ABSTRACT

This paper discusses research issues and projections of labour force, earnings, assets and retirement behaviour underlying the superannuation modelling by the Retirement Modelling Task Force. The paper overviews the parameter research and projection models developed for the RIM Task Force. Research methodologies for handling cross-sectional data in a dynamic framework are discussed. Work in progress is detailed along with further research directions.

Labour Force Status, Earnings, Asset Accumulation, Retirement Behaviour and Long-run Projections

Bruce R Bacon
Retirement Income Modelling Task Force

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The Retirement Income Modelling Task Force
c/- The Treasury, Parkes Place, Parkes, Canberra 2600.

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INTRODUCTION:

The Retirement Income Modelling (RIM) Task Force has as its principle object "To develop a capacity for modelling the impact of retirement income policies over the next half century and provide advice to departments and Ministers as required on policy options affecting retirement incomes." The Task Force is concerned with dynamic simulation modelling of the interaction of superannuation, labour markets, social security and taxation over a 60 year time horizon at both an aggregate and individual-based level. To meet this objective, models are required to project these interactions out to at least 2051. By then a full generation will have benefited from a fully phased in Superannuation Guarantee. To this end, the RIM Task Force currently has five superannuation models in use and its major aggregate model is nearing completion. The six models are summarised in Attachment A.

As is well known, Australia will experience a marked ageing of the population over the next half century. The aged dependency ratio is predicted to rise from 13% in 1972 to 37% by 2059. These demographic shifts are occurring in conjunction with major changes in the labour force participation for both males and females, including:

- a general decrease in the participation rate for men,
- a general increase in the participation rate for females,
- an aging of women having their first child,
- longer periods spent in education by the young, and
- early retirement.

To address these fundamental structural shifts occurring in the population a parameter research program was established to research the issues and to provide long-run projection models with particular emphasis on labour force status, earning profiles, asset accumulation and the retirement decision. These projections form the basic parameter inputs to the RIM superannuation models.

The parameter and superannuation models must be sufficiently disaggregated to provide insight into a wide range of public policy questions, including those specified in our Terms of Reference (see Gallagher 1995):

"- the quantum and distribution of retirement benefits
- *the age pension system and the social security system generally*
- *the quantum and distribution of superannuation tax concessions*
- *the fiscal balance*
- *superannuation assets*
- *private sector saving*
- *national saving*
- *workforce participation and retirement patterns*

as well as

- *demographic variables*
- *retirement benefits commutation patterns*
- *lump sum dissipation patterns*
- *fund earnings rates*
- *key macroeconomic and microeconomic variables*
- *the retirement age decision*
- *contribution/earnings patterns over the life cycle*
- *relevant tax, superannuation and social security parameters."*

In order to address such a wide range of issues the research calls extensively on micro economic data benchmarked against aggregate economic data. Using highly disaggregated micro economic data, along with the problems arising from utilising widely disparate data sources, raises significant research issues. These reseach issues form the focus of this paper.

THE RIM PARAMETER RESEARCH PROGRAM:

Development of microsimulation models of the interaction between superannuation, labour markets, social security and taxation over a 60 year time horizon, at both an aggregate and individual-based level, required research and development of **plausible, consistent and defensible** long-run scenarios and parameters as input to the RIM models.

Clearly the research must attempt to capture possible behavioural shifts over the next half century. If this is not difficult enough, it must done by gender, age and earnings decile (GAD). We have not attempted to develop models to explain the socio/economic shifts we have observed in recent times. Many of these behaviour shifts are poorly understood by the profession. For example, the shift to part-time work and other working life decisions is not well understood. Consequently, we have adopted a non-parametric approach which looks for, and estimates, stable long-run relationships in the historic data and which develops methodologies to project them in a consistent framework.

Many of the areas we have traversed have thrown up rich sources of information and data which, on the face of it, might form the basis for a good PhD thesis in their own right.

As noted above, a principle objective of the parameter research program is to provide the disaggregated demographic parameter sets which are critical for successful modelling of aggregate superannuation (RIMGROUP, see Attachment A). The demographic variables of interest to RIM include population totals, sex and age structure, fertility, deaths, migration, labour force status by full/part-time and public/private, disability, retirement, pensions and career earning profiles by deciles. These projections are produced by a set of annual demographic models for Australia to the year 2059. The models include a population model (POPMOD), a life expectancy model (LIFE), a labour force status model (LFSMOD), a financial assets model (ASSMOD) and a set of career earning procedures (CEPROC). This research is complemented by further modelling of the structure and distribution of superannuation assets and rates as reported by Rothman (1995).

POPMOD - Population Model

POPMOD provides annual projections of Australia's population by year for males and females by single year of age up to 100 plus years. The model is driven by parameter matrices for fertility, mortality and overseas migration. The overseas migration sub-model accepts projection of permanent and long-term arrivals and departures and measures of category jumping. POPMOD is based on ABS population projection methodology (Bacon 1994).

LIFE - Life expectancy Model

The life expectancy model calculates survival rates, survivors to age x, deaths at age x to x+n, life table populations and life expectancy for males and females by single year of age up to 100 plus years. The estimates are constructed from the mortality parameters used in POPMOD.

LFSMOD - Labour Force Status Model

This is long-run annual model of the Australian labour force to capture structural (trend) behaviour at fine detail (see chart 1). The model projects persons by labour force status, age, gender and income decile. (Marital status of females is possible but not currently in use.) Labour force status is split by employed/unemployed, full-time/part-time, public/private, wage and salary earners/employers/self employed. Persons not in the labour force are split by retired/never in labour force/permanently disabled/temporarily not in the labour force . There is no short-run behavioural response in LFSMOD, the model simply runs off the observed underlying long-run movements of key, and hopefully stable, parameters, which are estimated as non-linear trends with consistent asymptotic values. Apart from these time-varying parameter matrices, the model's only exogenous

inputs are population projections from a population model, such as POPMOD, and aggregate unemployment rates for males and females. Charts 2 and 3 are typical examples of the level of detail available as output from all sectors of the model (Bacon 1995a).

ASSMOD - Financial Assets Model*

This model will provide annual projections of non-superannuation financial assets (ordinary savings and equities) and housing assets for males and females by age group. Because of asset switching between married couples, the model redistributes family assets between husband and wife to estimate assets held by individuals. Asset distributions by gender, age and income will be projected.

Although these models are being developed to provide inputs to the RIM microsimulation models, they operate as stand-alone EXCEL systems and can be used as is, or modified to meet other policy analysis needs.

CEPROC - Career Earning Procedures

This is a set of complex procedures used to estimate career earning profiles by labour force status, age, gender and income decile. The procedures allocate the population by labour force status to each career earning decile. These allocations are used to construct the Income Decile Proportion parameters used in LFSMOD. Because of the complexity of these procedures, and the fact that they are a mixture of SAS and EXCEL, they have not been packaged as a stand alone model (Bacon and Miners 1995).

* Under construction

CEPROC RESEARCH TASKS:

RIMGROUP is a cell based microsimulation or group tax-benefit model and disaggregates the population into a number of groups or cohorts. The traditional approach defines cohorts by age, sex and birth date but does not split the groups by income rank and assumes that all members of each broad cohort earn the average earnings of that cohort. This approach has two serious limitations for appropriate modelling of superannuation policy options and their interaction with the taxation and social security systems in that applying an average earning profile to all individuals in a cohort:

1. does not permit the modelling of policy rules that operate at income margins; and
2. produces pooling of the cohort's superannuation accumulations. That is, all members of each broad cohort share equally in the superannuation fund of that cohort.

These limitations are to be addressed in RIMGROUP by estimating **career earning deciles.** The RIMGROUP model assumes that we can place each person in the population into a career earning decile in which they remain throughout their life. RIMGROUP estimates superannuation assets by accumulating the contributions of working cohorts as they are aged one year at a time. The main advantage of RIMGROUP over earlier models is its ability to model policies which vary by income and asset amounts, such as social security income and asset tests, as well as modelling tax expenditures and rebates for superannuation contributions. The modelling of accumulations within income deciles, which allow for different probabilities of changing labour force status (becoming unemployed for example), will reduce the major pooling bias found in earlier models. The introduction of the ten income deciles permits marginal analysis, though they are limited to analysis about the decile boundaries. This type of analysis could be improved if income distributional information were carried with each cohort. At this stage we do not intend to move down this path.

