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National Centre for Social and Economic Modelling
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APPSIM: The Australian Dynamic Population and Policy Microsimulation Model

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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 with a wide range of Federal and State government agencies.

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 five year project to construct the Australian Population and Policy Simulation Model (APPSIM) began in late 2005. APPSIM is a dynamic population microsimulation model, designed to provide answers about the future distributional impact of policy change and other issues associated with policy responses to population ageing. This paper provides a short introduction to APPSIM.

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Contents

Abstract	iii
Author note	iii
Acknowledgments	iii
1 Introduction	1
2 Overview	1
3 Method and platform	2
4 Policy environment	4
References	6

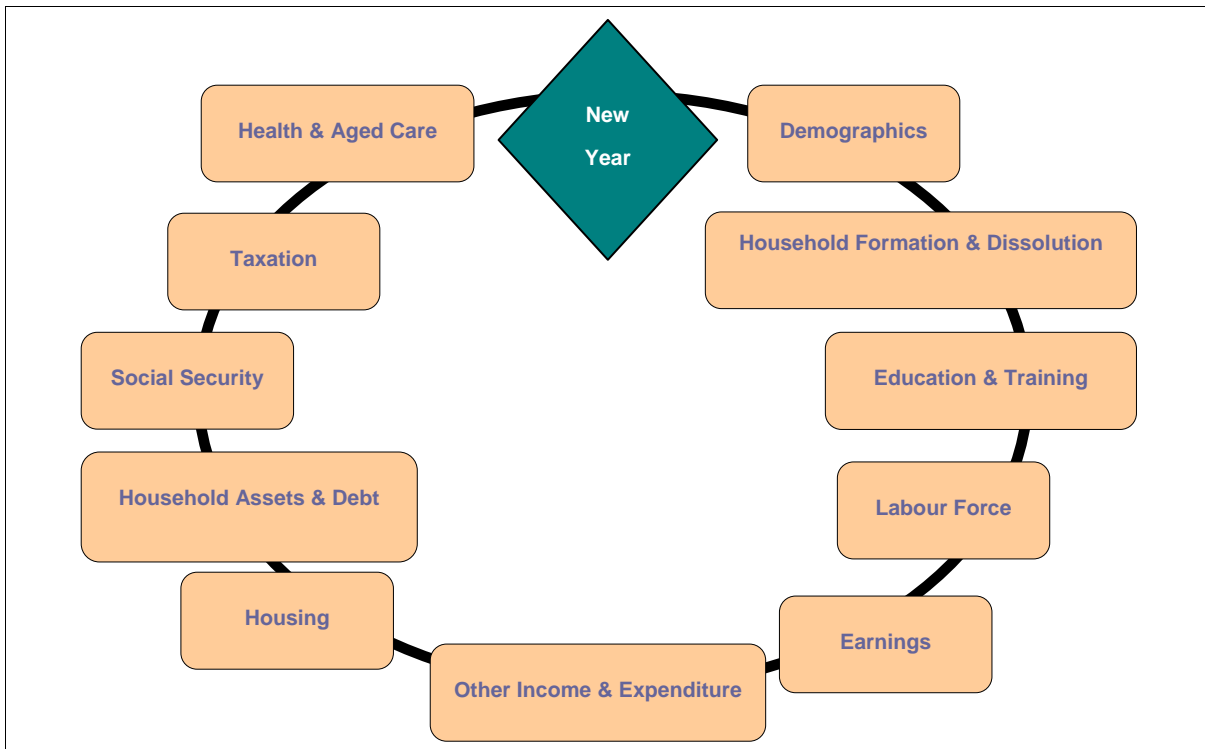
1 Introduction

In Australia, as in many other countries, there has been growing concern about the phenomenon of structural population ageing where, in decades to come, a relatively smaller proportion of taxpayers will have to support a relatively larger proportion of retirees. There have now been three official government reports in Australia, using cell-based modelling approaches, that have all concluded that in about 40 years time government outlays appear likely to exceed revenues by a substantial proportion of GDP if current program settings remain unchanged (Treasury, 2002, 2007; Productivity Commission, 2005).

As a result, NATSEM is now constructing the Australian Population and Policy Simulation Model (APPSIM), with 13 government agencies as research partners and with additional funding from the Australian Research Council. Construction of APPSIM commenced in late 2005 and the model is due for completion by mid 2010.

