Ageing in Australia: Some Modelling Results and Research Issues.

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> "Much of the literature on ageing has addressed issues associated with the implications for public programs - specifically for their cost to government - with relatively little attention focusing on some of the broader economic and social consequences of ageing at both the individual and societal level. Attention has thus been directed primarily to establishing whether the country can *afford* to age, and if not what needs to be done about it, with rather little discussion of what ageing will mean for the nature of Australian society itself. The issue of population ageing has thus become a focus of attention in Australia as in many other countries around the world, not so much as a trend which should be studied and understood, but more as an issue about which something needs to be done." (Saunders 1996).

The economic implications of population ageing are diverse and complex with many linkages back through the whole economy[1]. At the macroeconomic level, the channels through which the effects of ageing operate include behavioural changes to:

- labour force participation rates and retirement decisions,
- aggregate consumption-saving behavior across the life-cycle,
- productivity, and
- public expenditure and revenue.

Börsch-Supan (1996) notes that at the micro level, many economic variables vary by age - participation rate, productivity, consumption, saving etc. This implies that, even without changes in underlying economic behaviour, macroeconomic aggregates will shift as the population ages. He goes on to remind us that "while there is little debate of the basic economic mechanisms of ageing per se, their quantification, however, is a matter of heated debate."

[1] Single county analysis is necessarily problematic. Nearly all major economies are experiencing significant ageing although starting at different times and at different rates. The resulting reduction in world labour force will produce a general decline in the potential global output. The effect on Australia via movements in interest rates, exchange rates and international capital flows is difficult to assess. Attempts to address these issues are usually conducted in a general-equilibrium, multi-country framework (see Masson and Tryon 1990 and Turner et al 1998).

With this in mind, the paper contributes to the debate by drawing on RIM modelling in an attempt to unravel some parts of the story and provide some numerical estimates. In particular, the paper identifies tensions that may occur by the middle of the next century. The paper gives an overview of the RIM models used for ageing analysis and explores issues arising out of RIM's modelling approach. Some important methodological and research issues are raised and avenues for future possible research flagged.

RIM Modelling

The Retirement Income Modelling Task Force (RIM) [2] was established in 1992 to provide government with "the capacity for modelling the impact of retirement policies over the next half century and provide advice to departments and ministers as required on policy options effecting retirement incomes."

The Task Force was charged with developing 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 address its charter, RIM chose to develop four types of model[3] :

Demographic cohort models which project each age/sex cohort in the population by labour force structure, retirement behaviour, life-time earning profiles and wealth accumulation.

Hypothetical tax-benefit models which take a hypothetical individual or couple from work force entry to death capturing all relevant life events, taxes, benefits and retirement income decisions.

Static microsimulation models which are used for short to medium term costing and distributional exercises.

Group tax-benefit projection models which are cell based microsimulation models that dissagregate the population into a number of groups or cohorts. These models accumulate and project for each cohort a wide range of economic variables for the whole population. Because they are whole

[2] The Retirement Income Modelling Task Force became the Retirement and Income Modelling Unit in 1998.

[3] RIM decided not to build a macroeconomic model but simply has macroeconomic linkages exogenously imposed.

economy models they can project a range of aggregate measures and costings as well as provide distributional detail.

Modelling the Ageing Process

RIM analysis of the effects of ageing on the economy utilises RIM's demographic models and the group model RIMGROUP. The modelling is done by gender, age and earnings decile (GAD) and attempts to capture possible behavioural shifts that may occur over the next half century. Development of models of the interaction between superannuation, labour markets, social security and taxation over a 50 year time horizon, at both an aggregate and individual-based level is subject to considerable uncertainty. In this respect the results should not be considered as forecasts, but as **plausible, consistent and defensible** long-run scenarios.

RIM has 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 economics 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[4] which looks for, and estimates, stable long-run relationships in the historic data and methodologies to project them in a consistent framework.

The traditional approach to group models 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 ageing and its interaction with superannuation and the taxation and social security systems:

1. it does not permit the modelling of policy rules that operate at income margins; and
2. it produces pooling within each cohort. That is, all members of each broad cohort share equally the characteristics of that cohort.

