Australian Housing and Urban Research Institute

Medium and long-term projections of housing needs in Australia: positioning paper

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DISCLAIMER

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Information about future housing requirements is essential for planning by industry and governments at all levels. Since the demise of the Indicative Planning Council of the Housing Industry, no organisation in Australia is responsible for the systematic production of estimates of medium- and long-term housing demand. The inclusion of a substantial Housing Futures Program in the AHURI Research Agenda is indicative of the importance attached to projections of housing needs.

Project Aims

The overall aim of the project is to provide accurate and timely projections of future housing needs to assist government and industry stakeholders in planning and policy development.

In particular, this project aims to:

1. project housing requirements at the national and State/Territory level for a period of 30 years according to a range of scenarios;
2. project housing supply and demand for a ten-year period at a national and regional level according to a range of scenarios;
3. conduct analyses of demographic, social and economic trends related to housing as inputs to the housing projection models using existing databases;
4. develop and specify appropriate projection methods to enable regular updating of the resulting projections;
5. consult widely with users about needs and the appropriateness of the projections; and
6. disseminate the findings of the project to all interested parties.

Policy Context

At present in Australia, as no organisation is producing projections of the housing market in a systematic way across the country, notions about future housing markets are just notions. It has been our recent experience that debates about population futures for Australia display an abysmally low level of understanding of the potential future paths of population. If this is true for population, how much more is it likely to be the case for housing given that population is just one of the inputs to housing futures?

Work on the projection of housing needs inevitably has a strong policy focus. As shelter is one of the three basic human needs, the provision of housing has a high priority in government policy at the national, State/Territory and local government levels. Aside from area planning, the relationship between appropriate housing and population welfare ensures that information about housing requirements is essential to the development of housing and social policy.

The housing industry is a very major employer and substantial amounts of capital are involved in the provision of housing. Housing is also vital to other developments such as urban and regional infrastructure and retailing. As a result, projections of underlying housing demand have applications beyond government. Financial institutions, land developers, the construction industry, and infrastructure and service bodies are key stakeholders who require information about future housing requirements for planning purposes.

The housing market, the supply and the demand for housing is, therefore, a fundamental component of the economy. The future of the housing market is an essential factor in private and public planning.

Methods of Projecting Households and Housing

Houses are occupied by households. Therefore, allowing for vacant dwellings, the projection of housing demand is equivalent to the projection of the number of future households. Also, different types of households have demands for different types of houses and so it is important also to project households by type. Conventional household types include couples with children, couples without children, sole parents, lone persons and group households. It is also useful to distinguish households by tenure type: owner/purchasers or renters. Over a very long period of time, the rate of growth of households has exceeded the rate of growth of the population, that is, households have been getting smaller on average. This is why projections of the population are in themselves inadequate indicators of the growth in demand for housing. However, projection of the population is necessarily the first step in the projection of households. Once a population projection is available, we must then consider the ways in which the population forms or dissolves its households. There are three basic approaches:

1. Propensity models
2. Transition probability models, or macrosimulation
3. Dynamic microsimulation

Methodological sophistication and elegance increases as the model shifts through these approaches from propensity models to dynamic microsimulation. On the other hand, the difficulty of obtaining input data and computational complexity also increases as we shift from propensity models to dynamic microsimulation. Chapter 2 of the paper reviews the use of these methodologies in other contexts and discusses the relative merits of the three methodologies for the purposes of this project.

Summary of Proposed Methodology

The approach of dynamic microsimulation has been rejected for this project because of the difficulty of obtaining the required data at a regional level and because of the computational demands of this approach. The unavailability of reliable data also makes it necessary to rule out a full, transitional probability model. Thus, this project will apply a combination of transition probabilities and propensities.

The approach taken is to apply transition probabilities to the core transitions, but to use propensities to measure flow-on effects to other people. For women, transition probabilities are used for the processes of mortality, movement into a non-private dwelling, fertility, coupling, uncoupling and leaving the parental home. For men, transition probabilities are used only for mortality, movement into a non-private dwelling and leaving the parental home. This means that the processes of fertility, coupling and uncoupling are assumed to be female-dependent. As specified in detail in Chapter 3, all other transitions, which in a sense are 'secondary' transitions consequent upon the core transitions, will be obtained using propensities. These decisions ensure internal consistency in the estimates.

An equally important part of the exercise is the estimation of transition probabilities and propensities across the years of the projection as, inevitably, the probabilities or rates pertaining to the core transitions will have to be projected. How will mortality, fertility and migration rates change in the future. How will rates of leaving home and moving into non-private dwellings change? How will rates of coupling and uncoupling change? This is the sharp end of any projection exercise. Independent of the AHURI Research Agenda, work is progressing in the Demography Program at ANU on new methods for the projection of fertility (Kippen and McDonald), mortality (Booth and Smith) and movement into non-private dwellings of aged persons (Mason). McDonald (2000b) has recently examined trends in rates of first marriage and the ABS has published trends in divorce rates. As it becomes available, this work will be incorporated into the model. Work will proceed as part of the project on ways of projecting other transition probabilities. Investigation of associations between economic and social trends and household formation behavior will form part of this work. For example, transitions from the single to the coupled state can be examined in relation to movements in mortgage rates, real housing prices, unemployment, real wages and measures of the recent balance of the supply and demand for housing. Rates of young people leaving home may be related to real rents and vacancy rates in the rental market. A range of plausible scenarios for future transition probabilities will be determined from this work, but it must be pointed out that demographic transitions are complex because of the difficulty of separating ‘tempo’ and ‘quantum’. Using marriage as an example, tempo refers to the ages at which people marry while quantum refers to the proportion who ever marry at all. A fall in the rate of marriage at, say, age 27 can be due to either a delay in marriage or to a drop in the percentage who ever marry. Which of the two applies can make a considerable difference to the projection of future marriage rates.

It is proposed that the 30-year projections and the 10-year projections should be consistent with each other: the 10-year projections being distinctive in that they relate to more geographic units and the 30-year projections being distinctive in that they involve projections of transition probabilities and propensities beyond 10 years. It would be desirable if proposed AHURI short-term projections (not part of this project) were also nested within this framework.

The proposed methodology proceeds by dividing individuals in the population across nine household classification types (HCT) defined as follows:

1. Parent in a couple family with co-resident children.
2. Parent in a one-parent family.
3. Child in a couple family with children.
4. Child in a one-parent family.
5. Partner in a couple family without children.
6. Not partnered and no coresident children, living alone.
7. Not partnered and no coresident children, living with a couple family or a one-parent family, not including children in HCT3 and HCT4
8. Not partnered and no-coresident children, living with others
9. Usual residence is a non-private dwelling

Note there is no age limitation on the status of being a ‘child’, That is, for example, a 50-year old living with his mother would be classified as HCT4 and his mother as HCT2.

Individuals with these HCT classifications can be reduced by simple procedures to the following five forms of private households:

1. Couples with coresident children (defined by HCT1 and subsuming HCT3 and part of HCT7)
2. One-parent families (defined by HCT2 and subsuming HCT4 and part of HCT7)
3. Couples with no coresident children (defined by HCT5 and subsuming the remainder of HCT7)
4. Lone persons (defined by HCT6)
5. Group households, including households consisting of related individuals so long as the relationship is not a parent–child or a partner relationship (obtained by applying a factor of average size of group households to HCT8).

