Using Microsimulation Models in the Policy Process in an Ageing Society

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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 Ageing and Education, Science and Training.

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.

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Abstract

This paper describes recent developments in microsimulation modelling at NATSEM at the University of Canberra that are of relevance to the issues raised by an ageing population. Microsimulation models provide exceptionally detailed answers to questions about the distributional impact of government policy changes. The paper describes new initiatives at NATSEM in tax/transfer, health, regional, wealth and superannuation modelling.

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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

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). Such models start with microdata – typically the records of individuals from a national sample survey conducted by Bureaus of Statistics or administrative data. 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 age pension). 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 during the past decade or two, 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 services such as health, 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 long-term future impact of policy changes or the future structure of the population have not yet become widely used by policy makers in Australia. In addition, spatial microsimulation – or the production of synthetic small area estimates - is a relatively recent development, occurring in the late 1990s. This paper describes recent microsimulation modelling developments at NATSEM, and how they are being used to inform social and economic policy issues associated with an ageing population.

2 Tax and transfer policy

Throughout the industrialised world, the key use of microsimulation models has been to illuminate the immediate revenue and distributional impacts of changes in tax and social security policy. In Australia, NATSEM’s publicly available STINMOD model simulates payment of income tax and receipt of social security cash transfers against a representative population sample from a national ABS survey. The STINMOD model provides 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 great the gains and losses of particular types of families are. 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 Australian Federal government departments - such as Family and Community Services 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 by NATSEM to assess the likely distributional impact of the government’s large scale GST tax reform package for the Senate Committee on a New Tax System (Warren et al, 1999). This package involved a comprehensive raft of changes to the direct and indirect tax systems and to social security payments. Results from the model were one of the factors leading to the Government delivering more generous compensation to social security recipients (including age pensioners) and reducing the proposed income tax cuts to high income earners.

After all of the changes, NATSEM reassessed the impact of the final tax reform package and found that it provided the greatest benefits to single income couples with children and sole parents (Harding et al, 2000). However, age pensioners with modest to high levels of private income were also one of the major beneficiaries of the package. This is illustrated in Figure 1, which shows that the estimated average percentage gains in after-tax income from the tax reform package were much higher for an age pensioner couple at modest private income levels than for a single taxpayer at the same income levels. The STINMOD model can thus assist policy makers by looking at the impact of proposed policy changes by age. It can also be used to look at the impacts upon particular sub-groups of the population, such as age pensioners entirely reliant upon the age pension for their income or self-funded retirees receiving no age pension. (The age pension is income and asset-tested in Australia.)

The likely future assets and incomes of older Australians are important to policy makers, as they examine the extent to which older Australians are likely to be able to help finance their health, home care and retirement income needs. Data on assets for the whole population are not available in the national income and expenditure surveys carried out by the Australian Bureau of Statistics. As a result, NATSEM has imputed assets, using information available on the income surveys about the amount of declared income by asset type and housing tenure characteristics (Kelly, 2001).

Results from this modelling recently suggested that today’s older Australians have seen a substantial increase in the value of their assets over the 12 years to 1998 (Figure 2). This was partly because this group have very high home ownership rates
and have thus benefited from the doubling in house prices that occurred over this period. But it was also due to rising superannuation and share ownership among the aged. Interestingly, younger Australians had seen their average wealth fall over the same 12 years, due to falling home ownership rates among younger cohorts.

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

![Graph showing estimated percentage gain in disposable income from the Final GST Tax Reform Package.](image)

*Data source: Harding et al, 2000*

Figure 2: **Estimated net average wealth per adult by age of family reference person: 1986 and 1998** (1998 dollars)

![Bar chart showing estimated net average wealth per adult by age of family reference person.](image)

*Note: To derive all ‘per adult’ estimates in this paper, the total wealth of couples has been divided equally between the two partners. Note that all estimates are in 1998 dollars, with adjustment by the CPI.*

*Data source: Harding et al, 2001a*
3 Health models

In the last five years NATSEM has begun to apply microsimulation techniques to health policy issues. 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 about usage of prescribed pharmaceuticals by age, gender and so on. 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 to different classes of consumers. Under the PBS scheme, low income families are eligible for very heavily subsidised pharmaceuticals (Concessional category), while other families are eligible for more lightly subsidised pharmaceuticals (General category).

The PBS is an uncapped scheme whose costs have been increasing rapidly in recent years, so that the likely future growth in outlays by government is a cause for concern. NATSEM projected the population to 2020 and found that government outlays on the PBS were likely to increase five-fold by 2020, in the absence of policy change (Figure 3). This increase was partly driven by population ageing but, more importantly, was the result of forecast increases in drug prices.

During the past year NATSEM has been working with the Australian Pharmaceutical Manufacturers Association to build a sophisticated PBS modelling and forecasting capacity. 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). We hope to extend this model next year to begin looking at the benefits, as well as the costs, of new drugs (for example, in reduced hospital costs).

The prototype model is already producing very interesting results, as shown in Figure 4, which illustrates the estimated proportion of family disposable (after-income-tax) income being devoted to pharmaceuticals. The families eligible for concessional pharmaceuticals have been divided into five equally sized groups, called quintiles. As the figure shows, pharmaceuticals take only about two per cent of the disposable income of all such families. 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. Also included are
a small number of self-funded retirees, although most older Australians are covered by Health Care Cards that give them access to concessional pharmaceuticals.

