of excellence for analysing microdata and constructing microsimulation models. Such data and models commence with the records of real (but unidentifiable) Australians. Analysis typically begins by looking at either the characteristics or the impact of a policy change on an individual household, building up to the bigger picture by looking at many individual cases through the use of large datasets.

It must be emphasised that NATSEM does not have views on policy. All opinions are the authors' own and are not necessarily shared by NATSEM.

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Abstract

The aim of this paper is to provide an overview of social modelling, and in particular a general introduction to and insight into the potential role and usefulness of micro-simulation in analysing public policy. Despite having made a major contribution to the development of tax and cash transfer policies, there are many important areas of government policy to which microsimulation has not yet been applied or only slow progress has been made. This includes the health and disabilities fields.

Some of the main distinguishing characteristics of social models are discussed. The paper then describes recent microsimulation modelling developments at the National Centre for Social and Economic Modelling (NATSEM) and how these are being used to inform social and economic policy in Australia. Examples include: the potential use of NATSEM's static tax and cash transfer model (STINMOD) in assessing changes in the Disability Support Pension; modelling the Pharmaceutical Benefits Scheme; application of dynamic modelling for assessing future superannuation and retirement incomes; and the development of a geographical-based i.e. regional microsimulation model (SYNAGI). Various technical aspects of the modelling are highlighted in order to illustrate how these types of socio-economic models are constructed and implemented.

The key to effective social modelling is to recognise what type of model is required for a given task and to build a model that will meet the purposes for which it is intended. The results produced then have to be interpreted within the boundaries and limitations of the model. Some of the new models being built by NATSEM lie at the frontiers of current knowledge. The potential of microsimulation models in the social security, welfare and health fields is very significant. However, it is important to recognise that measuring economic and social benefits is 'not just about the dollars'. Policy decisions are necessarily going to involve value judgements - policies are created and implemented within a political environment. The aim is for social modelling, and in particular policy simulations, to contribute to a more rational analysis and informed debate. In this context, microsimulation models can make a significant contribution to the evaluation and implementation of 'just and fair' public policy.

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General caveat

NATSEM research findings are generally based on estimated characteristics of the population. Such estimates are usually derived from the application of microsimulation modelling techniques to microdata based on sample surveys.

These estimates may be different from the actual characteristics of the population because of sampling and nonsampling errors in the microdata and because of the assumptions underlying the modelling techniques.

The microdata do not contain any information that enables identification of the individuals or families to which they refer.

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1 Introduction

A standard definition of public policy has been “a public policy is an action which employs governmental authority to commit resources in support of a preferred value” (Considine, 1994, p3). Policy-making includes: the clarification of public values; commitments of money and services; and granting of rights and entitlements (Considine, 1994). These actions involve the public exercise of power and constitute one of the central processes through which societies respond to major social, economic, environmental and political issues. Public ‘economic’ policy questions usually involve the analysis of the cost and (re-) distributional impacts of changes in policy – what are the costs (or savings) to government versus the community? who are the winners and who are the losers? Social models can be used to examine the nature of policy and the detailed effects of structural changes. These models typically have been applied to government policy in the taxation, social security and welfare fields. A more recent phenomenon has been the emerging demand for social models from the private sector for informed analysis of changes in company policies and structural and fiscal arrangements with respect to client services – for example the likely implications of wealth accumulation and participation in private superannuation schemes.

In the past two decades, microsimulation models have become very powerful tools in many countries, being used routinely within government to analyse the distributional impact of policy changes to tax and cash transfer programs (such as disability or age pensions). Such models have frequently played a decisive role in determining whether or not particular policies are implemented. Yet, despite having made a major contribution to the development of tax/transfer policies, there are many important areas of public policy to which microsimulation has not yet been applied. Only slow progress has been made in moving beyond simulating the immediate impact of tax/transfer policies to include, for example, the use of health, disability or aged care services, the behavioural responses of consumers to policy changes, and the distributional impact of such economic changes as variations in protection or interest rates. Similarly, while the use of models estimating the current immediate distributional impact of tax/transfer policy change has become routine, microsimulation models simulating the future impact of policy changes or the future structure of the population have not yet become as widely used by policy makers. In addition, spatial microsimulation – or the production of synthetic small area estimates - is a relatively recent development, occurring in the 1990s.

The aim of this paper is to provide an overview of social modelling — and in particular microsimulation modelling — as it applies to public policy in Australia. It is important to acknowledge from the outset of the paper that the particular

perspective taken in discussing social modelling and microsimulation of necessity takes a somewhat instrumental and narrow view of what is public policy (this instrumental view being reflected in the standard definition given above). The paper examines socio-economic and technical aspects of modelling in which policy is conceptualised more as a theory of choice and a study of costs (and benefits) (March and Olsen, 1989). The origins of the policies that are referred to in the paper, the processes and decisions generating the policies, the bigger social questions surrounding these policies, and other types of 'social' policy, for example, are not discussed. These concerns would be included in a broader definition of public policy and would be addressed in the evaluation of public policy reforms.

The paper addresses two basic questions: 'what is social and microsimulation modelling?' and 'how are microsimulation models being applied in the social security, welfare, and health fields?' The specific objective is to provide a general introduction to and highlight the potential role and usefulness of microsimulation in analysing government policy (and private sector structures) as they relate to disability. Thus, while some of the limitations of this type of modelling will be discussed, the emphasis is more on the strengths and positive aspects of microsimulation modelling and its application. Some of the main distinguishing characteristics of social models are discussed briefly in the following section. A key to effective social modelling is to recognise what type of model is required for a given task and to build a model that will meet the purposes for which it is intended.

The paper then describes recent microsimulation modelling developments at the National Centre for Social and Economic Modelling (NATSEM) at the University of Canberra, and how these are being used to inform social and economic policy in Australia. Examples include the potential use of NATSEM's static tax and cash transfer model in assessing changes in the Disability Support Pension, modelling the Pharmaceutical Benefits Scheme, application of dynamic modelling for estimating future superannuation and retirement incomes, and the development of a geographical-base i.e. regional microsimulation model. Various technical aspects of the modelling are highlighted in order to illustrate how these types of social models are constructed and implemented.

2 Social Modelling

2.1 An introduction to social models

Social modelling can be defined simply as the representation of social phenomena and/or the simulation of social processes. Social models come in all shapes and sizes.

While there are endless types of social models, they can be classified according to some key characteristics, as listed in Table 1.

Table 1 Types of Social Models

simple	complex
small	large
qualitative	quantitative
static	dynamic
deterministic (rule-based)	stochastic (probabilistic)
non-behavioural	behavioural
non-spatial (national)	spatial (regional)

To illustrate the varying nature of social models, these dualisms are briefly discussed in turn.