The ten-year projections will make use of the 69 Temporal Statistical Divisions of Australia developed by Blake, Bell and Rees (see Section 3.1).

Chapter 1. Introduction

1.1. Introduction

This paper reports research by the Australian Housing and Urban Research Institute: Australian National University Research Centre. The research examines the future demand for and supply of housing in Australia through the development and application of new methods of projection of households and dwellings.

This Positioning Paper is the first in a number of outputs from this AHURI project. The Paper describes the policy issues to be addressed through the project, provides a review of the academic literature relating to household and dwelling projection methodologies and describes the proposed methodological approach.

Further outputs from this project will include a Work in Progress Report, a Findings Paper and a Final Report. The project will be completed by 1 July 2001.

1.2. Background

In the past, projections of future housing needs were provided by the Indicative Planning Council for the Housing Industry (IPC). The methodology used by the IPC was called into question in the early-1990s primarily because:

- the simple 'headship' method used by the IPC had become difficult to apply because of changes in census definitions. Specifically, the category, head of household, upon which the method depended, was abandoned by the Australian Bureau of Statistics;

- the approach used did not take into account the effect of economic variables on the establishment of new households. For example, rates of marriage, birth or children leaving home may be affected by prevailing economic circumstances or by longer-term economic trends such as trends in the affordability of housing, unemployment or wage rates: and
- users were interested in more detailed outputs than had been provided by the Council (King 2000).

Papers were commissioned to examine possible alternative methodologies (Bell, Cooper and Les 1995); however, no action was taken to produce new projections of housing needs. At this time, no organisation has responsibility for the important task of producing forecasts of underlying housing requirements in Australia.

Peter McDonald and Rebecca Kippen (1998), both involved with this project, were commissioned by the Victorian Department of Infrastructure to provide household projections by household type for the State of Victoria. The basic method developed by McDonald and Kippen for the Victorian projections was subsequently adopted by the Australian Bureau of Statistics to produce a new series of household projections for Australia by States and Territories. These projections were published for the first time in 1999 (ABS 1999). The Bureau did not take the additional step of providing projections of housing needs, that is, the difference between housing demand (households by type) and housing supply (the existing or projected dwelling stock by type).

The reconstruction of AHURI has provided an ideal opportunity to recreate the agenda of the Indicative Planning Council for the Housing Industry. The demand for estimates/projections of future housing needs in Australia has not disappeared. Future housing requirements are essential information for planning by industry and governments at all levels. We are now in a period of considerable demographic change. Immigration levels are changing, internal migration patterns are changing, family formation and dissolution is changing, the population is ageing and the baby-boom generation is entering the empty nest stage of life. All of these demographic changes have considerable implications for housing. For example, over the past 20 years, young people have been delaying the formation of their families. Marriage and first birth now occur at very much later ages (McDonald 2000a, 2000b). The impacts of these trends on housing demand are not well understood but it is likely that young people will be renting medium- or high-density dwellings at a higher rate than was the case in the past while delaying the purchase of a house. Greater attachment to a life style that includes renting may even lead to more permanent behavioural changes in regard to family formation and housing particularly for foot-loose, young workers in the new economy. A second major trend is the projected growth in ‘empty-nest’, couple households as the children of the large baby-boom generation leave home (ABS 1999). The housing decisions of this group potentially have profound implications for the housing market. Will they remain in their own houses, will they shift to medium density or will they sell up and retire to coastal resort locations? Finally, there is the ageing of the population and the rapid growth of households consisting of an older person living alone. Along with policies to support ‘ageing in place’, this trend also has important implications for the types of housing available (Australian Urban and Regional Development Review 1994). Production of new projections of housing needs is a very direct way of addressing the implications of these changes for housing. The inclusion of a substantial Housing Futures Program in the AHURI Research Agenda is indicative of the importance attached to projections of housing needs.

1.3. Aims of the research

The overall aim of the project is to provide accurate and timely projections of future housing needs to assist government and industry stakeholders in planning and policy development.

In particular, this project aims to:

1. project housing requirements at the national and State/Territory level for a period of 30 years according to a range of scenarios;

2. project housing supply and demand for a ten-year period at a national and regional level according to a range of scenarios;

3. conduct analyses of demographic, social and economic trends related to housing as inputs to the housing projection models using existing databases;

4. develop and specify appropriate projection methods to enable regular updating of the resulting projections;

5. consult widely with users about needs and the appropriateness of the projections; and

6. disseminate the findings of the project to all interested parties.

The output of this project will include:

- a description of the likely future environment for housing policy through the provision of medium- and long-term household projections at a national and regional level by household type. The medium-term projections relate these household projections to the supply of dwellings at a regional level, thus providing a much sharper focus to policy than is provided by household projections alone;
- an assessment of the impact of possible policy changes on the environment for housing policy through the development of alternative projection scenarios; and

- specification of projection methodologies which can be used to update projections made in this project.

The project brings together key Australian experts in the field of household and housing projections to formulate and develop a set of projection methods and techniques suited specifically to Australian needs and data sources.

A User Group of key stakeholder representatives, Commonwealth and State planning or housing officials, representatives of housing industry peak bodies and representatives of relevant non-government organisations, will be established. Users will be consulted about their needs and the appropriateness of the proposed methodology. As a key part of this project is to develop a methodology that allows projections to be made on an ongoing basis, the project is being designed with a view to extension beyond the first year of AHURI's research agenda.

1.4. National policy relevance

Work on the projection of housing needs has a strong policy focus. As shelter is one of the three basic human needs, the provision of housing has a high priority in government policy at the national, State/Territory and local government levels. Aside from area planning, the relationship between appropriate housing and population welfare (AHIW 1997:153-4) ensures that information about housing requirements is essential to the development of housing and social policy. Housing assistance for government is directed at all tenures, but particularly towards low-income people seeking public or private rental. Grants to first-home owners and the exemption of the primary residence from capital gains tax and from social security assets tests also support home owners. Negative gearing indirectly affects tenure and supply in the private rental market. The different forms of tenure have different demographic and economic profiles. Therefore there is value in estimation of the likely future demand for housing by particular household types, especially by location. For example, if there is a predicted high demand for cheap rental accommodation in an area in which there is very little public housing, there are implications for the ways in which social housing support are delivered.

For most Australians, the most important investment that they make during their lifetime is an investment in housing. Home ownership remains the societal norm although there are signs that rates of home ownership are falling for persons at younger ages. Does this reflect delay or will it constitute a permanent movement away from home ownership for these people? The answer to this question has important implications for housing in the medium term, but whatever the answer to the question, in the short-term, these people add to the numbers seeking housing in the private rental market. In addition, there are over half a million people today who are temporary residents of Australia. Many are students and working-holiday makers who are likely to be concentrated at the low end of the rental market. Others are high and middle-income earners. All of these trends increase the demand for rental accommodation overall and can mean that conventional low-income renters can face problems of affordability.

The housing industry is a very major employer and substantial amounts of capital are involved in the provision of housing. For example, the value of new residential building in Australia is around $16 billion per annum and the construction industry as a whole employs over 700,000 workers. Housing is also vital to other development such as urban and regional infrastructure and retailing. As a result, projections of underlying housing demand have applications beyond government. Financial institutions, land developers, the construction industry, and infrastructure and service bodies are key stakeholders who require information about future housing requirements for planning purposes (King 2000).