The ABS has released three Income Distribution Surveys (IDSs) as unit record tapes: 1981/82, 1985/86 and 1989/90 which provide a rich source of distributional data on individuals and income units. Using these data the following research tasks were addressed:

- Develop useful measures of career earnings for RIMGROUP.
- Research relationships between IDS and LFS
- Investigate male/female earning behaviour
- Investigate age specific relationship between wage rate and total wage and salary
- Investigate the period and current income from the IDS:
    - as to the most appropriate measure for RIMGROUP analysis
    - as a measure of labour force mobility

    - as a measure of early retirement
    - for mapping between the two
- Investigate earning profiles for part-time workers and those with own-business
- Develop methods for handling small sample noise and small sample bias
- Develop methods to reduce selection bias
- Develop methods to accommodate occupation reclassification
- Develop method for allocating total population to full-time wage and salary earning deciles
- Develop method for linking 1981/82, 1985/86 and 1989/90 IDSs to untangle age effects from period and cohort effects
- Investigate available indicators of earnings
- Investigate stochastic selection from sample.

SOME RESEARCH ISSUES IN CEPROC:

Distributional surveys have been used by a number of studies to estimate either an income profile for individuals or the average income profile for a particular group. It is often noted in these studies that cross-sectional data cannot separate age effects from cohort effects from period effects. Part of this research specifically addresses the two issues of selection bias and occupation reclassification, usually ignored by cross-sectional studies, which can significantly affect the interpretation of cross-sectional analysis. For example, studies which report significant downward profiles for cohorts in their later life (often represented as quadratic function of age) might simply be reflecting the fact that individuals on higher earnings have retired. The average income of the remaining individuals selected by the survey will, of necessity, be lowered. The second issue of occupation reclassification refers to the observed fact that many individuals change their occupation during their careers. Studies which use occupation as an explanatory variable (or regressor) and do not adjust for occupation reclassification introduce significant bias into their estimates. (Reclassification effects in other explanatory variables may be of significance in other studies). Casual analysis of data reveal that cohort behaviour is highly nonlinear. No functional form is obvious and parametric modelling has not been used in this analysis. Instead, we have developed a number of techniques which stochastically sample the data to create pseudo populations on which we estimate the desired quantities. Finally, analysis of disaggregated microdata from these sources raises the difficult issue of sampling bias. In the end, judgement dictates when to smooth or manually adjust data to compensate for the considerable noise introduced when the number of observations contributing to an estimate is very small.

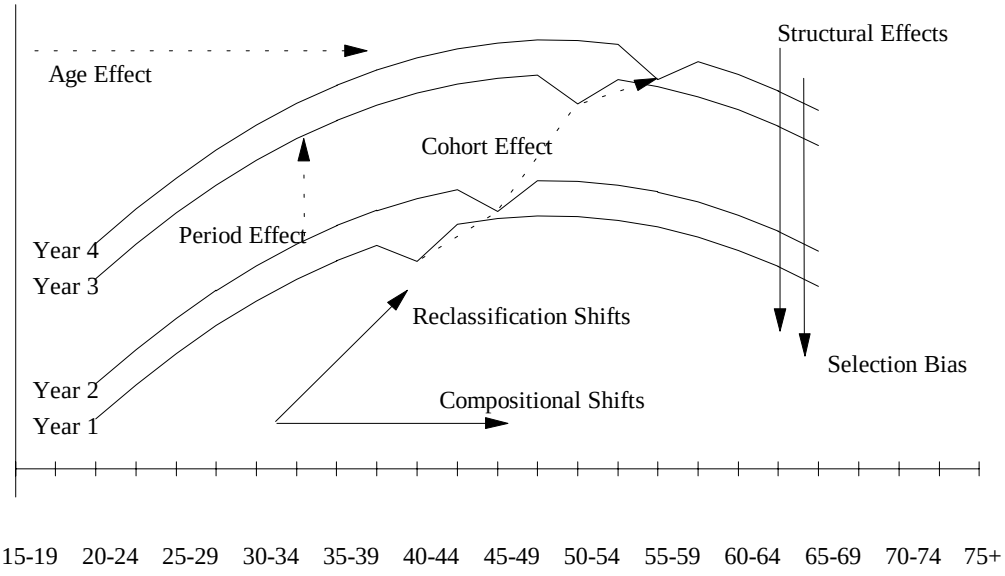
As noted above we have investigated a wide range of fundamental research issues. Some issues of particular interest include:

Issue 1. Cross-sectional Data

Previous studies have highlighted the difference in age-earning profiles from cross-sectional and longitudinal data. For example, Irvine (1981) notes that where ".. age earning profiles estimated from cross-sectional data are hump shaped .. the use of longitudinal data, however, yields a contrary result [in that] earnings never fall even though the rate of increase may slow down".

All model builders using cross-sectional data face a number of the methodological issues, particularly when attempting to use cross-sectional data as a proxy for longitudinal data. Chart 4 and Attachment B provide an overview of some of these issues. This research attempts to unravel some of these effects by employing past ABS Income Distribution Surveys.

Chart 4. Hypothetical Cross Section Age Earning



Issue 2. Shape of the Earnings Profile

The significant characteristics of the average wage and salary earning profiles for males and females are the humped (quadratic) profiles for males and the double humped profiles for females. Charts 5 and 6 illustrate this phenomena from the three IDSs from the ABS.

Chart 5.

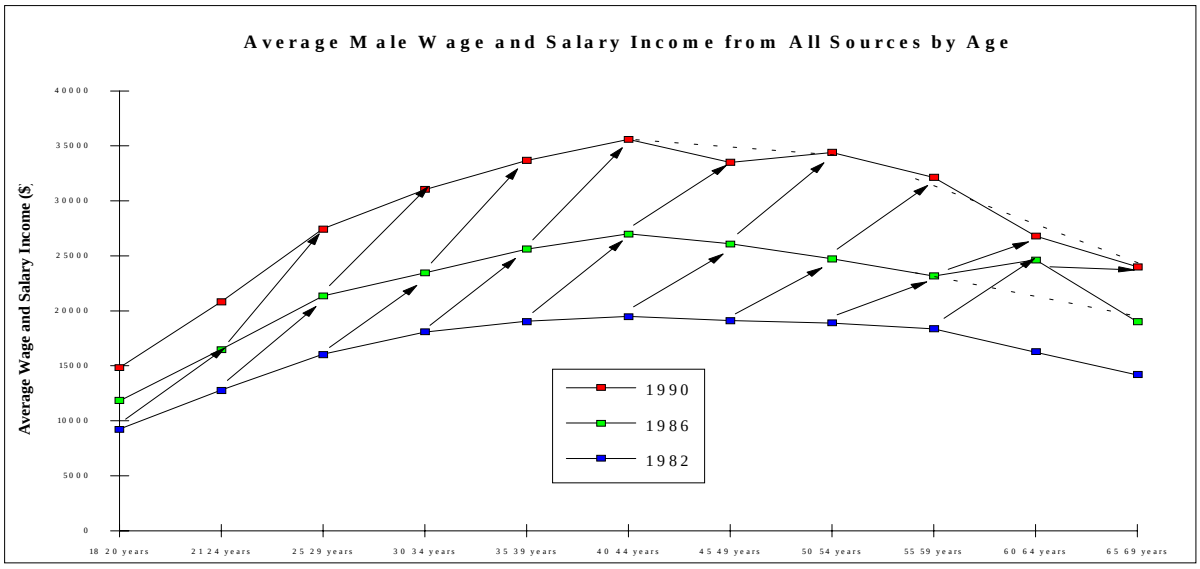


Chart 6.