- Models may be regarded as '*simple*' or '*complex*' or fall along some continuum between these two poles. Classification is somewhat arbitrary but it is clear that there is a wide range in the complexity of the construction, data requirements and applications of social models.
- *Small* models typically examine a limited range of types (hypothetical) of households or individuals and often do not attempt to include all the complex details of actual systems (e.g. income tax and transfer payments) under study (Creedy, 2001). In contrast, microsimulation models are *large* social models. These are typically population-based, use large cross-sectional datasets with a comprehensive range of information on households and individuals, and capture in detail the complexity of the systems being modelled. Some 'small' models can be very sophisticated and produce very realistic results. It is important to recognise that just because a model is large and complicated, this does not mean its output is necessarily more realistic or reliable than that produced from a simpler and smaller model.
- Models are almost invariably assumed to be *quantitative* (i.e. empirically or data driven) and mathematically or statistically constructed using, for example, either a spreadsheet approach using computer packages such as Excel or Clarisworks, or microsimulation modelling drawing on programmable computer languages such as SAS, C+, Fortran etc. This isn't necessarily the case or the ideal approach to take. *Qualitative* models, based on normative approaches, are also common in the social sciences. Both quantitative and qualitative models can have a large

number of parameters (variables), can be highly structured, and consist of stocks, flows (functional links) and feedback loops.

- Most social (microsimulation) models are *static* in that there is usually no attempt to model a time sequence of changes (Creedy, 2001). These models are commonly referred to as measuring the effects of policy changes on the ‘morning after’ the change. Static models are relatively ‘simple’ in structure and assess what each individual would, counterfactually, have under a new system or set of policy rules. Static models are most frequently used to provide estimates of the immediate distributional impact of policy changes. Static ageing techniques are typically used to either age a microdata file so that it more accurately represents the current world or to provide forward estimates of the impact of policy change during the next few years.

Dynamically ageing microsimulation models, on the other hand, involves updating each attribute for each micro-unit for each time interval. Dynamic models are more complicated in that a temporal element is introduced into the modelling. Individuals are aged and stochastically undergo transitions, as well as being subject to modified policy regimes (Halpin, 1999). *Dynamic* models often start from exactly the same cross-section sample surveys as static models. However, the individuals within the original microdata (the model’s cohort) are then progressively moved forward through time. This is achieved by making major life events - such as education and training, labour force participation, family formation and dissolution (marriage, children, separation, divorce), migration, retirement, death etc - happen to each individual, in accordance with the probabilities of such events happening to real people within a particular country. Thus, within a dynamic microsimulation model, the characteristics of each individual are recalculated for each time period. This involves the use of large transition matrices or econometric techniques to determine the various year-to-year shifts. Hence, dynamic microsimulation models are generally much more complex and expensive to build.

- Social models tend to be either *deterministic* or *stochastic* in nature. If a model is deterministic then it is rule-based - if A then B e.g. if an individual meets certain criteria then they are eligible for a government pension. Stochastic modelling, in contrast, is based on conditional probabilities that certain social conditions or processes will exist or occur – for example, the likelihood that an 18 year old from a high income family, completing year 12 from a private school, will attend university.
- The majority of models are *non-behavioural* in that no allowance is made for changes in individuals’ behaviour in response to policy changes. Other than being a standard practice in microsimulation modelling, it is often reasonable to make this assumption in the absence of any real world data as to how people would react to changes in their circumstances. A challenge is to incorporate

behavioural elements and responses (e.g. consumer preferences, labour supply responses, elasticities of demand) into social models. This adds complexity to the model and increases the technical difficulty in its construction and maintenance. However, some policies are designed to impact on behaviour — such as altering the consumption of certain goods and services, changing individuals' participation in the labour market or increasing compulsory savings through superannuation. Increasing patient copayments for prescribed medicines subsidised on the pharmaceuticals benefit scheme (PBS) is not only a method for government to raise revenue to help pay for the pharmaceutical bill but is also suppose to act as a price signal to consumers to encourage more appropriate patterns of consumption of PBS-listed pharmaceuticals. In such situations, behavioural models should be constructed if at all possible.

- Until recently, most econometric-based models were *non-spatial* – the concern being for 'who is affected' not 'where do these people live'. An important limitation of the models to date has been that results have only been available at the *national* level or, at best, at a State or Territory level. This is because the existing models have been constructed on top of ABS sample survey data, which does not by itself allow estimates at small geographic levels. Thus, it has not been possible in the past using most models to predict the *spatial* impact of possible policy changes upon the household sector. Regional models are now being developed through the construction of synthetic small area populations (see section 3.4) that will allow policy analysts to investigate the local area impacts of policy changes.

The aim is to determine what type of model - which of the above characteristics - best suits the tasks in hand. Microsimulation models are typically complex, large, by definition quantitative, more commonly static, deterministic, non-behavioural and non-spatial. However, as discussed later in the paper, newer models are emerging that are increasingly dynamic, encompass behavioural elements, or are designed as regional models. The overall key to effective social modelling is to design, build and use the model for the purposes for which it is intended, and to interpret the results within the limitations of the model.

2.2 Microsimulation Models

Microsimulation models are a pre-eminent type of social model. They now are used extensively throughout the industrialised world, most often for predicting the immediate distributional impacts of government policy change. Such models are unusual in the degree of detail they provide about distributional impact, and are regarded as one of the more useful modelling approaches available to those

interested in the likely future impacts of population ageing (including retirement incomes) (Citro and Hanushek, 1991; OECD, 1996).

The key use of microsimulation models has been to elucidate the immediate revenue and distributional impacts of changes in tax and social security policy. The idea of analysing the impact of social and economic policies by simulating the behaviour and characteristics of individual decision-making units was pioneered by Guy Orcutt in the United States in the 1950s (Orcutt, 1957; Orcutt et al, 1961).

Microsimulation models start with microdata i.e. “low-level” population data – typically the records of individuals from a national sample survey conducted by a national Bureau of Statistics. This is one of the most important advantages of large scale microsimulation models. Being based on unit records, it is possible to examine the effects of policy changes for narrowly defined ranges of individuals or demographic groups (Creedy, 2001). Further, they can mirror the heterogeneity in the population as revealed in the large household surveys. Other strengths are that the models can replicate the complexity of the policy structures, transfers, and settings, and they can be used to forecast the outcomes of policy changes and ‘what if’ scenarios – the results describe what, under specified conditions, may happen to particular individuals and groups.

An overview of microsimulation -what is microsimulation, the various types of models, some of the technical characteristics and considerations, and examples of model applications – can be found in Harding (1996) and Gupta and Kapur (2000).

The National Centre for Social and Economic Modelling (NATSEM) is a specialist microsimulation modelling centre, established at the University of Canberra in 1993. The NATSEM models and results are used by a wide range of Federal and State Government departments to answer questions about the distributional and revenue impacts of possible policy changes. The models have played an important role in public policy debate in Australia. Some of these will now be discussed to illustrate their technical construction and the potential usefulness of this type of social modelling.