The housing market, the supply and the demand for housing, is, therefore, a fundamental component of the economy. The future of the housing market is an essential factor in private and public planning.

At present in Australia, as no organisation is producing projections of the housing market in a systematic way across the country, notions about future housing markets are just notions. It is our recent experience that debates about population futures for Australia display an abysmally low level of understanding of the potential future paths of population. If this is true for population, how much more is it likely to be the case for housing given that population is just one of the inputs to housing futures?

CHAPTER 2. Approaches to Household and Housing Projections

2.1. Methods of household projection: an assessment

There are three basic approaches to the projection of households and, for that matter, projections of other features of populations:

1. Propensity models
2. Transition probability models, or macrosimulation
3. Dynamic microsimulation

Propensity models

In propensity modelling, the population is projected forward in time by sex and age categories. Then, for each age and sex category, the chance that the person has a particular household characteristic is determined by applying an assumed proportional distribution. In the simplest case, the 'headship' approach, the approach used in the past by IPC, persons in each age and sex category are divided between those who are household heads and those who are not. This is done according to an assumed proportional distribution of the population in each age and sex group into the two categories. The proportion that are heads is otherwise known as the headship rate or the 'propensity' of heads in the population. Headship rates or propensities are assumed to change over time in a given way, usually following the time series trend set in earlier years. For example, if headship rates for a given age and sex group have been rising by 1.5 percentage points every year over the past ten years, this trend might be assumed to continue.

McDonald and Kippen (1998) used a more detailed form of propensity modelling where, instead of being divided into two categories for each age and sex group as in the headship method, the population in each age and sex group was divided into nine household classification types. Time series trends from 1986 to 1996 were then used to project these distributions or propensities forward in time. A very similar approach was later adopted by the Australian Bureau of Statistics (1999). An example of a nine-category household classification type for individuals is the following:

1. Parent in a couple family with co-resident children.
2. Parent in a one-parent family.
3. Child in a couple family with children.
4. Child in a one-parent family.
5. Partner in a couple family without children.
6. Not partnered and no coresident children, living alone.
7. Not partnered and no coresident children, living with a couple family or a one-parent family, but not a child in categories 3 and 4
8. Not partnered and no-coresident children, living with others
9. Usual residence is a non-private dwelling

This classification is the one that is recommended for use in this project; it varies slightly (in categories 7 and 8) from those used by McDonald and Kippen and by the ABS. The main difference is that the classification used here does not distinguish between related and non-related individuals if the nature of the relationship is not parent-child or spouse-partner. For example, two sisters living together would be treated in the same way as two unrelated persons living together. The reasons for this are that it is rare for two related persons to be living in the same dwelling when their relationship is not parent-child or spouse-partner. Hence, there is little demand for information on households consisting of these relationships. For most policy purposes, two sisters living together would be similar to two unrelated women of the same ages living together. It is also very difficult to measure the transitions into and out of these relationships because they are not recorded. Adoption of the proposed classification also means that the conversion of persons to households is an extremely simple process.

Once projected at the individual level, the nine categories of individuals can be 'collapsed' easily into household types. The outcome is households specified as couple households with children, couple households without children, one-parent households, sole person households and group households. This categorisation of household types is much more useful for housing planning and any other aspect of planning than simple numbers of households with no classification by type, the standard output from the headship method. The type of household obviously affects the demand for particular housing types, locations and tenure. It also has a large impact on the demand for services of various types. For example, aged care facilities and services need to be related to the number of older people in a region but also to the type of household in which they live.

Projection by household type also allows the projected trends to be evaluated for ‘reasonableness’. That is, for example, we can examine the projected trend in the proportion of men in age group 30-34 years who are sole parents and decide whether of not it looks reasonable. It would be unreasonable, for example, for this category to fall to zero even though a projected trend might lead to this result. This kind of evaluation is much more difficult if what we are assessing is changes in household headship rates which have numerous underlying, but unobserved, causes (partnering, leaving the parental home, the size of group households, deaths, births, separations and divorces, and so on). The method also allows for some simple consistency checks such as whether the implied changes in the average numbers of children per family are reasonable. It is not suggested here that ‘reasonable’ means the same as the past. Rather it means that in observing some change in the number of households consisting of a particular type (eg, male-headed sole parent families), we can consider whether the change appears to be justified. Finally, the method has the advantage that it is simple and easily explained to users.

The principal difficulty with the propensity methods is that future trends must be expressed in terms of changes in the propensities, not in terms of the transitions in people’s lives that net out to determine the observed propensities. For example, the propensity for an individual to be a partner in a couple family with children can change through each of the following transitions:

A person in a couple relationship without children may have a child
A sole parent may take a partner
A lone person or person in a group household may partner with a sole parent
The last child may leave home for a person in a couple relationship with children
A person in a couple relationship with children may die or move into a non-private dwelling
The partner of a person in a couple relationship with children may die or move into a non-private dwelling
The couple relationship may breakdown

The propensity approach would provide the net effect of all of these transitions together without indicating their separate effects. The argument is that more reliable projections might be made by explicitly estimating all of these transitions (probabilities of shifting from one classification to another within a one-year period) and applying them to the projected population by sex and age. This is what is referred to as a transition probability model.

Transition probability models, or macrosimulation

In a transition probability model, a matrix of probabilities is specified that determines the chances that an individual in category i at age x will be in category j by age x + 1. For example, there will be a probability that, in ageing from age 36 to age 37, a person who is now married with children will separate and become a lone person. Through the separation, there is another chance or probability that the person will become a sole parent. If we allow for two transitions within the same year of age, there is also a possibility that the person may repartner very soon after the separation in which case they may become a partner in a couple family with children again or a partner in a couple family without children. The transition probability model requires that we have estimates of the relative chances of any of these four outcomes occurring along with the fifth possibility that there is no change as the person ages from age 36 to age 37. A matrix of transition probabilities applied to a vector of possible states of being is known in technical demography as an increment decrement life table. Matrix algebra is used to obtain the solution. Palloni (2001) provides an excellent exposition of increment-decrement tables. Classic studies are Rogers (1975) and Schoen (1988).

The limitation of transition probability modelling is that we need to have information available on a large array of possible transitions, and the information must be specific to each age and sex category that we are using. Furthermore, in projecting the population by category, we must specify the future changes in each transition probability. In the exercise we are undertaking here, for any one year in complete form, there would be between 2,000 and 3,000 possible transition probabilities to be estimated, and each of these would have to be projected across the years of the projection. While many of the transition probabilities will be zero (no chance that a 10-year old child in ageing to 11 can become a partner in a couple family with children), the specification of the model, in pure form, remains an exceptionally daunting task. In Australia, the task is even more daunting because the data required for the estimation of most transition probabilities are collected only in relatively small scale surveys, if collected at all. Furthermore, these surveys tend to be ad hoc or irregular, hence we cannot depend upon the likelihood that new estimates will become available when we need them. In these circumstances (very shaky data), the estimated transitions may not be robust, that is, they may be subject to substantial error, in which case, the use of the transition probabilities could lead to greater errors in projection than obtained by using the simpler, but less ‘elegant’ propensity methods.