Much of the literature interprets the downturn in the earnings profile seen in cross-sectional analysis, sometimes called the “end effect”, as a consequence of productivity increases going to the younger cohorts. For example, Miller (1965) considers that "evidence .. suggests that the relative increases in income associated with economic growth appear to be greater in the earlier years of working life than they are once the age of peak income is passed". Miller also considers that ".. all groups do not share equally in economic growth and that the young tend to benefit more than others" and outlines possible reasons as "young workers are more mobile than others in the workforce .. newer entrants to the labour force may also be better trained [and] ..employers may prefer younger workers.”

Harding (1994) also picks up these points but adds a third explanation, stating that "Three hypothesis seem particularly plausible .. to explain the down turn in age-earning profiles after middle age. First it may be explained by slower accumulation of human capital and faster depreciation of that capital after middle age. Second it may be explained by some older workers moving to lower paid jobs that are less demanding. Third it may be explained by those workers who accumulate wealth more quickly, retiring early, thereby resulting in a fall off in the observed average and medium wage and the near retiring age".

This research argues that the “end effect” is most heavily influenced by selection bias, occupation reclassification and hours worked (see below). More understanding of the earnings profiles is obtained by separating out the full-time and part-time influences. This research specifically addresses the two issues of selection bias and occupation reclassification, usually ignored by cross-sectional studies, which can significantly effect the interpretation of cross-sectional analysis.

Issue 3. Wage Rate vs Wage and Salary

Part of the “end effect” for wage and salaries is explained by a reduction in hours worked in later life. Current hours worked is collected in the IDSs and can be used to calculate a wage rate for each person. An adjustment for hours above standard hours which is not paid as overtime is made to improve the wage rate measure. Although human capital theory suggests that deciles based on wage rate are conceptually more correct, the fact that RIMGROUP will link to other parameter estimates via wage and salary dictates that deciles based on the latter should be used.

Issue 4. Wage and Salary Deciles

One approach to using cross-sectional data would be to simply rank the population according to some income measure, ie. wage and salary or total private income. This procedure puts the full-time workers in the top deciles, the part-time workers in the middle deciles and those unemployed, students or NILF (Not In the Labour Force) in the bottom deciles. Inclusion of this structure in RIMGROUP would have enforced a permanent labour force status to the cohorts under simulation. The approach we have adopted allocates every person in the population to one of ten earnings profiles base on their expected lifetime earning stream. That is, a "decile" will contain full-time, part-time , unemployed and those not in the labour force on the assumption that individuals move between these labour status but maintain the average income profiles for the decile over their lifetime.

The approach adopted for RIMGROUP is to use wage and salary earnings as a proxy for life time career earnings

$$E_{LT} = \sum_{t=0}^{N} WS_t \qquad \text{where } WS_t \text{ is wage and salaries in year } t$$

and to assume that the earnings measured for each age cohort in the cross-sectional data adequately reflect longitudinal behaviour. Age specific deciles based on this measure, however, capture all persons with some wage and salary and would result in full-time earners being allocated to the top decile and part-time earners to the bottom decile. Because RIMGROUP does not permit swapping between deciles, this approach would force those in the top deciles to remain in full-time employment during their career, and similarly would not permit part-time workers to re-enter full-time employment.

Issue 5. Selection Bias

As individuals leave the workforce the average income reported by those still working will be lowered if, for example, the average income of those leaving is higher than those remaining. This would not be a problem for RIMGROUP if income deciles were not used. However, if those leaving are not randomly distributed across deciles then the process of reranking will force individuals into incorrect deciles. This process is also true for individuals such as students who are still to enter the workforce. This research has identified that education and occupation (E.O) are correlated to income level, though in no structured way. By constructing pseudo populations using E.O for those who have left the work force at each age group, real individuals can be forced back to their correct decile.

Issue 6. Using the three IDSs

The number of people leaving the work force, or in particular, leaving full time employment can be estimated by appropriate adjustment of the corresponding cohorts across the three IDSs. This raises the problem that the IDSs are four years apart and there is a one year “cohort overlap” with each five year age group. We have investigated methodologies for adjusting for this overlap.

An underlying assumption when aging cohorts across the IDSs is that growth in wage and salary earnings is not age specific and that productivity gains are obtained by all age groups. Note that AWE is not used to inflate earnings, as AWE is a function of structural shifts in the age distribution.

Issue 7. Occupation Reclassification

Analysis across cohorts revealed a significant amount of occupation reclassification. Individuals who may start their careers as trades persons often end up in managerial roles. When attempting to identify the number of each occupation leaving the workforce, one must first adjust for occupation reclassification. This research does not identify whether the reclassification is structural or economic.

Issue 8. Stochastic Selection and Replication

The basic estimation technique employed in this parameter research is to stochastically sample the observations in a cohort based on education and occupation profiles to construct pseudo populations. If the number of drawings are small the sampling can be replicated a number of times to improve the statistical properties of the estimates.

Issue 9. Sample Size

The biggest problem faced with research on highly disaggregated data is the curse of small samples and sample bias in the estimates. No amount of replication can improve estimates drawn from a very small population. In the end judgement must be exercised in deciding when to smooth estimates across cohorts, when to remove or modify an outlier, and when and how to impute missing values. Usually it is obvious when the process has broken down due to a small sample problem and when corrective judgement should be applied.

Issue 10. Wage rate, Hours worked, Duration and Participation

As indicated above, the profiles for the wage and salary deciles can be split into wage rate profiles and hours worked profiles. The IDSs carry information about duration in their period data. Once all individuals in a survey have been identified as belonging to a particular decile, their corresponding duration data can be extracted from the survey. One must be careful however, since the duration data refers to their period income and not their current income. Nevertheless, it seems to be the only way to attach duration to career deciles. Finally, changes in participation rates are assumed to apply equally to all career deciles.

CEPROC Data Analysis

Structural Differences between Males and Females

Age specific labour force status and earning profiles for males and females are, as expected, quite different (see charts 7 and 8). Males for instance, have peak full-time employment in the 35-39 year age bracket with 20% in some other form of employment. Females on the other hand, have peak full-time participation in the 21-24 year age bracket with only some 50% full-time and 20% employed otherwise. The reduced participation during child bearing years has varied over the three IDSs with more women delaying having children and the socio/economic shift towards women re-entering the work force after child bearing. Currently, RIMGROUP does not simulate marriage throughout the accumulation phase and therefore does not provide the number of married females within a cohort. We accordingly have not employed information carried by marital status in our research, although we believe that it could improve our estimates of female career earnings if we had done so.

Chart 7: Male Labour Force Status 1990 - Percentage of Population

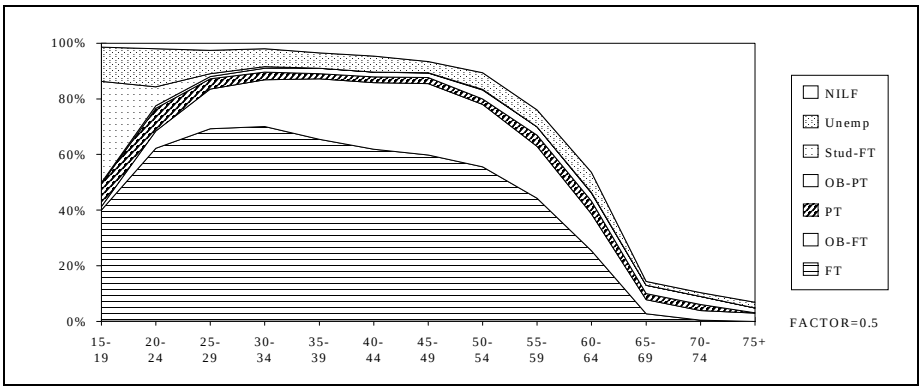
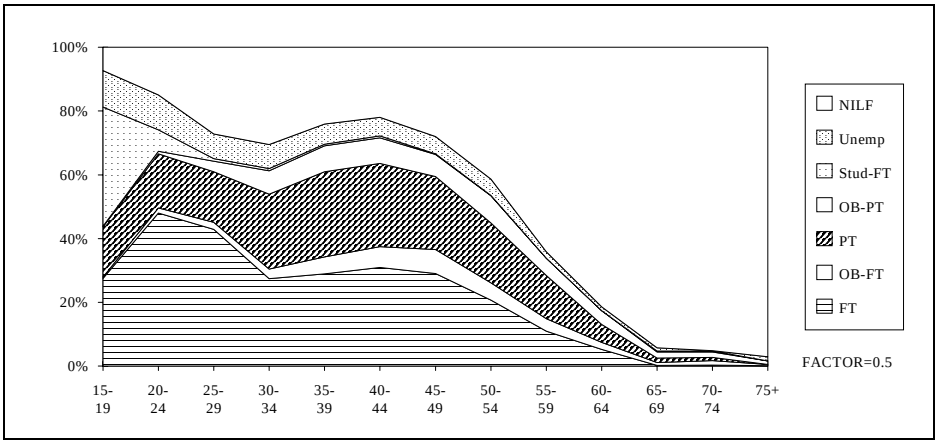