3 Examples of NATSEM’s Microsimulation Models

3.1 STINMOD - A static model of tax and transfer policy

STINMOD is NATSEM's publicly available static microsimulation model that simulates the payment of personal income taxes and the receipt of social security

cash transfers. STINMOD is used to estimate the impact of these systems on Australian families. In essence, STINMOD applies the rules of the income tax and government cash transfer programs to a database of income units¹ representing the Australian population (Bremner et al, 2002). From a modelling perspective, STINMOD can be conceptualised as having two major components. The first is the suite of ‘entitlement’ modules. These modules simulate the policy rules of the major federal tax and transfer programs, including eligibility, entitlement and interaction. These rules are translated into computer code using SAS software. The second component is the basefile. The policy rules are applied to a population database comprising income units, the individuals of which are a representative sample of the Australian population (Bremner et al, 2002). This database is referred to as the basefile, and is constructed from the representative population samples interviewed in national ABS surveys. Each record in the basefile, representing an income unit, contains information about the income unit as a whole and information on each person in the income unit.

The first version of STINMOD was released in 1994. Since then, the ANTS (A New Tax System) tax reform package has been implemented and more up-to-date data released. The latest versions of STINMOD, STINMOD01A and STINMOD01B, are based on the 1998-99 ABS Household Expenditure Survey (HES), and the 1996-97 and 1997-98 ABS Income Surveys (SIHCs) respectively. These basefiles include a wide range of demographic and economic indicators as well as income unit, family and household structure. Each person, income unit, family and household in the HES or SIHC datasets has a unique identifier attached to it. These identifiers allow users to link people in the same income unit, family or household (Bremner et al, 2002). In this way, the impact of policy changes can be investigated with respect to not only narrowly defined groups of individuals but also types of families. STINMOD01A reflects the income tax and social security systems as they were in the 2000-01 financial year while 01B provides forecasts over a five year period (outyears). The STINMOD01A basefile contains 8,653 income unit records, and 01B contains 23,263 records (combining the microdata from the two most recent SIHCs as well as including records representing a synthetic sample population of the institutionalized population).

STINMOD basefiles are constructed from known benchmark data (e.g. ABS surveys). The microdata are then up-rated to try to better reflect the current world. For example, unit records are aged by re-weighting them (see below) using sources such

¹ The Australian Bureau of Statistics defines an income unit as ‘one person or a group of related persons within a household, whose command over income is assumed to be shared. Income sharing is assumed to take place within married (registered or de facto) couples, and between parents and dependent children’ (ABS 2001).

as ABS population projections, labour force data, forecasts of key parameters such as the CPI, and Department of Family and Community Services (FaCS)(and other) administrative data and client projection figures. The aim is to match STINMOD output as closely as possible to available administrative, survey or census data.

The development of the ‘projected’ basefiles was largely a response to requests from users in federal government departments who needed to provide ‘outyear’ costings as part of the budget process. As a result, STINMOD is now an outyears model, with users able to choose the financial year they wish to analyse² (Bremner, 2002).

There are three important elements in generating a STINMOD base population file. These are calculating the weights attached to each income unit; uprating private incomes; and imputing family links and workforce independence (along with other miscellaneous imputations) (Bremner et al, 2002). Each of the individuals in an income unit has to be assigned a weight. This weight represents the likelihood of finding persons with a similar set of characteristics in the Australian population. Weights are provided in the ABS surveys but these apply to the time of the surveys and therefore need to be adjusted to better match up-dated administrative program numbers and compositional changes in the population.

Private incomes are also uprated as part of the STINMOD projected basefile creation process. This process includes revising wage and salary earnings (by full-time and part-time labour force status and by quintile of income), income from self-employment, and incomes from other sources (e.g. dwelling rents, interest, dividends, royalties and other investments). The value of transfer payments recorded in the surveys is not uprated, since STINMOD calculates these amounts directly. As the ABS microdata datasets do not contain all the information needed to be able to accurately apply the rules of the government cash transfer and income tax systems modelled in STINMOD, a number of imputations need to be performed as well. For example, the SIHC does not contain any information about parental income and family structure for single income units (young adults) living away from home and still considered dependants for cash transfer purposes. This information is vital to accurately determine Youth Allowance (formerly AUSTUDY) and family assistance outcomes. Similarly, the information needed to determine workforce independence for single income units is not collected in the surveys, so it must be imputed in STINMOD (Bremner, 2002).

The STINMOD model can provide estimates of the immediate distributional impact of a proposed policy change, such as a liberalisation of the age pension income test, or a tax cut -- showing who wins and who loses from the policy change and how

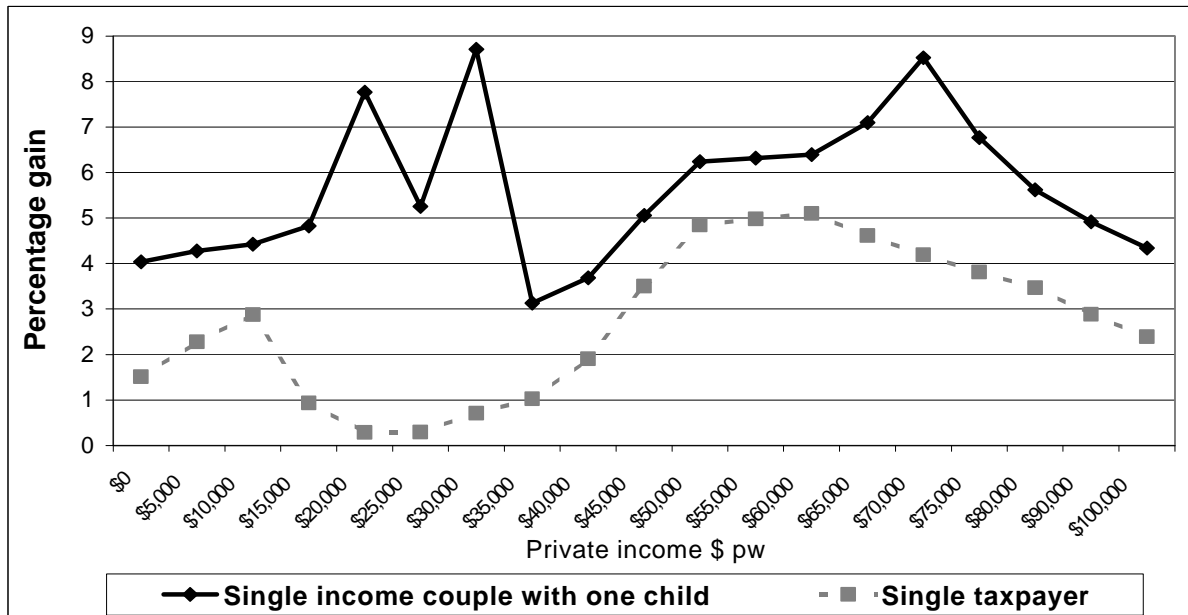
² The development of the outyears capacity in STINMOD stemmed from an outyears version of the model created by the federal Treasury.

great are the gains and losses for particular types of families. It also shows the impact on the spending of government departments and on revenue collected by the Australian Tax Office. The STINMOD model has now been used for more than five years by Federal government departments - such as FaCS and the Treasury - to look at the impact of policy change. In the late 1990s, the STINMOD model was joined with Professor Neil Warren's STATAX model of indirect taxes. The resulting STINMOD-STATAX model was used to assess the likely distributional impact of the government's GST tax reform package for the Senate Committee on a New Tax System (Warren et al., 1999). After all of the changes, NATSEM found that final tax reform package provided the greatest benefits to single income couples with children and sole parents (Figure 1). Results from the model were one of the factors leading to the Government delivering more generous compensation to social security recipients and reducing the proposed income tax cuts to high income earners.