From an international perspective, the use of transition probability modelling in household projections is rare. The methodology is most advanced in Western Europe, especially in the Netherlands and Germany. Two standard models are in existence, LIPRO developed in the Netherlands and PROFAMY developed in Germany. These models have a similar core methodology (increment-decrement life tables), but they differ in the range of transitions that are included and the level of flexibility available to change the transition matrices over time.

While these models are elegant from a theoretical perspective, they have faced major limitations in their application. None has ever succeeded in adequately implementing a projection of the type specified in this project. LIPRO has been described and evaluated for use in Australia by Bell, Cooper and Les (1995). Their conclusion was that LIPRO was not suitable for use ‘as is’ in Australia, but that some of its aspects might be incorporated in a specific Australian model. Rebecca Kippen has taken a course on PROFAMY in Germany. She reports that the package is still in a development phase and therefore is inappropriate for usage in this project. There are other, more ad hoc examples of transition probability approaches being used to model segments of the household projection matrix. A recent review of these methods, with a proposed approach applicable to China, is provided in Zeng, Vaupel and Wang (1997). Upon consideration of their review, we are of the opinion that the conclusion of Bell, Cooper and Les still applies, that is, the projections required for this project could not be obtained through the use of an existing European software package. Nevertheless, there are powerful arguments that an attempt should be made in this project to use transition probabilities when this is feasible.

Dynamic microsimulation

The third potential approach to projections of households and housing is dynamic microsimulation. Again, some models exist at present in Western Europe such as SONAR (Hooimeijer and Heida 1995) and LocSim (Hooimeijer and Oscamp 1999) and FAMSIM (Lutz ed. 1997). Both the latter two publications contain useful descriptions of dynamic microsimulation. In Australia, NATSEM has made use of a dynamic microsimulation model, DYNAMOD, for example, in the modelling of the Higher Education Contribution Scheme.

The essential feature of dynamic microsimulation is that the base units are individual persons similar to what we call unit records in survey analysis. That is, the simulation begins with a population of individuals who are representative of the population being studied and for whom we have information available on all of the characteristics that we wish to use in the projection. This population may be drawn from a sample survey or from a sample of the census. In Australia, most surveys either do not provide all the required information about the survey respondents or are too small to adequately represent the population at the level of disaggregation that is required. As mentioned above, social surveys in Australia tend to be ad hoc in nature with the content varying across time and with no planned schedule of surveys. Some ABS Surveys are regular and contain standard sets of information (such as the Labour Force Surveys and the Income and Housing Surveys) but these do not provide us with the geographic breakdown necessary to implement the household projections required in this project. An adequate sample could theoretically be generated from the Census of Population, but the sample required would breach ABS rules on confidentiality, that is, the ABS would simply not provide the required sample. The new longitudinal panel survey, HILDA, commissioned by the Commonwealth Department of Family and Community Services, has potential for use as a base population for dynamic microsimulation. In a sense, as a panel survey followed across time, it is a dynamic microsimulation, but again, the necessary geographic detail would not be available. To overcome the absence of geographic detail, it may be possible to estimate or simulate the required information, but the results may prove to be excessively hypothetical.

Once an initial population is available for a microsimulation, the projection proceeds by asking yes-no questions in respect of each individual as that individual ages by one year. For example, the question is asked in regard to a single woman aged 25, will she marry in the coming year? The chance that the answer is ‘yes’ is generated by random numbers based on the transition probabilities already described for macrosimulation. If the answer is ‘yes’, then this woman is ‘married off’ by the process and is not asked the same question in the next year. If the answer generated by the random numbers is ‘no’, then the woman concerned is subjected to the same question in the following year. Of course, if the answer is ‘yes’ for this woman, then the answer must be ‘yes’ somewhere for some man. The fact that a transition generated in the microsimulation requires others in the population to behave in a consistent manner (inter-individual dependency) provides a severe complication for dynamic microsimulation modelling. Conventionally, modellers have adopted a ‘female-dominant’ approach to solve the two-sex marriage problem. That is, we marry off the woman on the basis of probabilities of marriage for single women and then find an appropriate male spouse in the population by means of a table of the relative ages of brides and grooms. If a woman aged 25 marries, we can select a spouse from a probability distribution of the age of the man that she is likely to marry. The model developed by Zeng, Vaupel and Wang (1997) has aspects of simultaneous two-sex modelling. There are other individual interdependencies besides partnering. There is unpartnering, there are births that must be allocated to both a mother and a father, there are children leaving home that must be allocated to both a father and a mother (if the child is living in a couple family). Taking account of these interdependencies is computationally demanding, and, in general, a limitation of dynamic microsimulation is that it is computationally demanding, even for high-speed modern machines.

Besides the initial population of individuals, the principal input to dynamic simulation is the matrix of transition probabilities that is required for macrosimulation. Thus, dynamic microsimulation is subject to the same data constraints in this regard as macrosimulation. If you do not have an estimate of the chance that a man aged 18 will leave the parental home in the next year, then you cannot model this process using either method.

Unlike a macrosimulation, a microsimulation ran twice will produce two different results because it is a stochastic process. That is, the use of a transition probability as a base for random number generation does not necessarily produce the same number of events as the probability does when applied to a grouped population. If the chance that a woman aged 25 will marry in the next year is 0.15, a macrosimulation will produce 15 marriages per 100 women, but a microsimulation ran once may produce some other number despite the fact that the statistically expected number would be 15 marriages per 100 women. That is, for example, there will be some chance that the result will be 14 marriages per 100 women. The analogy is one of tossing a coin. If we toss a coin ten times, we expect to get five heads and five tails, but random chance means that often we do not get this result. The microsimulation provides the random chance result; the macro-simulation imposes the five heads and five tails result. It is sometimes argued that random chance variation is a desirable feature of microsimulation because it reflects the variability that in fact exists in the population. Indeed, it is argued that the microsimulation can be run a large number of times (known as the Monte Carlo approach - several rounds of coin tossing) and that the resulting variation provides a good measure of the likely degree of variation in the projections (given no change in the underlying behaviour). Of course, the Monte Carlo approach is as many times computationally demanding as the microsimulation is run and, for this reason, modellers usually do not use the Monte Carlo approach.

An advantage of microsimulation in projections of housing demand and supply is that the housing decision can become one of the transition decisions: will this person move house this year and to what type of house? Thus, people can be matched to houses as described by Hooimeijer and Heida (1995) and Hooimeijer and Oscamp (1999). Of course, again we would need data upon which to base this decision probability and data such as this are almost unknown in Australia, the nearest possibilities being the 1986 ANU Family Survey (limited by being only a survey of women of aged 20-49) and the 1997 Life Course Survey conducted by the Australian Institute of Family Studies (limited by a small sample size).

Given that microsimulation is highly demanding of data and computing, what are its major advantages? Its major advantage is in its output. Because events are attached to individuals at particular points in time, we are able to examine relationships between events (when do people buy houses in comparison to other life cycle events?) and we are able to describe people's life histories in a complex way.

The conclusion to be drawn is that, while microsimulation is indeed theoretically elegant, it cannot readily be used in this project primarily because of the data and computing demands. Essentially, we cannot easily obtain an initial population of individuals that would be adequate for the aims of this project.