Chart 8: Female Labour Force Status 1990 - Percentage of Population



Classification by Labour Force Status

The use of period income data in conjunction with the current labour force status allocation requires an analysis of the labour force status data in both the **current** and **period** time frames. Those with full time period wage and salary income (which is classified as those working full-time for more than half their weeks worked) can be allocated directly from their duration adjusted period wage and salary income. However, this group accounts for only 50 per cent of male and 30 per cent of female records. The remainder of the records need to be mapped across to the deciles by the approach outlined below.

We assume that the earnings measured for each age cohort in the cross-sectional data adequately reflect longitudinal behaviour. Age specific deciles based on this measure, however, capture all persons with some wage and salary and would result in full-time earners being allocated to the top decile and part-time earners to the bottom decile. Because RIMGROUP does not permit swapping between deciles, this approach would force those in the top deciles to remain in full-time employment during their career, and similarly would not permit part-time workers to re-enter full-time employment. To do this we have created deciles based on the full time wage and salary of the pseudo work force for those with **period** full time wage and salary income by ranking these individuals. To pick up labour force movements, however, we have developed a methodology for mapping that part of the population without **period** wage and salary income to these deciles by estimating **Transition Probability Matrices** (TPMs).

Allocating Non Full-time Persons to Deciles

The transition probability matrices map all non full-time workers in the IDS into full-time period income wage and salary income deciles by current income deciles or educational characteristics. The transition probability matrices from current to period labour force status are particularly noisy, many age-specific matrices having only a few observations. We have employed a regression analysis

using an inverted quadratic to smooth these data.

Full-time Employment

The TPMs used map from **current** full time wage and salary deciles to **period** full time wage and salary deciles and are well defined for both sexes for each age group are shown in charts 9 and 10.

Chart 9 : Male Full Time Current Wage and Salary to Full Time Period Wage and Salary

Actual Data *Smoothed Data*

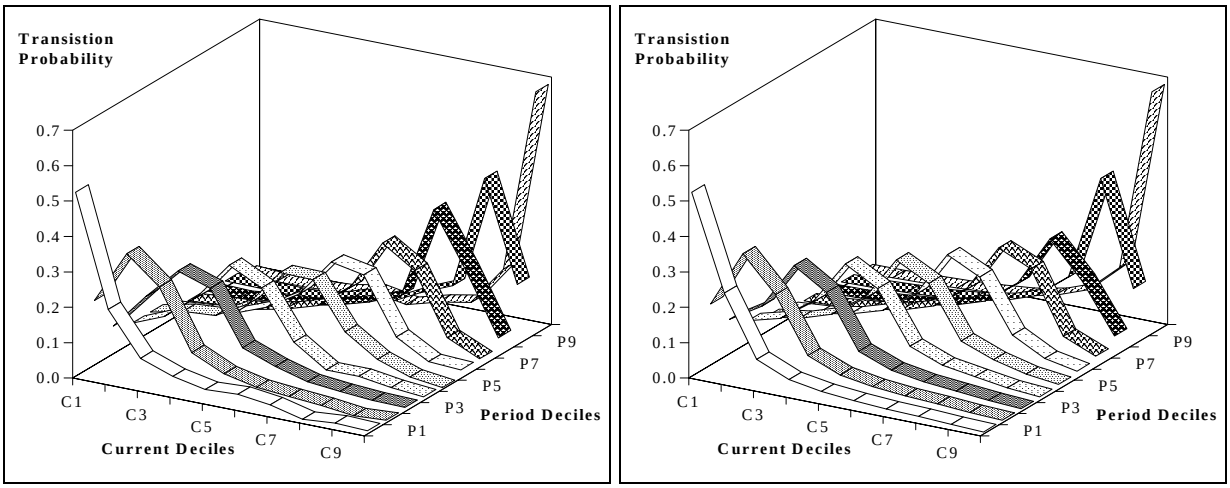
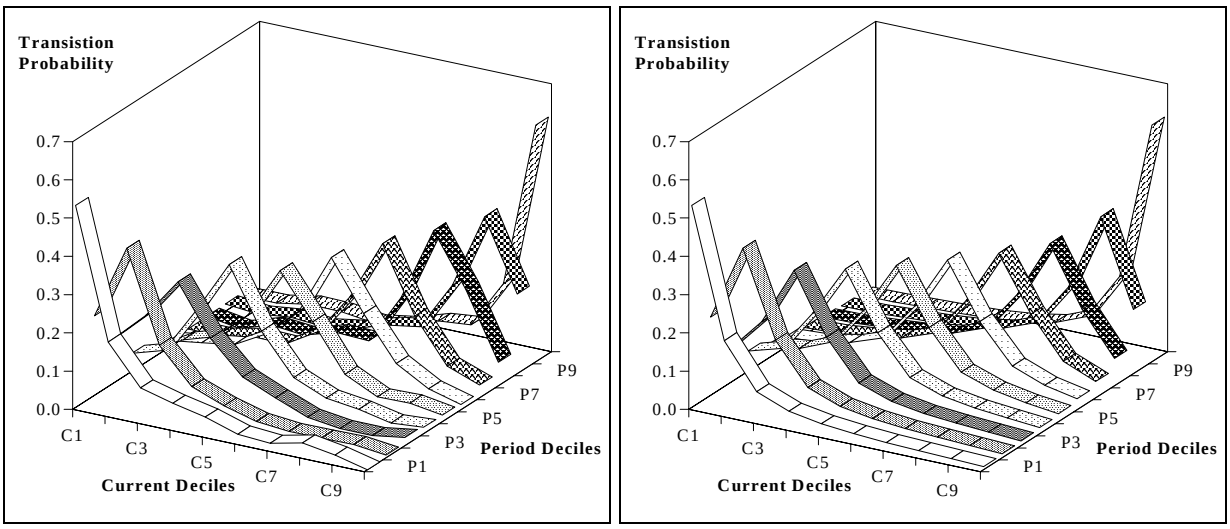


Chart 10. Female Full Time Current Wage and Salary to Full Time Period Wage and Salary

Actual Data *Smoothed Data*



Part-time Employment

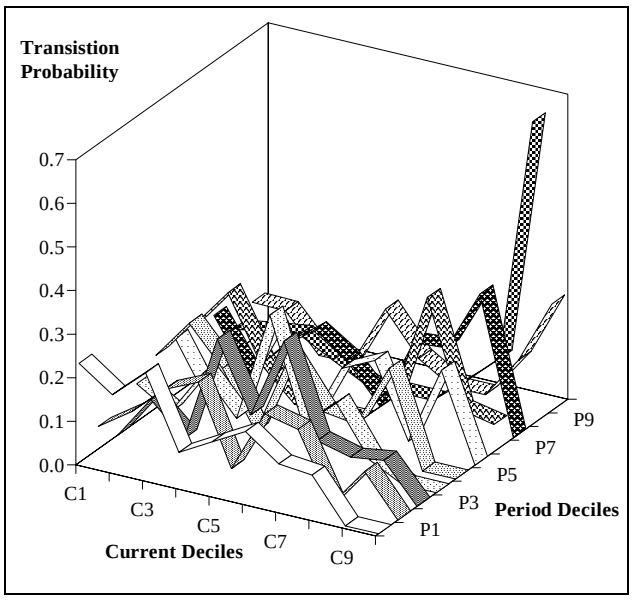
We have estimated separate deciles for full-time and part-time wage and salary earners. By estimating the number of full-time and part-time workers within a cohort and applying the appropriate earnings profile, the total wage and salary for the cohort can be calculated. This approach assumes, however, that persons in the top full-time decile stay in the top part-time decile when they go part-time and vice versa. Our research suggests that this is not necessarily the case.