2 Overview

APPSIM is a closed, stochastic, cross-sectional, dynamic population microsimulation model. The model provides snapshot output of the characteristics of the population and government programs as at 30 June each year (the Australian financial year runs from 1 July to 30 June). At this stage the model is expected to project out to about 2050. The planned processes to be included in the model are relatively comprehensive, and summarised below in Figure 1. The planned scope of the model is ambitious, including taxes, wealth, housing and health status and service usage (Kelly, 2007a).

Figure 1: Overview of planned structure of APPSIM

3 Method and platform

After a review of the available possibilities for the base data for APPSIM (Kelly, 2007b), the publicly released confidentialised one per cent unit record file from the 2001 Australian census was selected. This contains the records of about 188,000 persons in about 75,500 households. While the list of variables available on this base data file does not include all those necessary for APPSIM (e.g. there are no earnings or marital histories), the large sample size was seen as a crucial advantage (Cassells et al, 2006). Each person record has a weight of 100 and there are records for those in both private and non-private dwellings (such as nursing homes).

Other key data sources being used in APPSIM include the HILDA longitudinal survey and ABS demographic and other data. The HILDA survey contains about 7000 households and currently five waves are available (see <http://melbourneinstitute.com/hilda> for the latest information). It is being used to calculate the probabilities of transition between different states, such as the probability of having a baby (Pennec and Bacon, 2007) or the probability of moving from unemployment to employment (Keegan, 2007). ABS demographic data and projections are being used to provide information about population projections and such macro-demographic variables as the expected total number of births within a

year, while the Longitudinal Study of Immigrants to Australia is being used to simulate the characteristics of future immigrants (Pennec and Keegan, 2007).

After a review of the available modelling languages currently available, C# was selected as the primary language for constructing APPSIM (Percival, 2007). One priority for the model is for it to be useable by policy makers within government, so all of the parameter files – including the co-efficients of the equations predicting behaviour, key policy parameters (such as income test parameters), and any macro targets for alignment – are embedded within Excel spreadsheets and can be readily changed by the user.

The model is incorporating a facility for the macro alignment *within* each module to be turned on or off – that is, it will be possible to run the model in unaligned mode (so as to inspect the outcomes that the micro-behavioural equations produce) or to run it in an aligned mode (that is, tied to projections, such as those used by Treasury in the Intergenerational Report or to ABS population projections). Figure 2 shows two of the APPSIM interface screens, showing how the input files are stored in Excel and how the alignment on/off feature will work (Kelly, 2007c).

The time unit for the model is one year, with continuous time functions not being used. Generally speaking, there will be no sub-year transitions recorded. For example, a male will not be recorded as being married for nine months within a financial year and single for the final three months: rather, their marital status will be output in the ‘annual snapshot’ as being single as at 30 June of the relevant financial year. The exception to this is in the modelling of labour force status, where it both unrealistic and important to the outcomes of the model to assume that a person’s status remains the same for an entire year. (For example, social security is essentially means-tested on current income in Australia, so modelling sub-annual periods of unemployment is important.) At this stage, Keegan envisages that the labour force status of individuals as at 30 June in a particular financial year will be assigned (and this figure will probably be aligned to the projections used within the Treasury’s Intergenerational Report modelling), and then an attempt will be made to go back and ‘fill in’ the weeks and number of hours worked during that year (2007).

As observed in Harding (2007), we are already encountering major challenges in estimating the transition equations required to move the simulated Australians through their lives. The sample size of the HILDA data is relatively small, at around 7,000 households, and this means that sampling error is present in our predictive equations. In addition, as Bacon and Pennec observe (2007), the five year time frame is not long enough to fully capture long term dynamics, such as the rising age of first marriage for females. This is likely to necessitate the use of alignment, to ensure that the summed micro outcomes in future years appear reasonable.