2.2. Matching of households and houses

The issue of matching households to houses just considered in the discussion of microsimulation must be addressed in this project. This is essentially virgin territory for work of this type that usually stops with the projection of housing demand (households). The only major exception to this rule is the work of Hooimeijer and colleagues in the Netherlands, but even in this work, application has been restricted to one or a very small number of geographic units. In the regional component of this projection, we aim to project housing supply (dwellings) as well as housing demand and to reconcile the two. The essential issue here is: does the supply of dwellings (and their cost) affect decisions made by people about life course transitions? That is, for example, if houses are in short supply and/or are costly in some way (rents, deposits, interest rates), will this have an impact on whether people partner or have children? Or, is the direction of causation the reverse, that is, do people make their household formation decisions largely independent of the housing market and then their decisions influence the market? Some empirical research of the relationship between the growth of households and the availability and costs of dwellings would seem to be desirable.

On another dimension, if we project 10 per cent more households than there are dwellings in a region, what happens? Do people leave the region? Are dwellings built? Indeed, will our household projections influence the construction of dwellings? There is a sense that these are negotiated outcomes rather than outcomes that can be predicted by a statistical model. That is, the reconciliation of supply with demand at a regional level is probably a process best undertaken by consultation with government and industry experts with local knowledge.

The matching of households to dwellings also implies a matching of household types and desired tenure to dwelling type and available tenure. For example, if there are lots of two bedroom apartments available for rental but the excess demand is from families with children who are purchasers, then there is a mismatch. Here, there is likely to be a degree of looseness or tolerance in the model because households may be somewhat flexible about the dwelling type in which they live – as her children leave home and her husband dies, a woman is very likely to remain in the same house. The tenure of a dwelling can also be changed fairly readily. Dwelling type and tenure preferences of different household types might be used to carry out initial matches of supply and demand, but, as described above, reconciliation requires appropriate consultation with persons with appropriate local knowledge.

2.3. Heterogeneity

Projections in Australia conventionally suppress aspects of heterogeneity of the population. For example, official ABS State and Territory population projections are not conducted independently of each other but are forced to sum to a previously determined national level projection. There is an argument that a projection made independently for a sub-population may be more accurate because it gives full freedom to the operation of the particular characteristics of the sub-population. Consistent with this would be an argument that the population of Australia is best projected by adding up independent projections at the State and Territory level (of course, insisting that interstate migration estimates are consistent across States and Territories). The argument would be, for example, that projections of fertility rates at an individual State and Territory level when aggregated provide a better estimate of the national fertility rate than a direct projection of fertility at the national level. The disaggregated projections provide for State and Territory heterogeneity in fertility rates to be taken into consideration. The illustration of disaggregation used here is the State and territory level, but other disaggregations are possible, either geographic or social.

The impact of social heterogeneity in the population can be illustrated by an example relating to the projection of births. If we are aware that age specific birth rates vary by the educational level of women and that the educational composition of the population is changing over time, it would seem to be more sensible to include education as a specific variable when births are projected. That is, we would project both the rates of birth by education level and the changing education level of the population. Total future births would then be obtained by summing the numbers of births projected for women of different education levels. If this approach were to be followed, then our projection of births would have taken account of the educational level heterogeneity of the population. In conversation, Hooimeijer has suggested that, in the Netherlands, educational heterogeneity is by far the most important type of heterogeneity in relation to household formation behaviour. The methodology for the medium-term regional projections proposed below involves classification of the Australian population into a very large number of cells. Because of this large number, further classification of each cell by educational level is impractical, however, the use of education in the long-term projections needs to be evaluated.

In the medium-term projections to be conducted in this project, a considerable amount of heterogeneity in the population will be taken into account through the use of data specific to a large number of geographic regions. Regional heterogeneity of family formation behaviour is considerable in Australia (in relation to fertility rates, see ABS 2000a: 62-66 and Department of Infrastructure 2000). As far as possible, this heterogeneity will be taken into account by the projection methodology by at least using local level fertility rates as input to the model.

2.4. Conclusion

There is no agreement at present on the best methodology to be used to make projections of housing needs in Australia. The principal parameters in the choice of method are the needs of users and the availability of data. There are model methodologies used in other countries but they are often specific to the needs of users in those countries and to the data environment of those countries. For example, some methods require the use of population registers, that is, a continually updated listing by name and various characteristics of all members of the population. Without population registers, the main source of data in Australia is the five-yearly Censuses of Population and Housing, although a range of valuable information is also available from ABS surveys and other sources.

In this circumstance, the approach taken here is to bring together the main Australian experts in this field into a single group to formulate and develop a set of methods and techniques suited specifically to Australian needs and resources. In addition, a User Group of key stakeholder representatives will be established to assess the needs of users. The User Group should consist of Commonwealth and State planning or housing officials, representatives of housing industry peak bodies and representatives of non-government organisations concerned with shelter.

As far as possible, the model adopted for this project should make the processes of family and household change as explicit as possible and thus move beyond current static propensity models. Furthermore, it is desirable that the model employed for the medium-term projections is consistent with that used for the long-term projections so that both have similar trajectories. It would be desirable also that the medium-term projection methodology is consistent with the methodology used for AHURI short-term projections (not part of the current project).

The overall conclusion to be drawn from the review of methodologies is that the model to be used in this project should be a combination of transition probability modelling and propensity modelling depending upon data availability. Pragmatism, whatever will get the job done in the best possible way, is a significant consideration.

Various scenarios in relation to possible demographic, social and economic trends will be provided. Estimates will be by household type and housing type. The construction of the model will be backed by analyses of existing databases. These studies will examine demographic, social and economic trends and their likely impacts on housing. This work will commence immediately and continue as the technical aspects of the projection methodology are developed. A series of short working papers will flow from this work.

Chapter 3. Proposed Methodology

In the light of the discussion of potential methodologies in the previous chapter, this chapter describes in detail the methods proposed for usage in this project. First, the regions to be used in the ten-year regional projections are defined. Second, the classification of individuals and households to be used is described and justified. The third section deals with the matching of households with dwellings. The section describes how this can be done through the identification of a household reference person. The fourth section provides a detailed, step by step description of the methods to be used given a set of future transition probabilities and propensities. After a summary in the fifth section, the sixth section describes the process of estimating future transition probabilities and propensities. The final section in the chapter deals with consistency between the medium-term and the long-term projections.

3.1. Specification of regions

Ideally, the regions for which projections are made should be housing market regions. That is, they should be regions that, as far as possible, circumscribe the localities in which people who live in the region will seek housing when they want to change their housing. This limits the amount of inter-regional migration for purely housing market purposes. Inter-regional migration will then be driven by other considerations such as education or employment. Ideally, also, the regions will be relationship (marriage) market regions in that the two partners to the new relationship will both live in the region.

There has been no comprehensive study in Australia that attempts to identify the nation’s housing markets. However, in the early 1990s, the Commonwealth Department of Employment, Education and Training (1993) identified ‘natural labour markets’ in Australia in a comprehensive fashion. These are useful to the extent that labour markets and housing markets overlap, a proposition that must be true to some extent as most people in Australia live within about a 30 minute drive of their place of work:

> Individuals usually work or look for work in the geographic area within commuting distance, and moving residence is not an acceptable option for the vast majority of workers (DEET 1993: 3).