We can however, argue that part-time workers do not individually contribute significant amounts to superannuation funds. With this assumption, earnings of part-time workers may be adequately represented by their average wage and salary. This approach therefore estimates career deciles for full-time wage and salary earners, but employs the average part-time wage and salary earnings for each decile.

When we come to allocating the part-timers to their corresponding full-time deciles we run into sampling problems at the age-specific level. Small sample sizes have required the development of techniques for examining the behavioural patterns which exist at the disaggregated level but may be distorted by the sample size. The principle used is that patterns evident in aggregate data can be applied to more noisy disaggregated data and is fundamental to our research methodology. For part-time workers there is identifiable behaviour at only the aggregate level. Here a clear mapping from **current** part time income to full time **period** income is available for both males and females. However, when this data is further broken down by age this pattern is distorted by the small samples. Consequently, we can estimate an appropriate behavioural response from the noisy data. This methodology allows us to construct TPMs for part-time workers (see charts 11 and 12) and persons in their own business.

Chart 11. Male Part-time Current Wage and Salary to Full Time Period Wage and Salary

Actual Data



Smoothed Data

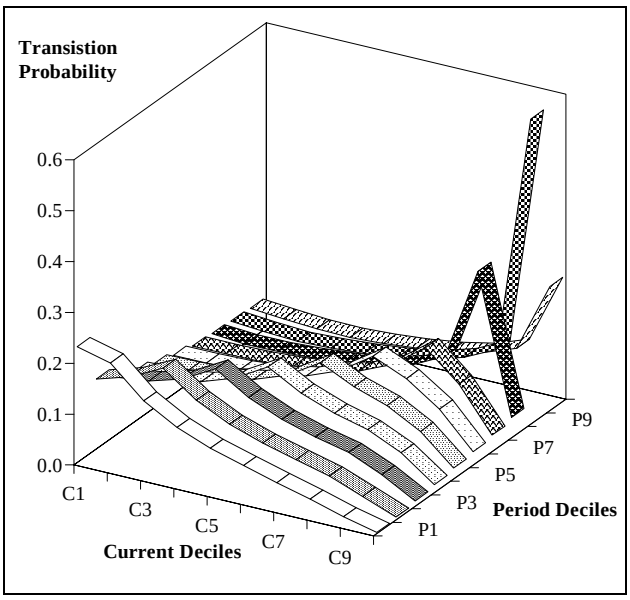
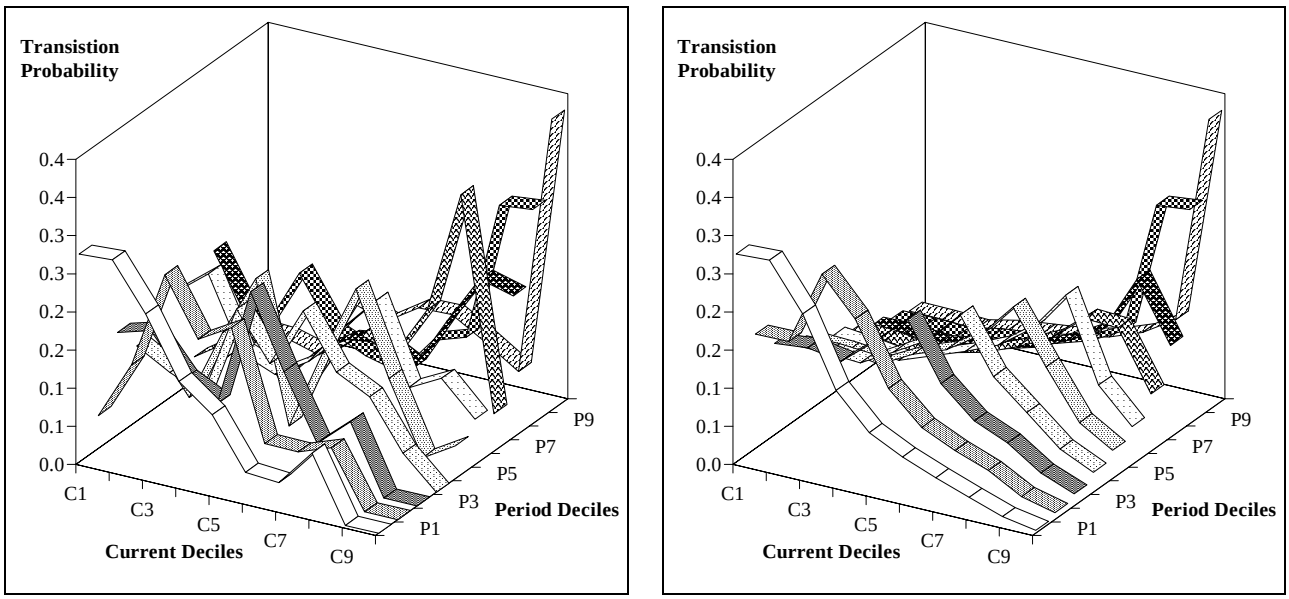


Chart 12. Female Part-time Current Wage and Salary to Full Time Period Wage and Salary

Actual Data *Smoothed Data*

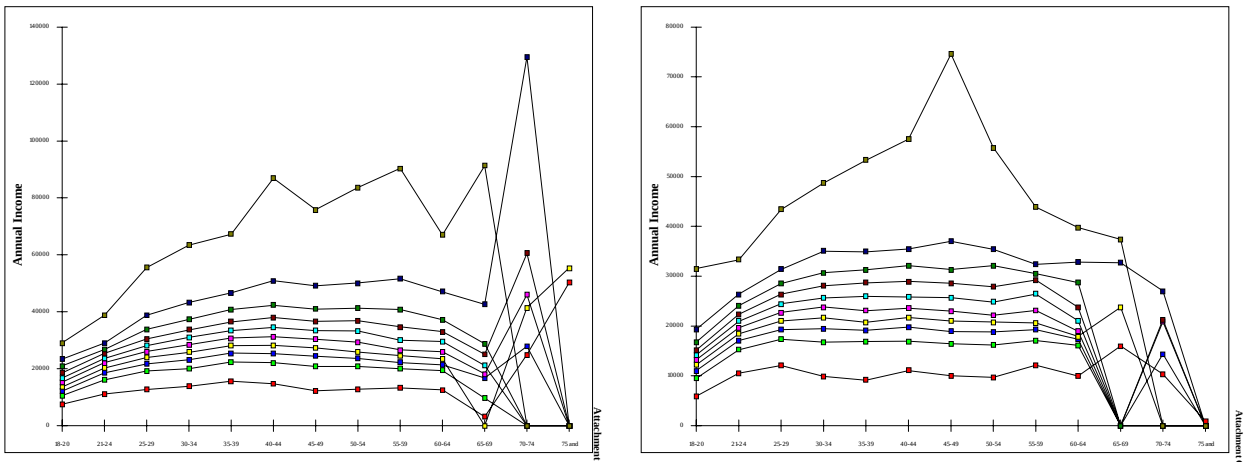


Outputs

The parameter research has produced a set of age earning profiles for use in RIMGROUP as a proxy for life time earnings on which superannuation contributions are modelled. The outputs include age earning profiles by decile for full-time wage and salary earners (chart 13), average age