Tax and cash transfer microsimulation models, such as STINMOD, have to date not been specifically applied to the disability field. However, they do offer significant opportunity for assessing the fiscal and distributional impacts of social security and welfare policy reforms such as those announced in the 2002-03 Federal Budget. In Australia, Government provides means-tested income support to people with disabilities as well as to partners, parents and other carers of people with disabilities, assistance with employment or training related transport costs, and services which increase the independence and employment opportunities of people with disabilities (2002-03 Budget Paper No 1, p6-30). Key payments include the Disability Support Pension (DSP), the Carer Payment and the Wife Pension³. These cash transfers are contained within STINMOD's entitlement modules. During March 2002, the average number of DSP recipients was 653,000, an increase of 34,000 over the previous year (FaCS Portfolio Budget Statements 2002-03, p138).

³ The Wife Pension is being phased out. No new grants have been made since 1 July 1995.

Figure 1: Estimated Percentage Gain in Disposable Income from the Final GST Tax Reform Package



Source: Harding et al, 2000.

The budget measures announced on the 14th May 2002 are expected to result in a significant reduction in Commonwealth Government expenditure on the disability support pension after 1 July 2003 (although government assistance to people with disabilities⁴ overall is anticipated to increase from \$8,946m in 2001-02 to \$10,436m in 2005-06⁵). Reduction in DSP spending will be the outcome of the Government’s measure “*Recognising and Improving the (Work) Capacity of People with a Disability*”. The aim of this policy is to ‘continue the move towards a more active social security system tailored to addressing individual circumstances and maintaining participation in the workforce’ (2002-03 Budget Paper No 1, p6-29). This reinforces the Government’s approach of moving towards welfare assistance based on prevention, intervention and mutual obligation (2002-03 Budget Paper No 1, p6-28), and reflects the government’s commitment to encouraging self-reliance and

⁴ Carer allowance (adult) and carer payment have been reclassified from the *Assistance to the Aged* sub-function to the *Assistance to people with disabilities* sub-function.

⁵ This growth in total expenditure is largely due to the indexation of payments, maintaining the single rate of the disability pension at a minimum of at least 25 percent of male total average weekly earnings as well an increase in the expected number of recipients (largely through ageing of the population). (Source: 2002-03 Budget Paper No 1, p6-28)

community contribution through participation in the labour force and community life (FaCS Portfolio Budget Statements 2002-03, p123).

The Government's rationale for *Recognising and Improving the (Work) Capacity of People with a Disability* is that "many people with disabilities, who receive DSP, could improve their financial circumstances through part-time work. Currently such participation is voluntary and less than ten percent of DSP customers report earnings" (FaCS, Budget 2002-03 What's New, What's Different, p10). The DSP qualification criteria will change such that people with a disability who can work at least 15 hours a week at award wages within two years of assessment will no longer qualify for DSP. Currently, the work criteria is being unable to work full-time (full-time work being defined as at least 30 hours a week at award wages). The Government argues that "Restricting DSP to people who cannot work at least 15 hours a week at award wages instead of the existing 30 hour limit is consistent with modern labour market trends towards increased part-time and casual employment. The change will encourage people with disabilities to make the most of these opportunities where they have the capacity for substantial part-time work" (FaCS, Budget 2002-03 What's New, What's Different, p10). This budget measure will substantially reduce the number of new DSP claims approved, the Government stating that most unsuccessful claimants will move onto other more appropriate income support payments, such as the Newstart Allowance⁶ (2002-03 Budget Paper No 1, p6-30). It was also announced in the budget measures that existing recipients also would be assessed under the new criteria at the time of their DSP review, with a resultant shift of many recipients from the DSP to Newstart Allowance.

These changes in Government policy have implications for social modelling. The pathway being implemented by the Federal Liberal Government in the social security and welfare arenas⁷ introduces more of a stochastic and behavioural element into the uptake of social security payments. The government is imposing much greater state pressure and expectations on potential social security recipients. In essence, individuals with disabilities are being forced to make choices as to the degree to which they are able to participate in the labour market. The implication of this policy change for modelling is that the increased subjectivity, uncertainty and variability in individual personal decision-making as to whether or not people will apply for and be granted a pension makes the modelling much more difficult than is usually the case with deterministic 'rule-based' micro-simulation. The data

⁶ Newstart is for unemployed people aged over 21 or people who are temporarily unable to work due to illness, injury or disability.

⁷ As revealed in the use of terms such as 'mutual obligation', 'self-reliance' and 'participation'.

requirements to undertake this ‘new’ social modelling are much greater, and are usually beyond the information contained within national surveys.

To illustrate this, consider the potential of STINMOD to model changes to DSP policy settings. The DSP is subject to both an income and assets test. Liberalisation or contraction of the income test, for example, can be modelled relatively easily in STINMOD by changing the parameters within the entitlement modules and some of the SAS coding, and the consequential impacts on families estimated. The links in the microdata between individuals, income units and families is particularly significant since, in the disability field, the role of partners and parents (and other carers) is critical - not only as carers of people with disabilities, but also in the sharing of income and assets and in benefiting from the wins or bearing the losses from policy changes. STINMOD allows the impact on family income and shifts in the position of the family relative to other Australian families to be estimated, as well as the impact on the individual beneficiaries.

Given the income data within STINMOD, it is possible to estimate the number of individuals and families that would be affected by replacing the income test for DSP with that for Newstart for example – the program the Government expects most new and current DSP recipients to go onto. The difference in the income eligibility criteria between these two schemes is shown in Table 2, and a comparison of the payment rates (effective from 1 July 2002) between DSP and the Newstart Allowance in Table 3. The change in personal and family disposable income for different groups of persons with disabilities (e.g. for different age groups or family types) from shifting between these two schemes, and the net savings to Government, can be estimated using STINMOD. The differences between these two schemes in their income tests and payment rates are quite marked. Thus, one would expect to detect from the microsimulation modelling noticeable changes in the numbers of eligible recipients, in personal and family disposable income levels of persons with a disability on DSP versus Newstart, and in government outlays. Similarly, the degree to which DSP recipients and their families would be ‘better-off’ by participating in part-time paid employment could be simulated in STINMOD, by allocating to DSP recipients, on some pro-rata basis, possible number of work hours, award rates and expected earnings.