This description prioritises place of residence over place of employment. This is not necessarily the case. People seeking a new residence may already be employed. For such people, the logic would be reversed, that is, they would seek a residence that was within easy commuting distance of their place of employment. Irrespective of the causal direction, the association of housing markets with labour markets is clearly an important consideration. DEET (1993) identified 216 natural labour markets (NLMs) in Australia defined as agglomerations of local government areas (LGAs). One option for this project would be to simply adopt these 216 regions as the housing markets for the study. A problem with this approach, however, is that LGA boundaries are not constant and if the 1996 Census is to be used to provide base data for the study, some LGA boundaries, particularly in Victoria, changed between the definition of the DEET labour markets and the 1996 Census. Also, many of the 216 NLMs are small in population terms. The smaller the population, the more likely it is that reality will differ from projection because of random variation. Thus, population size and constancy of geographic boundaries are considerations in the selection of regional areas to be used in the projections.

The DEET study also considered that the metropolitan cities each constituted a single labour market. McDonald and Moyle (1996), in an analysis of ‘household reference zones’ in Sydney and Melbourne, have criticised this approach. Based on place of employment and the locations of the present and most recent housing of people in selected LGAs in Sydney and Melbourne, they identified very distinctive reference zones within these two cities. McDonald and Moyle argue that, in making a choice about new housing, households first make a choice about location on the basis of criteria such as employment, schools, familiarity and proximity to family and friends, Having made the choice about locality, the housing choice is based upon dwelling preferences and affordability. No study of housing choices in Australia has applied this framework.

Housing market regions have not been established in Australia and there is insufficient time or resources available in the first year of this AHURI project to undertake an assessment of what constitute housing market regions. In Australia, data sources by region are based on regions designed for other purposes. Thus pragmatic considerations necessarily enter the process of selection of regions. Nevertheless, the notion of the selected regions as being housing market regions needs to be maintained as far as possible and comparison of the selected regions with the DEET natural labour markets is desirable.

At this stage of the modelling, the selection of regions will be driven largely by data availability. Different types of data are available at different geographic levels in Australia, although the unit most commonly used in statistical collections is the SLA (Statistical Local Area). These correspond essentially to Local Government Areas although in Brisbane and Canberra, they consist of smaller units (suburbs). At the 1996 Census, Australia was divided into 1,330 SLAs. In combination, they comprised 59 Statistical Divisions (SDs), another possible regional unit. As already mentioned, a difficulty with both SLAs and SDs is that their boundaries change from census to census thus complicating the use of time series data obtained from censuses and other sources. Also, in regard to capital city SDs, the regions defined are too large for the purposes of this project, that is, they are very much larger than a single housing market. To address this difficulty, Blake, Bell and Rees (2000) have constructed what they call Temporal Statistical Divisions (TSDs). These are ‘temporally consistent regions based around a combination of SDs and the concentric zones identified by planning agencies in the five mainland State capitals’ (Blake, Bell and Rees 2000: 166). TSDs can be obtained almost exactly (a one per cent population tolerance error was allowed) from combinations of SLAs at the time of each census. These regions have several advantages: data across time refer to the same geographic areas and the regions make use of units that are commonly employed for planning purposes (SLAs, SDs and the concentric zones around cities). The detailed specification of TSDs is given in Blake, Bell and Rees (2000) and is not repeated here. A total of 69 TSDs was identified. The look-up tables specifying the SLAs that comprise each of the 69 TSDs are available from the National Key Centre for Social Applications of GIS at the University of Adelaide, www.gisca.adelaide.edu.au/kra/pd/

Some TSDs are too small for the purposes of this project; the smallest TSD has a population in 1996 of just 12,000 people. When divided across two sexes, nine household classification types (see below) and 100 age groups (single years of age), this would leave an average of just seven people per cell – at which level, we could know them all personally. Thus, some amalgamation of small TSDs will be undertaken as part of the projections in the first year of the project. On the other hand, some TSDs, particularly the outer regions of some cities are either too large or extend beyond a reasonable concept of a housing market. Division of these outer regions will be investigated at an early stage. The constraint may prove to be the specification of consistent boundaries across time. If this task proves too complex in the short-term, TSDs will be adopted for this project with further investigation being undertaken in a second year project.

3.2. Household Classifications of Individuals and Households

Little is know in Australia about the types of dwellings and the tenure status of different household types. This project will provide comprehensive information on this topic for the first time. Nevertheless, it is apparent that there are differences across the five household types that will be used in the study. For example, sole parents, younger lone persons and group households are much more likely to rent and to live in apartments than couples with children, older couples without children and older lone persons (Mudd et al. 1999; Yates 1999). Classification of households into five types is a considerable advance on no classification as used in the former IPC projections. Classification enhances the accuracy of the projections by disaggregating the forces of change and at the same time it enhances the usefulness of the data for policy purposes. It was this recognition following the projections that were made for Victoria based on the McDonald-Kippen propensity method that led to the development of similar projections by the Australian Bureau of Statistics. It is apparent that projections of households that do not incorporate household type are no longer acceptable to the policy process.

To facilitate the projection of households into households types, mirroring the McDonald-Kippen approach, individuals in the population will be divided across nine household classification types (HCT) defined as follows:

1. Parent in a couple family with coresident children.
2. Parent in a one-parent family.
3. Child in a couple family with children.
4. Child in a one-parent family.
5. Partner in a couple family without children.
6. Not partnered and no coresident children, living alone.
7. Not partnered and no coresident children, living with a couple family or a one-parent family, not including children in HCT3 and HCT4
8. Not partnered and no coresident children, living with others
9. Usual residence is a non-private dwelling

Note that there is no age limitation on the status of being a ‘child’. A child may be a 50 year old living with a 75 year old parent.

These categories are almost precisely the same as those used by Kippen and McDonald (1998) in their projections of households in Victoria and, following McDonald and Kippen, by the Australian Bureau of Statistics (1999) in their household projections. This classification has the very considerable advantage that it provides estimates of households that have direct meaning in housing markets and in other areas of planning. Matching of housing demand to housing supply is likely to be much more accurate if we know both the household type and the age of a reference person. Another advantage is that individuals with these classifications can be reduced by trivially simple procedures to the following five forms of private households:

1. Couples with coresident children (defined by HCT1 and subsuming HCT3 and part of HCT7)
2. One-parent families (defined by HCT2 and subsuming HCT4 and part of HCT7)
3. Couples with no coresident children (defined by HCT5 and subsuming the remainder of HCT7)
4. Lone persons (defined by HCT6)
5. Group households, including households consisting of related individuals so long as the relationship is not a parent–child or a partner relationship (obtained by applying a factor of average size of group households to HCT8).

Thus, only one minor calculation is required to convert the HCT classification to households, the conversion of people living in group households to the number of group households. The conversion factor is available at a regional level from the 1996 Census and can probably be assumed to remain constant across time, although trend data are also available to assess this assumption. This conversion of individuals to households is even simpler than the approaches used by McDonald and Kippen and by the ABS. However, there remains one minor problem. A small correction is required to deal with the situation of multiple family households. In this context, a multiple family household is defined as a household in which there are two or more couple families, or a couple family and a one-parent family, or two or more one parent families living in the same dwelling. Following the ABS Census approach, a household corresponds to a dwelling. As multiple family households may vary in frequency across regions, region-specific corrections are probably required.