Chart 13. Full-time Superannuation Salary Deciles

Males **Females**



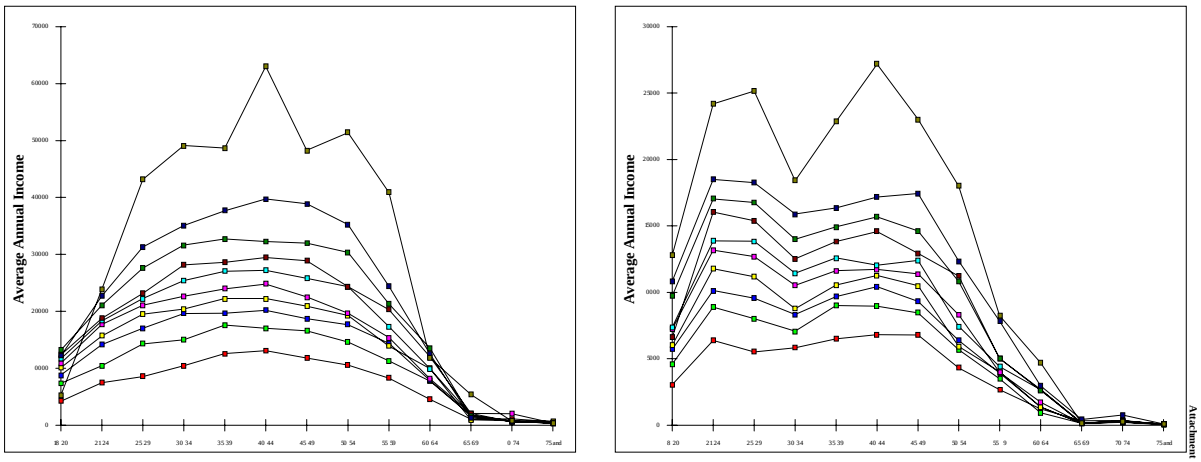
earning profiles for part-time workers and those with own business income only, and decile labour force status shares for the population. Charts 14 and 15 show the unadjusted (unsmoothed) age earning deciles for males and females. Finally, chart 16 shows the interaction between labour force

status and career earnings as represented by the final average earning profiles for each decile after all

persons have been allocated. Note the bunching (and crossing) at each end of the profiles reflecting the fact that tertiary students, with little or no income, are more likely to found in the upper deciles. Similarly, the upper deciles are more likely to retire early from full-time work. The student effect is more pronounced for males than for females.

Chart 16. Final Average Earning Profiles

Males **Females**



NILF AND RETIREMENT:

A research issue of current interest revolves around estimation of retirement behaviour. The RIM models depend on plausible age-specific projections of retirement. LFSMOD projects the number of persons not in the labour force (NILF). These people have diverse reasons for not being in the labour force. In 1994 some 32% wanted to work even though classified as not in the labour force. Of those who do not want to work, only about quarter state they are retired or voluntarily inactive. Voluntarily inactive, however, does not necessarily mean retired.

Because some of the non-retirement reasons for not being in the labour force exhibit long-run trends, age-specific labour force participation is not necessarily a good indicator of retirement. For example,
those who have never worked (see table 1) and those with some marginal attachment to the labour force not only respond to the economic cycle, but show underlying structural shifts.

Workforce and retirement patterns of males and females are very different. Table 1 shows that while nearly all males over 45 had a full-time job in 1986, 20% of females over 45 never had. This ratio has fallen to 16% in 1994 and is expected to fall further. Further modelling of this process will be necessary. More important however is the different retirement behaviour of females. This is

emphasised by table 2 which shows that while only some 7% of males retire from full-time work before they are 45, nearly 60% of females have done so.

Table 1. Proportion of persons aged 45 and over who had never had a full-time job

	1983	1986	1989	1992	1994
Males	-	0.8%	0.7%	1.0%	1.0%
Females	-	20.1%	17.7%	16.2%	16.4%

Table 2. Proportion of persons aged 45 and over who had retired from full-time work before they were 45

	1983	1986	1989	1992	1994
Males	3.6%	5.2%	5.7%	7.0%	7.2%
Females	61.9%	60.2%	60.7%	59.9%	56.5%

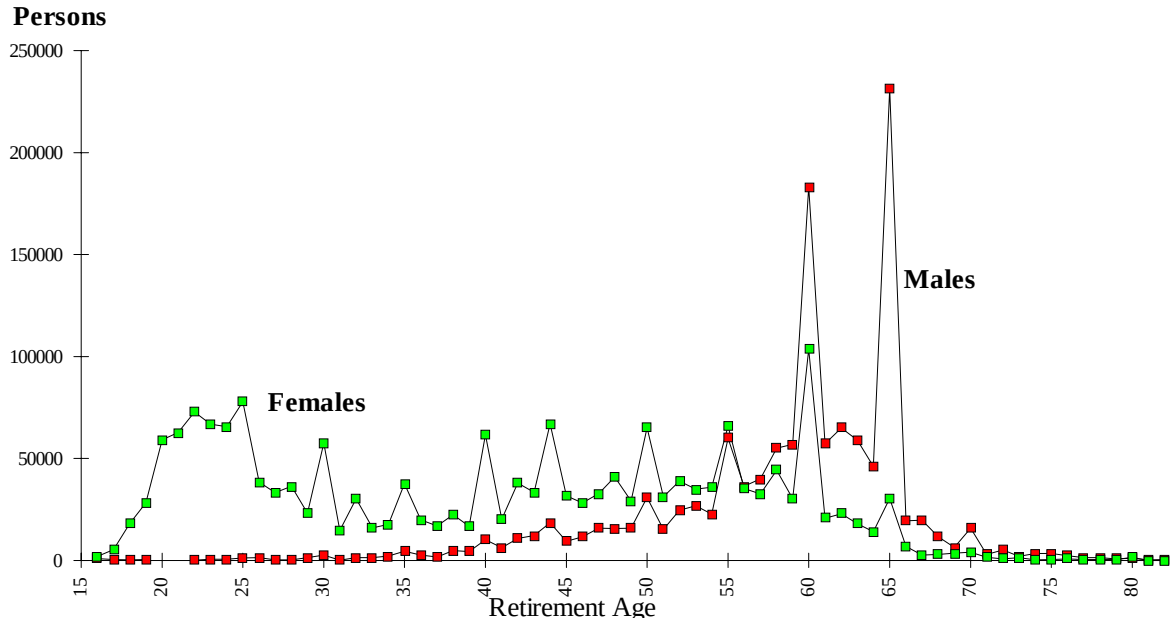
Retirement is a complicated process. People do not just retire directly from work. Those in full-time work can take part-time work, become long-term unemployed, etc. before taking the decision to leave the work force permanently. ABS surveys indicate that the number of people who state that they retired from their last job is approximately half those who state they have worked at some time, are currently retired or voluntarily not working and do not want to work any longer.

The RIM models need to capture retirement in terms of access to, or change in status of, superannuation funds. Not only do we need to determine and project the age of retirement, but we need to distinguish retirement from full-time work, part-time work and other NILF status. In particular we are interested when people take their final superannuation benefits. Further, we need to know which earning decile and what superannuation funds they belong to. We have two major surveys from the ABS which provide some insight into some of these issues. The survey of *Persons Not in the Labour Force - Australia* and *Retirement and Retirement Intentions - Australia*. These surveys can be used to estimate the number of retired persons by age. If we assume that "once retired - stay retired", the number retiring comes from the difference between years, after allowing for death.

Chart 17 illustrates the difference between males and females. Male retirement from full-time work

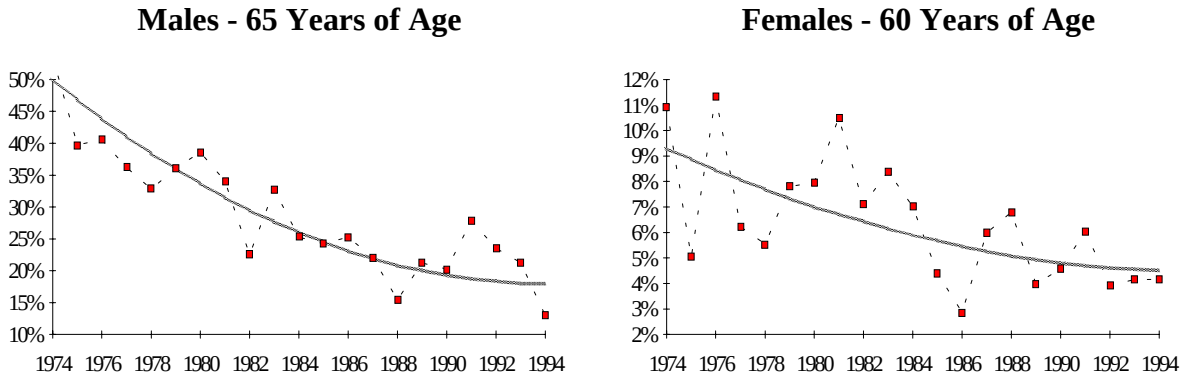
does not occur to any degree until they pass 40. The retirement rate progressively increases until pension age of 65. Apart from retirement when they got married, females, on the other hand, appear to have a relatively constant retirement rate from full-time work across all ages until they reach 60 years of age. Remember that this data is for persons over 45. We would expect that rate of retirement for females between 20 and 25 will have fallen for those now under 40. This is an area of current investigation.