STINMOD is very effective at modelling such broad scale changes or ‘what if’ scenarios (e.g. what if 50% or 75% of DSP recipients were transferred to the Newstart Allowance) but difficulties start to emerge when considering how to explicitly model the proposed change in the ‘hours of work’ criteria – the cornerstone of the budget measure. Essentially, there are insufficient data within the SIHC to accurately model this. Review of STINMOD01B’s basefile indicates that 93% of individuals receiving DSP state they work no hours and therefore derive no earnings from paid employment (in keeping with the number quoted by FaCS above). Importantly, the

national surveys contain no data that would indicate either the capacity or the propensity of persons with a disability to work at least 15 hours, and specifically what proportion and who of the 93% of individuals, who have identified themselves as not working, could work if encouraged to do so. It also is not known whether or not the 7% who currently report working some hours are willing to or could work more hours. The policy centres much more on value judgements as to who is able or not able to work, and is therefore more discretionary and consequently much more difficult to model.

In this situation, the microsimulation modelling is limited by the lack of appropriate individual behavioural data on labour market participation, which is needed to adequately simulate the policy changes. Over the past two years NATSEM has assisted FaCS in the development of a microsimulation model known as ADMOD. ADMOD is based on administrative (i.e. client-based) data, and therefore contains much more detailed information on social security recipients. The budget changes to DSP may be more reliably and accurately modelled using ADMOD, but this model is not publicly available and is not population-based.

Table 2 Income Tests (effective from 1 July 2002)

Scheme	Family situation	For full payment/ allowance (per fortnight) ^a	For part payment/ allowance (per fortnight)
Disability Support Pension	Single	up to \$116	less than \$1 185.00
	Single + 1 child	up to \$140.60	less than \$1 209.60
	Couple (combined)	up to \$204	less than \$1 979.00
	Illness Separated couple (combined)	up to \$204	less than \$2 342.00
	Additional children	add \$24.60 per child	add \$24.60 per child
Newstart Allowance	Single 21 and over	up to \$62	less than \$612.00
	Single over 60 after 9 months, or on Mature Age Allowance	up to \$62	less than \$663.14
	Single, over 18, with dependent children	up to \$62	less than \$654.86
	Partnered, over 18 with children, or over 21, each	up to \$62	less than \$560.29

^a For DSP, income over these amounts reduces the rate of pension payable by 40 cents in the dollar (single), 20 cents in the dollar each (couple); For Newstart, fortnightly income between \$62 and \$142 reduces fortnightly allowance by 50 cents in the dollar. For income above \$142 per fortnight, fortnightly allowance reduces by 70 cents in the dollar. Partner income which exceeds cut-out point reduces fortnightly allowance by 70 cents in the dollar.

Source: <http://www.centrelink.gov.au/internet/internet.nsf/individuals/index.htm>

Table 3 Maximum payment rates (effective 1 July 2002)

Scheme	Status	Pension Rate Per Fortnight
Disability Support Pension (under 21, no children)	Single, under 18, at home	\$250.40
	Single, under 18, independent	\$387.00
	Single, 18-20 years, at home	\$283.90
	Single, 18-20 years, independent	\$387.00
	Member of a Couple, under 18 years	\$352.10
	Member of a Couple, 18-20 years	\$352.10
Disability Support Pension (over 21, or under 21 with children)	Single	\$421.80
	Couple	\$352.10 (each)
Newstart	Single, no children	\$369.00
	Single, with children	\$399.00
	Single, aged 60 or over, after 9 months	\$399.00
	Partnered	\$332.80 (each)

Source: <http://www.centrelink.gov.au/internet/internet.nsf/individuals/index.htm>

3.2 A Socio-Economic Model of the Australian Pharmaceutical Benefits Scheme

In the last few years NATSEM has begun to apply microsimulation techniques to health policy issues. This has direct relevance to people with a disability especially in terms of issues of equity in the access to pharmaceuticals and health services. In 1997-98, the first Pharmaceutical Benefits Scheme (PBS) Model was developed, which used STINMOD as a base and then added data from the National Health Survey (NHS) about usage of prescribed pharmaceuticals according to age, gender and concession cardholder status. The model simulated spending on pharmaceuticals by different types of households; the resultant government outlays under the PBS; and the remaining out-of-pocket costs (patient copayment contributions) to the two different classes of consumers i.e. concessional and general patients (Walker et al, 1998; Walker, 1999).

Since the early 1990s, PBS expenditures have grown at over 10 per cent a year — well above the growth in the total health budget (6 per cent) or the economy (4 per cent in terms of GDP). PBS policy settings - the levels of patient copayments and the PBS safety net arrangements - have increased, in general, only in line with inflation. The PBS is an uncapped scheme and the likely future growth in outlays by government is a cause for government concern. A near-28% increase in PBS copayments and safety net thresholds, effective from 1 August 2002 and 1 January 2003 respectively, was announced in the 2002-03 federal budget, this measure expecting to generate \$1.1b in savings to the Government over four years (Department of Health and Ageing Portfolio Budget Statements 2002-03). Future increases in expenditure will be partly

driven by population ageing but are also the result of forecast increases in drug prices and the introduction of new high cost biotechnology and other targeted drugs – many of which will be used by people with disabilities.

During the past year, NATSEM has been working with the Australian Pharmaceutical Manufacturers Association (APMA) to build a sophisticated PBS model and forecasting capacity to examine the distributional and cost impacts of the PBS. The goal is to be able to simulate the widest possible variety of changes - in the drugs listed under the PBS, in their prices, and in the rules of the PBS (such as the amount that consumers have to pay before becoming eligible for government subsidy as well as the safety net thresholds, which are the arrangements put in place to protect individuals and families from large overall expenses for PBS listed medicines).