Individuals living as usual residents of a non-private dwelling would not be collapsed into a household type. Together, they would constitute the demand for non-private dwelling accommodation in each region.

The base population for the projections therefore would be the population by sex, single years of age and HCT in each region at the time of the 1996 Census. Initial imbalances in the number of coupled males and females at the time of the Census would be adjusted, probably using a female-dominant model. That is, the number of couples would be taken to be the same as the number of coupled women.

3.3. Reference Persons

In order to match households by type to dwellings by type (see below), a household reference person will be defined for each household. The reference person would be the woman in a couple relationship, the lone parent in a lone-parent family and the lone person in lone person households. It may not be necessary to specify a reference person in a group household. For these households, the more pertinent information is probably the number of members of the group household.

3.4. Steps in the Projection Process

The following provides a step-by-step description of the proposed projection methodology. There is no doubt that modifications will be made to this design as the work proceeds, but the modifications are likely to be minor.

For each region.

Base data

1. Obtain the population by sex, single years of age and household classification type (HCT). The source of data is the 1996 Census. Projections are made on an annual basis from 1996 to 2011, thus single-year of age input data are required. The age categories to be used will be 0-99 in single years and 100+. The standard age cutoff of 85+ is inadequate given the growth of population above 85 years of age and the importance of housing for these people.

Mortality

2. Survive the population by age and sex for one year using a life table appropriate to the region but, generally, not specific to HCT. For older age males, as indicated by empirical study of mortality rates by marital status, it may be necessary to use lower mortality rates for those who are partnered. Use a national level assumption about the trend in mortality rates across time.

3. Deaths have flow-on effects to other HCT. A death of a partnered person creates an unpartnered person. Tables of relative ages of partners would be used to determine the ages of the newly unpartnered people. These tables may have to be obtained from the 1996 Census. These propensities would be presumed to remain constant over time and not vary across regions. The chance of becoming unpartnered through death of partner would be assumed to be the same at each age for those with and without coresident children. This assumption is necessary to change the household classification of coresident children whose parent dies. For a child, the death of a parent leads to a shift into a lone parent family if the child is in a two-parent family prior to the death. A table of the relative ages of mothers/fathers and children can be used to allocate the death of a parent to a child of a given age. Again, tables from the 1996 Census could be used for this purpose. There will be regional variation involved here and this will be considered if possible. If the child is in a lone parent family, the process is complex. Here, the essential feature is whether the child is an adult (aged 18+) or a child aged less than 18. This is a very complex process involving a very small number of people. An ad hoc approach is implied (random allocation). The death of a person in a group household leads either to a lone person household or to a smaller group household. It also opens a 'vacancy' in a group household. Again, the numbers involved will be very small and some simple estimation process can be employed. This would make use of a distribution of group households by numbers of members. Note a death of a person in a lone person household implies a dwelling becomes vacant.

Fertility

4. Estimate the annual number of births to this population and survive the births to the end of the year (population aged less than 1). Use age specific birth rates appropriate to the region. The trend over time in the age specific birth rates needs to be determined in some way.

5. Use of age specific birth rates allocates the births to women at each age. A propensity can then be used to allocate births within age of mother to HCT (two-parent or one-parent). Apply age and HCT-specific propensities of whether the birth is a first birth or a later birth. Alternatively, use could be made of parity specific fertility rates recently calculated by Kippen (Kippen 2001). A first birth in this context means a birth to a woman who has no coresident children. This propensity may have some element of regional specificity, but broad regional estimates may be sufficient. Data for these

propensities could be obtained from the census (a table showing children under one year of age by age of mother and number of children in the family, for broad regional types). These propensities could be assumed to be constant across time. The children born are allocated to the consequent HCT.

6. Allocate first and later births to men on the basis of a table of the relative ages of fathers and mothers. This can probably be a single table across all regions and be assumed to be constant across time. First births for women will be equivalent to first births for men. Ditto for later births. No births are allocated to uncoupled men.

Couple transitions

7. Apply 'age and sex specific couple transitions' to the HCT categories. These are transitions from being coupled at the beginning of the year to being uncoupled, and vice versa. These transitions will vary by region, so some level of regional specificity is desirable. These transitions may also need to be changed over time. In making the couple transitions, do we take specific account of those who become parents for the first time during the year? Data are sparse in this area especially for non-marital partnering so there is a substantial data creation exercise involved here. Ratios of the proportion partnered at age x + 1 to the proportion partnered at age x for each age, sex and region can be obtained from the base data set and would be a useful starting point for the measurement of couple transitions (considering also the impact of migration on this ratio). Alternatively, it may be more accurate to use changes in proportions partnered at age x across two censuses and interpolate for intervening years. The interpolations then provide changes from age x to age x+1 the following year. This method was used by Kippen (2001) in obtaining parity specific birth rates for Australia. There may also be sense in separating marriages and consensual unions as good data are available for propensities to marry and divorce, at least at the national level. As with birth rates, there are more data available for women and, for this and reasons of simplicity, we propose to use a female-dominant approach. That is, we obtain transitions for women and then attach (or detach) male partners with a table of relative ages of partners at couple formation or dissolution. Census tables of relative ages of partners may be useful in this regard, although there is some evidence that divorce rates are somewhat related to the age difference of the spouses. Relative age tables, at a national level, could also be obtained from the marriages and divorces registration data.

8. Where the decouplings are of couples with children, a propensity needs to be applied to determine whether the children stay with the male partner or the female partner. This propensity can be assumed not to vary by region or across time. For the partner not accompanied by children at the decoupling, a propensity must be used to divide these people across the possible HCT categories. Some data on household type of people following marriage

breakdown are available from surveys conducted by the Australian Institute of Family Studies.

9. The coupling or uncoupling of parents also changes the HCT of the children. Here we would need propensities by age of child when relationships of parents (including step-parents) are formed or dissolved. Since the ABS ceased publishing data on the ages of children whose parents have divorced, data are sparse on this topic. A special table may need to be purchased from ABS.

Children leaving home

10. Apply children leaving home transitions. These are probabilities that a child at home at age x leaves by age x +1. Unless good data are available, these would be assumed to be the same across the two relevant HCT categories. As children both leave and return home, these may have to be 'net' transitions in a year. They are highly likely to vary according to region but data at a regional level will be difficult to obtain. Assumptions will need to be made about the changes in these transitions across time. The children leaving home then have to be allocated to HCT categories. Again data tend to be sparse in this regard. The initial database (step 1) may be able to be used to generate these transitions. That is, at the 1996 Census, the ratio of the proportion of children aged x +1 still at home to the proportion aged x still at home provides an indication of the proportion who remain at home while ageing from x to x + !. This ratio can be calculated for each year successively as the projection develops. Alternatively, it may be more accurate to use changes in proportions at home at age x across two censuses and interpolate for intervening years. The interpolations then provide changes from age x to age x+1 in the following year.

11. Use a propensity to divide children leaving home into the last child to leave (that is, a couple family without children or a sole person HCT is created when they leave) and those who are not the last child. Those who are last to leave then need to be allocated to women by age and HCT category. Where the woman is partnered, relative ages of partners tables would be used to allocate last children leaving home to men. This raises the issue about whether HCT types with coresident children should be sub-divided by the number of children in the household. Such a sub-classification would involve a considerable increase in calculations but would facilitate the estimation of the last child leaving home.