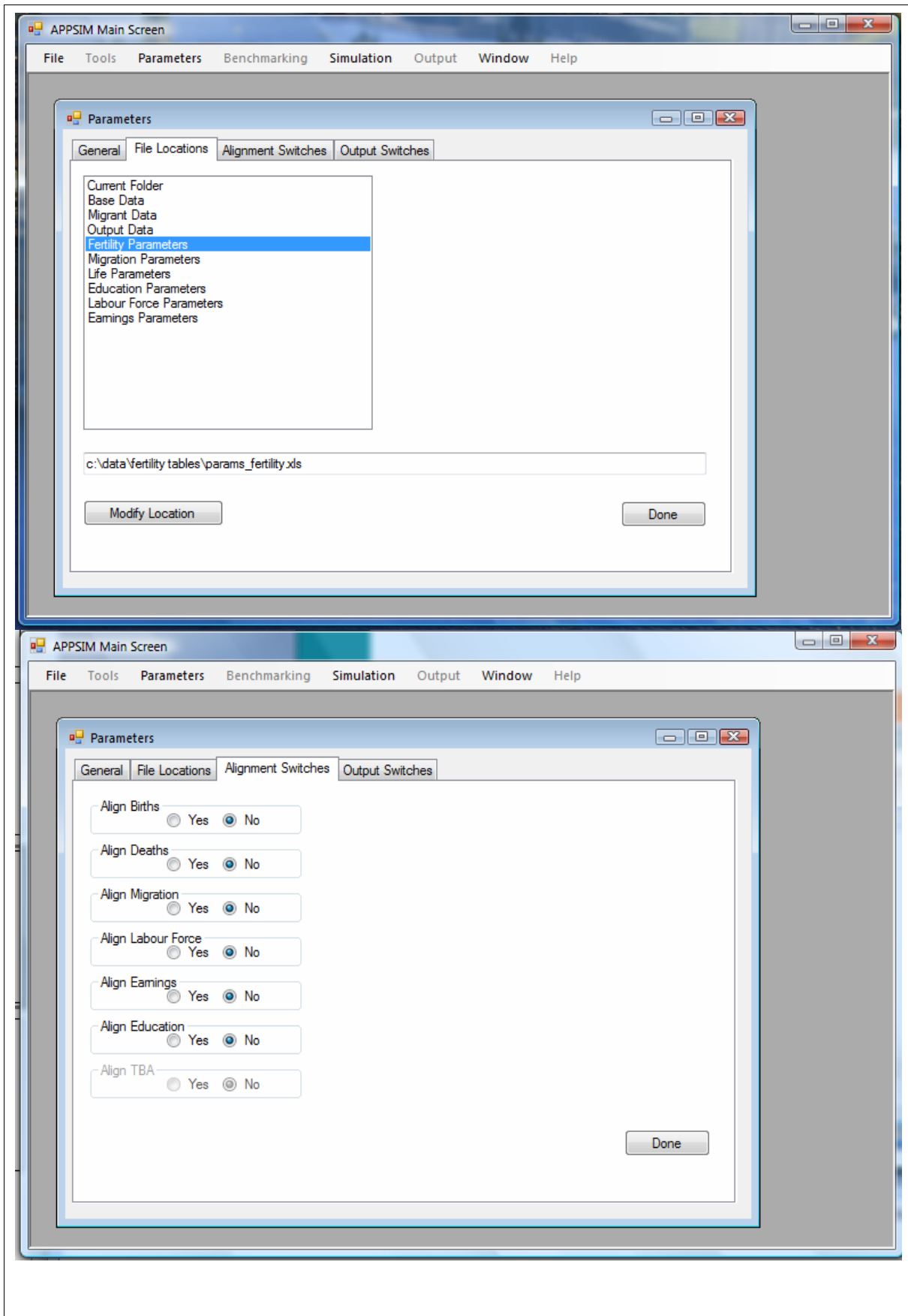
4 Policy environment

APPSIM is currently planned to be very broad in scope. Thus, for example, while some other dynamic microsimulation models have been able to ignore migration, APPSIM includes the simulation of migration because of its importance within an Australian context. This means, for example, that officials will be able to change future immigration targets and test the consequent effects upon future tax revenues and outlays. Similarly, it is planned that APPSIM will include health status and health service utilisation within its scope, as well as aged care and social security. APPSIM is being designed to answer the types of questions that other dynamic microsimulation models have tackled, such as the likely future distributional consequences of changes in social security and taxation programs and the likely future retirement incomes of the baby boomers.

One area in which the planned approach to APPSIM differs from NATSEM's earlier attempts with the DYNAMOD dynamic microsimulation model is in the emphasis to be placed on ready access by the user to model parameters and output. The ability to import and export seamlessly between Excel and C# is important in this regard, with multiple default output charts and tables being automatically generated at the conclusion of each run of the model.

At this stage the goal is to create a model that is as user-friendly as possible, so that it can be used by as many Commonwealth agencies as possible. The existing STINMOD static microsimulation modelling approach provides one possible template for the future role of APPSIM, with NATSEM maintaining the STINMOD model, which is then used by the Commonwealth as a whole (Lloyd, 2007). Such a 'shared modelling infrastructure' approach is a cost-efficient path for a small country like Australia - and also means that the endless debates about why the results from different models differ can be avoided!

Figure 2 Examples of APPSIM Interface Screens



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