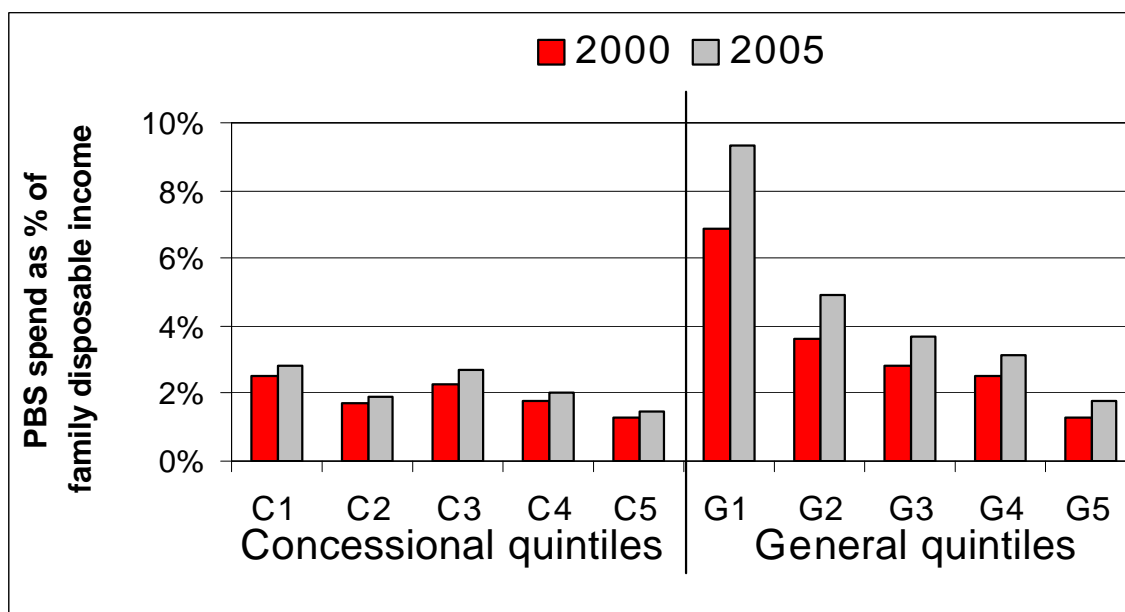
The APMA model is made up of two modules: a medicine and a patient module. The medicine module is based on data on monthly expenditure and scripts for all items listed on the PBS. It uses this time-series data to project total scripts and average costs per script into the future. These data then form the inputs to the patient module. The patient module is based on an input dataset (basefile) at the person-level with a family identifier to link family members. This link is crucial since the PBS rules regarding safety net thresholds concern family expenditure on drugs.

Four data sources are combined at the unit-record level to create the patient module's basefile: STINMOD01A provides the base population dataset; the ABS 1995 National Health Survey (NHS) is used to derive information on the usage of prescribed pharmaceuticals across 36 drug classes; the number and type of drugs are imputed by sex, age and concessional cardholder status with weekly household expenditures on prescribed pharmaceuticals being obtained from the 1998-99 HES; and administrative data on PBS scripts and costs across the 36 drug classes, from the Pharmaceutical Benefits Branch (PBB) of the Department of Health and Ageing is used to align the model (i.e. to revise scripts per person so aggregates match real data). The model's population database is the non-institutionalised population that spends on prescribed drugs (i.e. the dataset contains only spenders on prescribed medicines)⁸.

⁸ The APMA Model basefile excludes persons (and their families) that have no expenditure on prescribed drugs, and persons living in institutionalised care, for example, hospitals or nursing homes. Prescribed drug usage figures at ages above 70 years, therefore, are likely to be under-estimates.

The script data in the person-level dataset is revised each year to be consistent with the aggregate level of scripts estimated in the medicine module. As with STINMOD, the basefile is up-rated using ABS population projections, trends in male weekly average earnings and the CPI, for example. Using average costs generated by the medicine module, patient and government expenditures on PBS prescribed drugs are estimated for a base year such that these match actual figures on PBS scripts and expenditures for that year. The module then can forecast PBS scripts and expenditures for the next five years, as well as simulating ‘what if’ scenarios reflecting possible policy changes in the PBS settings. Figure 2 for example illustrates the estimated proportion of family disposable (after-income-tax) income being devoted to PBS-listed pharmaceuticals. As the figure shows, these pharmaceuticals take only about two per cent of the disposable income of families receiving concessional rates. However, the poorest 20 per cent of general category pharmaceutical users are estimated to spend about seven per cent of their after-tax income on pharmaceuticals. This is projected to increase to over nine per cent by 2005, which suggests that spending on pharmaceuticals is likely to become an important financial pressure on those on low incomes outside the social security safety net. Included within this group are working poor singles and couples without children, who are not receiving social security payments.

Figure 2: **Estimated spending on pharmaceuticals as a percentage of family disposable income, 2000 and 2005**



Source: APMA-NATSEM PBS model. The families within the ‘concessional’ and ‘general’ categories have been divided into five equally sized groups (called ‘quintiles’) on the basis of their income.

NATSEM recently was successful in gaining an Australian Research Council Linkage Grant, with the APMA as the industry partner, to extend this model to begin looking at the benefits, as well as the costs, of prescribed medicine usage. To date, the primary utility of the model has been based on its capacity to generate PBS expenditures, as well as to estimate the corresponding effect on families belonging to various income groups. While the model has provided valuable insights into the effects of various policies on government expenditure on PBS medicines and distributional equity, it does not have the capability to quantify the value that pharmaceutical spending delivers.

To present a more comprehensive picture of the contribution of pharmaceuticals to the economy and society, one needs to present not only the *costs* but also the *benefits* that it delivers — particularly in the form of improved health outcomes. Extending the model to include health outcomes will be more complex and resource intensive than the modelling attempted to date. Modelling health outcomes presents a range of theoretical and practical challenges, particularly at the level of aggregation at which the APMA model currently operates. There are limitations in the methodology and data available for health outcomes modelling which will need to be explored and overcome if the current model is to be significantly progressed. However, the outcomes of achieving this are potentially enormous.

For example, a necessary first step to developing a health outcomes facility is the introduction of diseases and disabilities into the model's basefile. Adding variables on morbidity patterns to complement the variables already available on drug usage and cost patterns would enable us to, for example, identify groups of individuals with specific health problems and disabilities and examine the impact of policy changes in the PBS settings on these sectors of the community. It would be possible to examine, for example, options that raise copayment thresholds for general patients but simultaneously protect the chronically ill through concessional rates and safety net provisions. The next step would be to quantify health outcomes, which is much more difficult.

The significance of this type of microsimulation modelling is that this new PBS model will increase Australia's capacity for making informed decisions about the rules of this scheme and, ultimately, about the overall social and economic value of the PBS to Australian society and to specific members of the community.

3.3 DYNAMOD – A dynamic microsimulation model

The modelling efforts described above fall within the province of *static* microsimulation modelling. NATSEM's *dynamic* model, DYNAMOD, has been under