Chart 17. Age of Retirement from Full-time Work - Persons Over 45 - Nov 1994



To capture retirement dynamics we need some understanding on the phenomina of early retirement. Chart 18 shows that if the retirement rate for males at age 65 and females at age 60 (the pension ages) has fallen significantly With this information and matrices of age retired from full-time

Chart 18. Retirement Rate at Pension Age



work by current age from the *Retirement and Retirement Intentions* surveys, time series of age-specific retirement rates have been modelled (see chart 19). Other sources of information include an ATO summary file which will give some insights into the distribution of ETPs. Note however, that ETPs are not necessarily directly related to final retirement.

WEALTH AND ASSETS:

Saving substitution effects are probably the most important but least understood of all economic behaviour. To fully model the development and growth of superannuation assets, estimates of the distribution and degree of substitution from non-superannuation assets are required.

As a first step it is necessary to estimate the current wealth of the nation. Wealth data is notoriously scarce and difficult to construct. However the parameter research program has attacked the problem using the ABS income distribution surveys, the National Accounts and a sample file of pensioners from the DSS.

Analysis of the IDS shows that on average most Australians hold their wealth in their private dwelling.
In 1990 Australians had on average $9148 of ordinary savings (interest bearing), $9088 of equities and

Table 3. Distribution of Wealth among Wage Earners Aged 55-64 Years.
(average asset holdings by wealth deciles, 1990 - $'000)

Wealth percentiles	Interest bearing assets	Equities	Home equity	Total wealth
0-9	1	0	0	1
10-19	6	1	9	16
20-29	5	0	34	39
30-39	3	0	48	51
40-49	4	1	61	66
50-59	8	0	70	78
60-69	9	0	85	94
70-79	15	3	104	122
80-89	16	7	148	171
90-94	39	38	178	255
95-98	51	190	210	451

99-100	90	554	515	1159

some $54768 invested in their homes. This coverage of wealth is narrow. It excludes many income stream assets and other forms of wealth (see Table 4 for a more extensive coverage). Nevertheless, the data provides valuable insight into wealth distribution.

Considering the wealth of those at retiring age (Table 3), the poorest 10% of Australian had not accumulated any significant financial assets or housing. At least 50% had accumulated less than $80,000 and the top 10% held almost 75% of these forms of wealth. These figures give an indication that the likelihood of easy saving substitution is probably restricted to those in the top few deciles.

Table 4. Preliminary Estimates of the Wealth and Asset Holdings of Age Pensioners#.

Assets - Billion Dollars - Dec 1994	**Males**	**Females**	**Total**
Number of Pensioners ('000)	425	1205	1630
Allocated pensions ($b)	0.20	0.08	0.28
Allocated annuities	0.02	0.01	0.02
Superannuation pensions *	6.96 **	3.52	10.48
Rollover superannuation	0.07	0.03	0.10
Annuities	0.30	0.50	0.80
Total Income Stream Assets	**7.54**	**4.13**	**11.68**
Bank, CU, PBS, IBD cash assets	5.34	14.66	20.00
Managed investments	1.58	3.66	5.24
Insurance / Friendly Society assets	0.16	0.19	0.36
Bonds, debentures and loans	0.87	2.42	3.29
Listed securities	0.04	0.09	0.14
Other investments	0.22	0.58	0.80
Total Investment Assets	**8.21**	**21.61**	**29.81**
Owner Occupied Dwelling * **	**30.66**	**87.51**	**118.17**
House contents			
Farm and livestock			
Other real estate			
Business equity			
Other Assets	**5.52**	**11.83**	**17.35**
Total Assets ($b)	**51.93**	**125.08**	**177.01**

\# From a Dec 1994 sample file of DSS pensioners
* Estimated from superannuation income stream using lifetime annuity factors
** Very Preliminary
*** Estimated by inflating the housing equity of pensioners from the 1989/90 IDS

As an indication of the saving elasticities for each of these assets we have estimated smoothed savings functions. As shown in charts 20 to 22, these assets show relatively linear behaviour in logarithmic space. The final functions can be used to estimate the rate of increase in assets by income and age.

Recent press reports that the MINTEL retirement income stream products research program measures some $78 billion of invested funds held by retired Australians, of which $26 billion are held by pensioners and $52 billion held by self financed retirees. These estimates are below our own estimates for 1995 which indicated that retired Australians had some $350 billion of assets: $110 billion of financial assets and $240 billion of home equity.

Further, analysis of the DSS sample file for December 1994 provides greater detail and coverage of the wealth of pensioners with some $40 billion of financial assets and $17 billion held as other assets (Table 4). From the IDS we estimate that pensioners had some $120 billion in home equity in December 1994.

INTERGENERATIONAL TRANSFERS:

The Survey of Families in Australia 1992 consists of some 34,000 persons interviewed between March and May 1992. The survey is basically qualitative with some gross weekly income data on five main income categories. The survey records some quantitative information on the incidence of inheritance and support for home and land purchase over the ten years before the survey.

Money inheritance

Of the 13.5 million people aged 15 years or older, 4 percent report that they received an inheritance of sums of money amounting to $10,000 or more over the ten year period to the survey date.

Housing (Accommodation) inheritance

3 percent of the population aged 15 or more had received an inheritance of land, a house or other residence in the ten years prior to the survey. 20 percent of those receiving money or accommodation inheritance had received both.

Support for home and land purchasing

The Family Survey collected data on the receipt of

- gifts of money for a home, land, home deposit, mortgage, or large home improvement;
- loans of money for the above items;
- gifts of land, homes or home improvements.

7 percent of the population aged 15 or more had received at least one gift of this kind in the last ten years, with parents being the main provider of this kind of support. Almost 50 percent of recipients of accommodation gifts or loans were aged between 25 and 34 years.

Table 5.

Age of recipient		Money	Housing	Support
	15-24	3%	5%	9%
	25-34	13%	12%	49%
	35-44	20%	22%	31%
	45-54	24%	24%	9%
	55-64	22%	19%	2%
	65-74	12%	12%	
	75+	5%	6%	

Table 6.

Inherited from		Money	Housing	Support
	mother	34%	34%	17%
	father	23%	24%	21%
	parents	6%	6%	26%
	male spouse	7%	10%	
	female spouse	1%	2%	
	other male relative	16%	12%	11%
	other female relative	12%	11%	13%
	other relative	2%	1%	11%

Table 7.

Sex		Money	Housing	Support
	male	43%	48%	52%
	female	57%	52%	48%

Table 8.

Age of provider	15-24	
	25-34	
	35-44	3%
	45-54	23%
	55-64	37%
	65-74	28%
	75+	9%

Providers of home and land purchasing

9 percent of the population said that they had helped their children with this kind of support. Providers were likely to be aged between 55 and 74 years (65%).

Inheritance is received over all age groups but is most likely to be received between 35 to 64 years. That is, there is no significant bunching. Further, the similarity in distribution for money and housing inheritance would suggest that they are similar in character. It may be that , as housing is in general the most significant asset held by an individual, money inheritance might simply reflect the liquidation of housing inheritance. This is likely to be the case where housing inheritance must be divided between a number of beneficiaries.