The PBS scheme is under great pressure, due to population ageing, rising drug prices and the extension of very costly pharmaceutical subsidies to self-funded retirees. The new PBS model is intended to increase Australia’s capacity for making informed decisions about the rules of the scheme.

Figure 3: **Estimated cost to government of the Pharmaceutical Benefits Scheme, 1996-97 and 2020 (1996-97 $)**


Figure 4: **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.
There has also been very little information in the past about the income and socio-economic characteristics of the users of health services. This has meant, for example, that State governments have not known about the distributional impact of their hospital outlays, while the Federal government has not had a clear picture of who benefits from Medicare. In a project with the Department of Health and Aged Care, NATSEM has imputed socio-economic characteristics onto Medicare data so that, for example, the Department can look at whether there is a regional divide in the provision of Medicare services. In another long-term project with NSW Health, the Health Insurance Commission and the Productivity Commission, NATSEM is imputing socio-economic information onto the records of the users of NSW hospitals. This will mean, for example, that all three of these agencies can gain a clearer picture of whether those from affluent suburbs are relatively more likely to use hospitals or certain types of services. In the future a policy modelling capacity will be added, so that the impact of changes in health insurance policy upon public hospital usage can be estimated.

4 Spatial models

Another particularly exciting development during the past three years at NATSEM has been the creation of spatial microsimulation models. The SYNAGI models involve the creation of SYNthetic Australian Geo-demographic Information – down to the streetblock level. Regional issues have recently assumed much greater importance in Australia. There is a growing realisation that the gains from economic growth have not been equally distributed amongst the different regions within Australia. For example, poverty rates differ greatly by State of residence, and there appears to have been growing poverty and inequality in many areas of regional and rural Australia (Vinson, 1999; Gregory and Hunter, 1995; Harding et al, 2001b; Lloyd et al, 2000).

The life experiences of all Australians — and the economic opportunities available to them — are profoundly affected by the region in which they live. Those who live in areas that are developing rapidly are more likely to experience abundant job opportunities and increasing wealth (with rising house prices). 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 (Walker and Abello, 2001).

The new NATSEM spatial microsimulation models combine data from the Population Census and sample surveys (such as the ABS Household Expenditure Surveys and the Income Surveys). The crucial advantage of the Population Census,
the importance of which cannot be over-emphasised, is that it contains *detailed regional* socio-demographic information. However, although the CDATA Census product from the ABS is regarded as being among the best in the world, it has important limitations that have constrained regional analysis in Australia until now. One limitation, for example, is that detailed data on expenditures, incomes and assets 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 each Census Collectors District (rather than being in the form of records for each family, which is what is required for a microsimulation model). This means, for example, that relationships between characteristics of interest cannot be fully explored (such as age by income by educational qualifications).

On the other hand, the ABS sample surveys such as the Household Expenditure Survey (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 ‘State’.  

The new spatial microsimulation modelling techniques developed at NATSEM blend the Census and sample survey data together to create a synthetic unit record file for every Census Collectors District. 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 Household Expenditure Survey (HES) and Census variables to be comparable, and then reweights the HES, utilising detailed sociodemographic profiles from the Census. This is done for each Collectors District separately, and a reweighted HES unit record file is generated for each District. NATSEM has now established a collaboration with the School of Geography at Leeds University, who are also engaged in the construction of spatial microsimulation models using very similar techniques (Ballas and Clarke, 1999).

To date, the output from the Marketinfo model has principally been used by private sector clients - to determine where to put new shopping centres; to examine what percentage of total spend 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 Collectors District.

However, the modelling techniques are now starting to be used to address the concerns of public policy makers. For example, last year NATSEM looked at estimated poverty rates by statistical subdivision in the Australian Capital Territory (Harding et al, 2000). 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 (Figure 5). South
Canberra also had a relatively high poverty rate, partly because 15 per cent of all South Canberra residents were aged 65 years or more – twice the ACT average. This year we have used the new model 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. 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. For example, Figure 6 illustrates what will be a typical output from the model, showing where Centrelink’s age pensioner customers live.

**Figure 5: Estimated poverty rates in the ACT, 1999**

![Bar chart showing estimated poverty rates in the ACT, 1999](chart.png)

Source: Harding et al [2000, p. 20].
5 Conclusions

Microsimulation models are now 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 and retirement incomes (Citro and Hanushek, 1991; OECD, 1996).

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 upon older Australians and the potential impact of population ageing. The models have played an important role in public policy debate being used, for example:

- by the Senate during the GST tax reform debate,
- by State governments for the assessment of changes in public housing policy (Percival et al, 1998); and
- by academics for examining the implications of reforming the tax and social security systems (Keating and Lambert, 1998; Dawkins et al, 1998).

This paper has described some recent modelling developments at NATSEM of relevance to policymakers concerned with population ageing, including the development of complex health and spatial microsimulation models. These new models lie at the frontiers of current knowledge, with microsimulation techniques only now being applied to the analysis of health and spatial issues, both in Australia and internationally. 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.

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