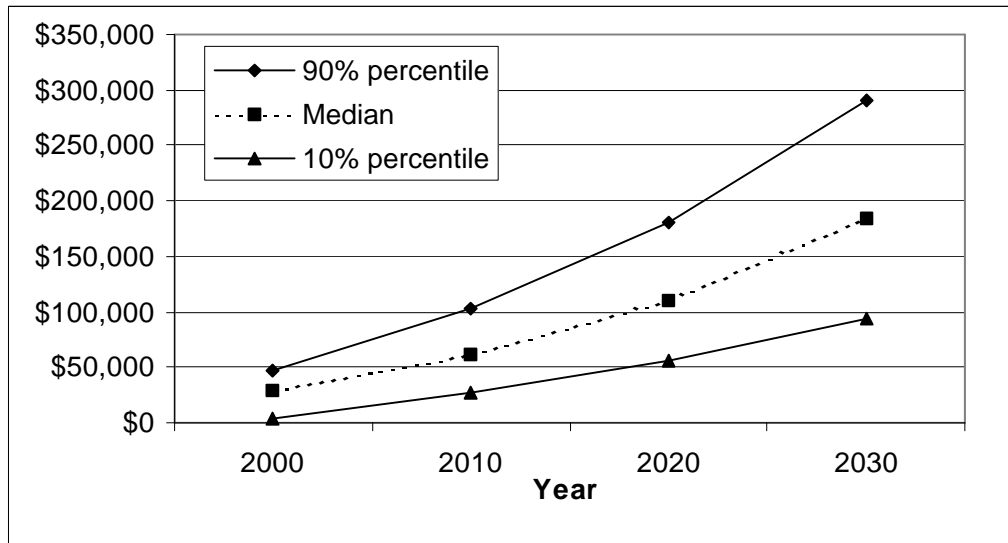
construction for the past nine years (King et al., 1999). The model starts with the 1986 Census one per cent sample (about 160,000 individuals). It then ages each of those individuals, month by month, for up to about 60 years. Dynamic models are particularly useful for looking at the likely future or long-range impacts of government policy or current social and economic trends. During the past year NATSEM has been adding assets and superannuation to the DYNAMOD model, with the aim of throwing light on the likely future retirement incomes of Australians.

The level of superannuation coverage for both men and women has increased dramatically since the introduction of the three percent industrial award superannuation and then the Superannuation Guarantee in 1992. The latter of these, with its compulsory nine per cent employer contributions for every employee earning more than \$450 per month, is having a dramatic impact on the coverage of superannuation. In 1993, only half of all employees aged 15 to 74 years were covered by superannuation. The NATSEM simulations suggest that this proportion has now increased sharply, to about 85 per cent of all such employees (Kelly et al., 2001).

The introduction of compulsory superannuation is making a particularly dramatic difference for women, who were less likely than men to be covered by superannuation at the beginning of the 1990s. In 1993, female average superannuation assets were worth 43 per cent of average male assets. In other words, in 1993 the average woman had accrued less than half the amount that the average man had. By 2030, the average woman's superannuation is forecast to have increased to 70 per cent of the average man's. (Women still lag behind because they remain more likely to take time out of the labour force for parenting and, when in the labour force, earn less than men.) The results from DYNAMOD suggest that compulsory superannuation will particularly benefit women in their 40s and early 50s.

The DYNAMOD forecasts indicate that in the near future almost all Australians will be retiring with at least some superannuation entitlement. However, for many Australians, accumulated superannuation is expected to be relatively low. Even by 2030, about 10 per cent of women of retirement age are forecast to have superannuation assets of less than \$100,000 (Figure 3). The middle (median) amount of superannuation for such women of retirement age is forecast to be just under \$200,000 by 2030, up from less than \$50,000 in 2000. If a government decided that this was an inadequate level of superannuation coverage, DYNAMOD could then be used to simulate a world where the Superannuation Guarantee was raised to, say, 15 per cent of earnings.

Figure 3 **Forecast Superannuation Assets for Women Aged 55 to 64 Years, 2000 to 2030.**



Source: Kelly et al. (2001).

3.4 Regional models – Synthetic Australian Geo-demographic Information (SYNAGI)

A particularly exciting development during the past three years at NATSEM has been the creation of regional microsimulation models. Regional issues have recently assumed much greater importance in Australia. There is a growing realisation that recent gains from economic growth have not been equally distributed amongst different regions in Australia. For example, the overall stability in national poverty rates since the early 1980s appears to have disguised increasing poverty and inequality in many areas of regional and rural Australia (Vinson, 1999; Gregory and Hunter, 1995; Harding and Szukalska, 2000).

The region in which people live profoundly affects the life experiences of all Australians and the economic opportunities available to them. For example, those who live in areas that are developing rapidly are more likely to experience abundant job opportunities and increasing wealth. In contrast, those who live in highly depressed areas may face a constellation of problems, including greater difficulties with crime and personal safety and poorer health (Taylor et al, 1992; Gregory and

Hunter, 1995; Murphy and Watson, 1997; Vinson, 1999; Walker and Abello, 2001; ACT Chief Minister's Department, 2002).

The new regional microsimulation models, being developed under NATSEM's 'Synthetic Australian Geo-demographic Information' (SYNAGI) banner, combine data from the population census and the ABS sample surveys (such as HES and the Income Distribution Survey). The crucial advantage of the census, the importance of which cannot be over-emphasised, is that it contains *detailed regional* socio-demographic information. However, although the census products from the ABS are regarded as being among the best in the world, they have important limitations that have constrained regional socio-economic analysis in Australia until now. One limitation, for example, is that detailed data on expenditures and incomes are not available in the census. A second important problem is that output for the whole census file is only available as a pre-defined series of tables for area units - the smallest unit being the Census Collection District (CD) which is approximately 200 households - rather than being in the form of records for each person or family, which is what is required for a microsimulation model. This means that many of the relationships between characteristics of interest cannot be fully explored.

On the other hand, the ABS sample surveys, like the HES, contain exceptionally detailed expenditure and income data at the individual and household level, but *lack any detailed geographic information*. In part, this is to protect the confidentiality of respondents to the survey. Often the most detailed geographic classification available in the publicly released data is the 'State'.

To overcome the problem of the non-spatial element in microsimulation models, during the past two years NATSEM has begun the construction of regional microsimulation models. To date, these new types of model have combined data from the population census and the ABS sample surveys. The new spatial microsimulation modelling techniques developed at NATSEM blend the census and sample survey data together to create a synthetic unit record file of households for every CD. In other words, the characteristics of interest unavailable in the census but available in the survey are synthesised at CD level by utilising both data sources.

The first model to be constructed by NATSEM using these new techniques was the Marketinfo model, which provides detailed regional expenditure and income estimates. The model first recodes the HES and census variables to be comparable, and then re-weights the HES, utilising detailed socio-demographic profiles from the census. This is done for each CD separately, and a re-weighted HES unit record file is generated for each area. To date, the output from this model has principally been used by private sector clients - to determine where to put new shopping centres; to examine what percentage of total spending in an area is received by their shops; to

maximise the efficiency of direct marketing efforts, or to examine the estimated incomes and assets of consumers living within each CD.

However, these modelling techniques are now starting to be used to address the concerns of public policy makers. For example, NATSEM has looked at estimated poverty rates by statistical subdivision in the ACT (Harding et al, 2000a). This study indicated that just over 13 per cent of all residents living in the North Canberra area were in poverty, with this being due to the high concentration of students and public housing tenants in this area. This model has also been used to examine postcodes with the highest and lowest poverty rates within each state (Lloyd et al., 2001).