4 percent of the population received money inheritance and 3 percent received housing inheritance with 20 percent of these receiving both. This implies that some 5½ percent of the population reported receiving some form of inheritance over $10,000 over a ten year period. Given a life expectancy of 74 years for males and 80 years for females (assuming this rate to be constant and ignoring age specific information) this rate implies that around 40 percent of the population receive an inheritance of over $10,000 over their life time. That is, 60 percent of the population do not receive an inheritance of $10,000 or more.

In 1990, 56 percent of income units owned or were purchasing a home, 34 percent rented and 10 percent lived rent free. On the assumption that parents pass their housing assets on to their children and given that roughly 80 percent of the population aged 45 are home owners or purchasers, the estimate of 40 percent receiving inheritance would on the face of it appear to be a lower limit. A more detailed analysis of the micro data may provide more insight into the inheritance process.

PARAMETER INTEGRATION:

As noted above, this research provides detailed parameter inputs for the RIMGROUP model:

- population projections
- labour force dynamics
- income decile dynamics
- retirement dynamics
- asset structure
- superannuation dynamics.

The are about 140 parameter files (matrices) for input into RIMGROUP

POPMOD	x 4
LIFEMOD	x 2
LFSMOD	x 10
CEPROC	x 10
ASSMOD	x 10
superannuation	x 100.

Smoothing and Interpolation:

The population model provides estimates of the population by gender to the year 2059 in single year ages from 0 to 100+. This is the basic input data to drive RIMGROUP in single year age steps. Much of the parameter research, however, is based on grouped data, particularly data grouped by age. The estimates from these data must be interpolated to single year age steps in such a way as to preserve the underlying behavioural responses and to maintain aggregate consistency. Further, as we have previously noted, much of the data is very noisy and often only partial in nature. These sampling problems have made many of the estimates highly irregular requiring them to be smoothed

before being used by RIMGROUP. We have employed cubic spline smoothing techniques in three dimensions to impose, as appropriate, smooth changes across the variables. We have developed smoothing/interpolation procedures which appear to produce satisfactory results. The procedures employed are however, not perfect. The smoothing process can not (currently) use weighting information about data items, nor can aggregate consistency restrictions be directly applied. We have developed a number of adjustment techniques to get around these deficiencies and to approximate aggregate consistency. In all, these procedures have produced plausible parameter files. Charts 23 to 27 illustrates the results of these procedures.

Labour force status parameter files for gender by age (18-100 in single years), earning decile and percentage of population for each labour force status has been constructed. This required the development of an interpolation method for labour force projections from LFSMOD and a smoothing and interpolation method for labour force decile data from the IDS. The latter procedure ensures that the smoothed estimates add to 100%. The age-earning profiles are

estimated and smoothed separately for full-time and part-time workers. Because analysis have shown persons switching between full-time and part-time work do not stay in the same earnings decile (a design feature of RIMGROUP), we have assumed that the part-time earning profiles are constant across deciles. A procedure was written to combine these two outputs into the final parameter integration files. A similar set of procedures was written to smooth and interpolate superannuation parameters. Methods were developed to maintain the means of the smoothed data and to impose zero values on leading edges as appropriate. The population files for parameter integration are produced by POPMOD (Bacon 1994).

Consistency and Benchmarking

Smoothing and interpolation can cause problems with aggregate consistency. Interpolated data may not add up exactly to the group totals they were estimated from. This problem can be important at critical points in the data (eg at mandated retirement age). Techniques for forcing consistency are under investigation. Finally, all parameter files are benchmarked against aggregate data sources and against other micro economic data bases. This process is carried through to the outputs of the RIMGROUP model. For some areas the results generated are necessarily different to the underlying input data. This usually arises through combining data sources using different definitions, scope, accuracy and aggregate totals. In the end, considerable fine-tuning and judgement is necessary. We are currently benchmarking the integrated parameter data base.

CONCLUSION:

This paper discusses parameter estimation and research issues underlying the superannuation modelling by the Retirement Modelling Task Force. Research methodologies for handling noisy micro data and techniques for handling cross-sectional data in a dynamic framework have been developed.

Our resources have been singularly focused on estimating parameter inputs to meet the objectives of the RIM Task Force. As is often the case with economic research, many of the techniques and methods developed could, in hindsight, readily be improved. We hope to return to some of the more critical issues to improve our estimates and projections. Finally, many interesting issues and data were discovered along the way which could be researched in more detail. Sadly these must to be left for another time and place.

The research has culminated in a consistent set of long-run projections and projection models of labour force, earning profiles, asset accumulation and retirement behaviour. We believe that the scenarios produced will stand up to the test of plausibility, consistency and defensibility**.**

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Attachment A

Superannuation models developed by the Retirement Income Modelling Task Force

- INDMOD - which is a lifecycle projection model of superannuation and retirement incomes for hypothetical individuals and couples written in EXCEL;
- RIMHYPO - which is a very detailed lifecycle projection model of working life incomes, superannuation, other savings and retirement incomes for hypothetical individuals and couples written in SAS;
- RIP - the Task Force's enhanced version of the National Mutual Retirement Income Policy Model which tracks the aggregate superannuation accumulations and retirement incomes of age gender cohorts and which gives estimates of the national saving and fiscal impact of superannuation policies;
- MEMSUPER - which is a static microsimulation model of employee personal superannuation based on a highly disaggregated summary file from the ABS Superannuation survey 1993; and
- SEMSUPER - which is a static microsimulation model of self employed personal superannuation based on a highly disaggregated summary file from the 1992/93 individual taxation returns.
- RIMGROUP - a new aggregate projection model. RIMGROUP projects the superannuation, other savings and retirement incomes of age, gender, career income decile groups of the population by tracking mortality, labour force status, sector of employment, income and type of superannuation fund across every year of a group's working life. Calculations are done at the average for the group and accumulated assets are pooled. The approach is hence at a level of aggregation above unit records but below age-gender cohorts. The model gives projections on both the 'quantum and distribution' of taxation, saving, social security payments and tax concessions.

Attachment B

Cross Sectional Data Issues

Age Effects: Are changes related to the increasing age of an individual. An individual who continues to work full time would see earnings increasing along with experience (age related). Individuals tend to reduce the hours worked as they approach retirement age. To isolate this effect, it is an individual's hourly wage rate which would rise with experience (age). It is with these age effects that RIM is primarily concerned.

Cohort Effects: Specific to single cohorts born in the same year (or around these years). Example: larger cohorts face higher competition for employment, giving rise to lower earnings on entry to workforce. It is noted by Ruggles and Ruggles that for a cohort was born in 1911 and which entered the work force around 1930 when labour market conditions might have severely depressed their earnings, their initial retardation appears to have been carried through the rest of their working life. Further, the cohort effect appears to worsen with increasing experience and hence have a flatter age earning profile.

Period Effects: Effects on a number of cohorts at the same time, due to everybody living through a particular event. The most obvious example is economic booms and busts. All cohorts expect their earnings to be effected in a similar manner to these events.

Selection Bias: Human capital literature notes that age earning profiles from cross-section data, such as the IDS, are humped shaped but profiles from longitudinal data are not. That is, if an individual is followed through their life, their earnings do not fall, though the growth rate may decline. If the individuals who leave employment have different earning profiles than those who remain, that is, if the process is not random, the average earnings will be shifted. When using cross-sectional data to estimate the average age earning profile of individuals in the population, this selection bias distorts the interpretation of these measures.

Ruggles and Ruggles for example says "it would appear that the profile is considerably less flat in the ages 35 to 60 in more recent years than in 1957. In other words the middle group would appear to have gained relatively more than either the young or old". This statement misses the point that selection bias is operating and that the data are measuring the average earnings for those left in the earning cohort. That is, the effect is easily explained by the young staying at school longer and the well off old retiring earlier.

Reclassification effects: Occur where individuals move between E.O classifications. For example, these shifts occur where apprentices upgrade their education qualification as part of their training. Comparisons of cohorts across IDSs also identify shifts from trade occupations to managerial positions over time.

Compositional shifts: Occur where the work force structure changes over time. The introduction of more computer based applications is one such shift which has increased the number of jobs available for semi-professional workers as opposed to trade and machinery based workers. The change in worker demand impacts on the wage and salary structure of a profile while the work force supply adjusts to the change.