Transitions to non-private dwellings

12. Apply sex, age and HCT specific transitions from private dwellings to non-private dwellings. These may vary by region and across time. What are the data sources on these transitions? For age and sex categories, the ratio of the proportion in non-private dwellings at age x + 1 compared to the same ratio at age x can be useful as is the comparison across time at age x with interpolation. This is available from our base data but there would be an

implied assumption that the residential care facility to which the person moves is in the same region as the dwelling from which they move. We shall also require transitions that are specific to HCT because the availability of care from a spouse or another coresident person is likely to delay the move to a non-private dwelling. The shift of a person to a non-private dwelling has a flow-on HCT effect to other members of the household that the person has left. If the person is a lone person, then the dwelling becomes vacant. Once the HCT of those moving into non-private dwellings is known, propensities would be used to measure the flow-on effects to other individuals. This, of course, is mainly an issue relating to aged persons. We hope to work cooperatively in this work with the Aged Care Unit of the Australian Institute of Health and Welfare. The Institute's, Frieda Mason, is presently undertaking an ANU Demography PhD degree, her topic being the projection of the need for aged care services in Australia, especially home-based care versus care in residential care services.

Migration

13. To this point in the process, we have projected the population present in the region at the beginning of the period by age, sex and HCT. The next step is to estimate in-migrants and out-migrants to the region by age, sex and HCT. We have regional age and sex specific numbers for the year 1995-1996 (the year prior to 1996 Census) and we have total numbers at earlier censuses. Thus we could use a time trend for totals and apply the age-sex distribution of 1995-1996. Unfortunately, inter-regional migration in Australia is very volatile and even relatively short-term projections are hazardous. Also, migration is very likely to be selective of HCT categories or of those making transitions during the year. Indeed, many migrations are directly associated with changes in HCT (marriage, divorce, children leaving home). Thus, it seems that it will be necessary to get some information on the linkage between migration and HCT. In addition, migration will be associated more closely than other forms of behaviour with the change in the dwelling stock in the region. Thus, we need to obtain planning data on how governments see particular regions in the future (Will there be greenfields development or redevelopment of existing sites?). In the end, migration may best be handled as part of the reconciliation of supply and demand (see points 15 and 16).

Estimation of households

14. Collapse the population at time t + 1 into households as described above. The sex and age of the reference person would be tagged to the household type. Check the results for inconsistencies.

Match households and houses

15. Compare the projected housing demand at time t +1 with the housing supply projected from time t. This would be done according to dwelling type and characteristics of the reference person. There is a question of what dwelling types we wish to use (structure, numbers of bedrooms and tenure types are probably adequate). In this regard, we need a table from the 1996 Census

that shows dwelling type by household type by age and sex of the reference person for all regions. This table will provide important information on the types of houses occupied by different household types.

16. Differences between demand and supply must be rationalised by creation of new dwellings net of demolitions, occupation of vacant dwellings including those that have become vacant because the last resident of the dwelling has died or left, changes in tenure or by movement (of households) out of the region to other regions. The implications of increments to the vacancy rate may also need to be considered. There is also the possibility of a feedback loop – that shortages or excesses of dwellings lead to modifications to the transitions used in the projections. How this is done needs to be considered specifically for each region and in consultation with State and Territory Planning offices. In projecting from 1996 to 2001, actual data on changes in the dwelling stock can be used.

17. There will also be an assessment at the end of the results aggregated across regions. That is, do the projections look reasonable at the national level and at the State and Territory level?

3.5. Summary of the Methodology

The approach taken in the methodology described above is to apply transition probabilities to the core transitions, but to use propensities to measure flow-on effects to other people. For women, transition probabilities are used for the processes of mortality, movement into a non-private dwelling, fertility, coupling, uncoupling and leaving the parental home. For men, transition probabilities are used only for mortality, movement into a non-private dwelling and leaving the parental home. This means that the processes of fertility, coupling and uncoupling are assumed to be female-dependent. All other transitions, which in a sense are 'secondary' transitions consequent upon the core transitions, will be obtained using propensities. These decisions ensure internal consistency in the estimates.

3.6. Projection of Transition Probabilities and Propensities

The methodology described above shows the mechanics of how the model will move from one year to the next given the transition probabilities and propensities for each year. An equally important part of the exercise is the estimation of transition probabilities and propensities across the years of the projection. Comments on the need for change across time are made above for each process, but, inevitably, the probabilities or rates pertaining to the core transitions will have to be projected. How will mortality, fertility and migration rates change in the future. How will rates of leaving home and moving into non-private dwellings change? How will rates of coupling and uncoupling change? This is the sharp end of any projection exercise. Independent of the AHURI Research Agenda, work is progressing in the Demography Program at ANU on new methods for the projection of fertility (Kippen and McDonald), mortality (Booth and Smith) and movement into non-private dwellings of aged persons (Mason). McDonald (2000b) has recently examined trends in rates of first marriage and the ABS (2000b) has published trends in divorce rates. As it becomes available, this work will be incorporated into the model. Work will proceed as part of the project on ways of projecting other transition probabilities. Investigation of associations between economic and social trends and household formation behavior will form part of this work. For example, transitions from the single to the coupled state can be examined in relation to movements in mortgage rates, real housing prices, unemployment, real wages and measures of the recent balance of the supply and demand for housing. Rates of young people leaving home may be related to real rents and vacancy rates in the rental market. A range of plausible scenarios for future transition probabilities will be determined from this work, but it must be pointed out that demographic transitions are complex because of the difficulty of separating ‘tempo’ and ‘quantum’. Using marriage as an example, tempo refers to the ages at which people marry while quantum refers to the proportion who ever marry at all. A fall in the rate of marriage at, say, age 27 can be due to either a delay in marriage or to a drop in the percentage who ever marry. Which of the two applies can make a considerable difference to the projection of future marriage rates.

Some internal migration flows in Australia are subject to sharp fluctuations in relatively short time frames. For example, net internal migration to Sydney was

–15,400 in 1987, -52,600 in 1990 and –11,600 in 1999. For the same years, Melbourne's net internal migration was –15,000, -14.500 and 4,200 (ABS 2000c). These movements are extremely difficult to predict. There has been some analysis to suggest that, in the case of Sydney, there is an inverse relationship between net international migration to Sydney and net internal migration. While there is a surface plausibility to this relationship in the 1970s and 1980s, the association largely disappears in the 1990s. Inevitably, prediction of internal population movements will be a weak part of the model emphasising the need for annual revisions of the data input to the model.

3.7. Consistency of the medium and long-term projections

Only one methodological approach has been described above. This implies that this approach is to be applied to both the medium-term and the long-term projections. Thus, it is proposed that the 30-year projections and the 10-year projections should be consistent with each other, the 10-year projections being distinctive only in that they relate to more geographic units and the 30-year projections being distinctive in that they involve projections of transition probabilities and propensities beyond 10 years. It would be desirable if proposed AHURI short-term projections (not part of this project) were also nested within this framework.

3.8. Concluding remark

The methodology described above, despite its high degree of specificity, is necessarily subject to change. Changes are inevitable as the User Group provides input and as the project team confronts the realities of data acquisition and development. Furthermore, during the task, it is inevitable that 'smarter' ways of doing different steps of the process will emerge. Nevertheless, the broad framework of the projection methodology will remain as described.

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