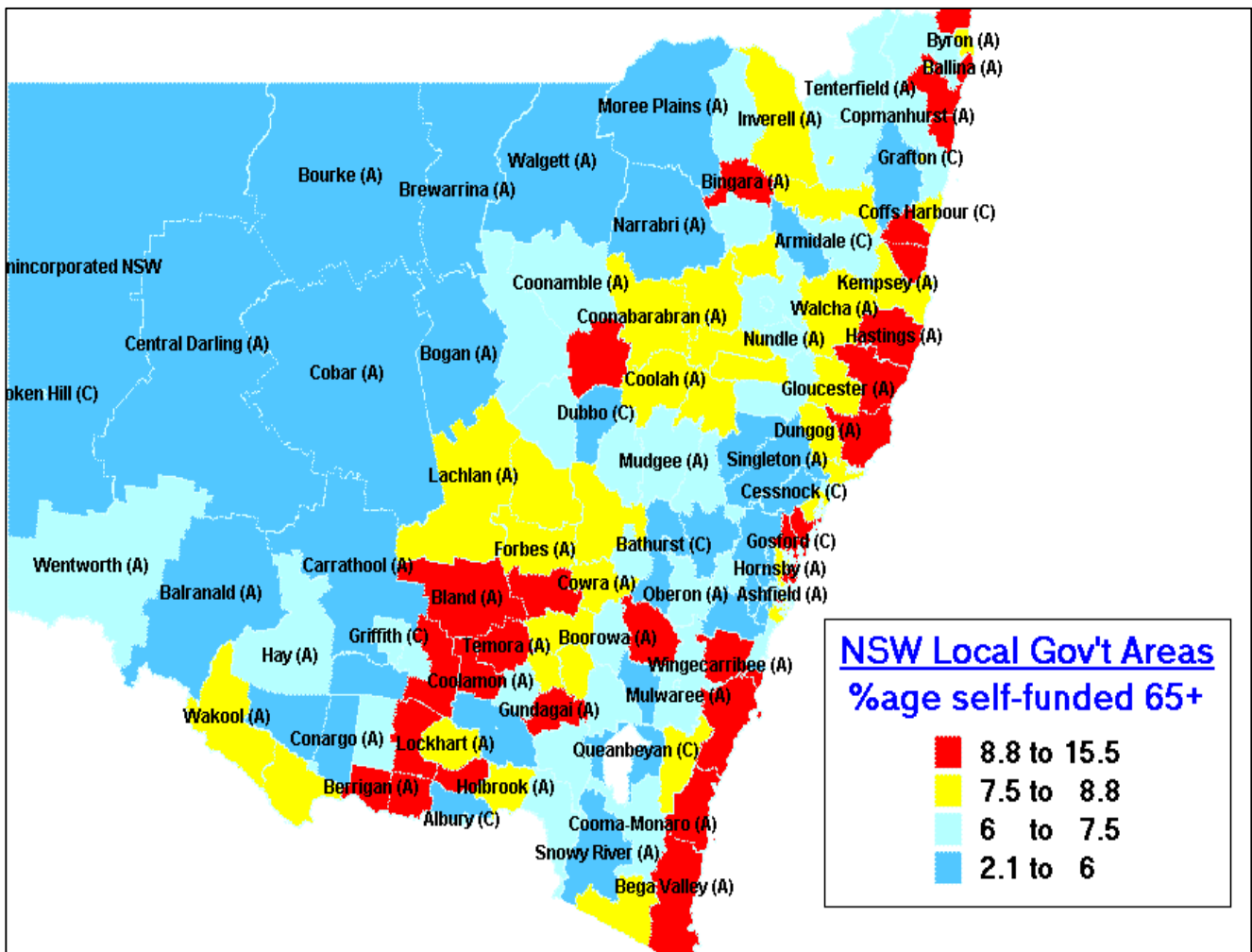
NATSEM is also engaged in a long-term project to develop a small area model of the characteristics and access channel usage of Centrelink clients, both now and in five years time. This may be of particular interest to people with disabilities, who have difficulties in attending Centrelink offices in person because of problems with mobility and limitations in transport. The model will help Centrelink with its property management strategies, as well as providing forecasts of the likely demand for each of the various methods of accessing Centrelink services. Figure 4, for example, illustrates what will be a typical output from the model – Figure 4 showing where Centrelink's age pensioner customers live.

NATSEM is now spearheading a project that aims to substantially improve the decision-support tools available to State and Territory governments by providing them with, first, far more detailed small area data than has previously been available, via the creation of a synthetic small area household database; and second, the capacity to assess the current and future impact of possible policy reforms and likely social, demographic and economic changes at the small area level, through the construction of regional microsimulation models on top of the synthetic household data.

These efforts to develop spatial microsimulation are at the leading edge internationally. Other countries where spatial microsimulation is being developed comprise the highly regarded CORSIM project in the US (Caldwell et al, 1998); Sweden (Comaren, 1999); and Leeds and Liverpool Universities in the UK (Voas and Williamson, 2000, Ballas and Clarke, 1999). NATSEM's current work involves refining the techniques used to create the synthetic small area data; providing much more extensive validation of the outcomes; adding additional characteristics to the simulated households; simulating the impact of tax, social security and other changes at a spatial level; developing techniques for ageing the small area data forward through time; and initiating linkages between NATSEM's dynamic modelling of wealth and superannuation and the spatial projections of households. The significance of this project is that it seeks to create robust and validated spatial

datasets and models that State and Territory policy makers can have confidence in and use to address their key policy issues.

Figure 4: Illustrative SYNAGI Output: Where do self-funded retirees live? (Pensioner retirees aged over 65 years as a proportion of the population)



4 Conclusions

This paper has described some recent modelling developments at NATSEM, including the development of complex health and regional microsimulation models. These new models lie at the frontiers of current knowledge, with microsimulation techniques only now being applied to the analysis of these issues, both in Australia and internationally. As Halpin (1999) highlights, the next phase in the development of microsimulation modelling is to apply these to social issues wider than the 'bounded domain of government transfer policy' - their traditional focus. It is expected that ultimately these new models will extend to the health and regional analysis fields the same sophisticated decision-support capacity as microsimulation models currently provide to policy makers in the tax and social security arenas.

Microsimulation models have been criticised for embodying more technical knowledge than theory (Halpin, 1999). In practical terms, these models are relatively complex, have significant data handling and computing requirements, are costly to build and maintain, and usually require a team of developers with a wide range of expertise and skills. Models are limited by their design, their assumptions and algorithms, and data requirements. The key is to make these explicit and then interpret the results within the models' limitations and capacities.

The aim is to use social models appropriately and for the purposes for which they are built. In this way, the potential of microsimulation models in the social security, welfare and health fields is very significant. However, it is important to recognise that measuring economic and social benefits is 'not just about the dollars'. Policy decisions are necessarily going to involve value judgements - policies are created and implemented within a political environment. The aim is for social modelling, and in particular policy simulations, to contribute to a more rational analysis and informed debate which leads to the implementation of equitable public policies. In this context, microsimulation models can make a significant contribution to the evaluation of public policy, as well as private sector structures, and more specifically as they relate to people with disabilities. While the challenge will be to develop models that will perform well, the future prospects are very exciting.

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