These limitations are addressed in RIMGROUP by estimating **career earning deciles**. The RIMGROUP model assumes that we can place each person in the population into an career earning decile in which they remain throughout their life. Detailed discussion on how career earning deciles are estimated is given below.

[4] RIM has developed a range of tools for univariate and bivariate smoothing, interpolation and profiling.

RIMGROUP is a comprehensive[5] cohort projection model of the Australian population which starts with population and labour force projections, and tracks for each cohort the accumulation of superannuation for specified account types, estimates non superannuation savings, and calculates tax payments and expenditures, social security payments including pensions and the generation of other retirement incomes (Rothman 1996 and 1997).

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 fine detail such as 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 demographic variables required by RIMGROUP include population totals, sex and age structure, fertility, deaths, migration, labour force status by full/part-time and public/private categories, 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 migration model (MIGMOD), a population model (POPMOD), a life expectancy model (LIFE), a labour force status model (LFSMOD), a retirement model (RETMOD) and a set of career earning models (CEPROC) (see attachment B). These demographic models are complemented by further modelling of the structure and distribution of superannuation assets and rates as reported by Rothman (1995) and the structure of retirement investments.

Ageing and Population Growth

Due to a rapid decline in birth rates along with the ageing of the "baby boom" cohort, Australia will experience a largely unavoidable ageing of the population over the next half century. It is unavoidable in the sense that almost all the ageing can be attributed to the fall in fertility.

Increases in life expectancy along with the "baby boomer" generation moving through to retirement will produce a marked ageing of the population over the next half century. Australia's population was 18.5 million people as at June 1997 and is projected to grow to around 24.9 million by 2051. Population growth has trended down from around 1.6% in 1971 to around 1.2% in 1997 and is

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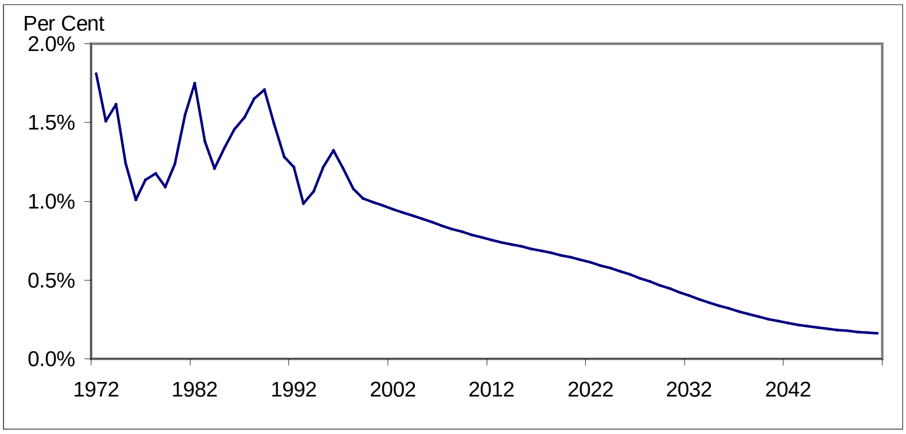
[5] Much of the strength of RIMGROUP comes from the detailed modelling of the legislative provisions on taxation, superannuation and social security.

predicted to fall to 0.16% by 2051 (Chart 1). To illustrate the degree of ageing occurring in the Australian population the elderly dependency ratio[6], which rose from around 14% in 1971 to 18% in 1997, is projected to rise to 40% by the year 2051.

Chart 1. Historic and Projected Population Growth Rates



source: RIM Unit

Ageing and the Supply of Labour

These shifts in the population size and structure 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, a move from full-time to part-time employment, an ageing of women having their first child, longer periods spent in education by the young, and early retirement.

Increasing life expectancy along with a trend towards early retirement, means that males in the next century will spend an increasing proportion of their lives in retirement. Women, on the other hand, will spend more time in the work force as more re-enter the work force after child raising and stay in the work force longer, at least for the foreseeable future.

The total participation rate in Australia have been rising over the last two decades. These movements are driven by a long run increase in female participation which has been offset, to a lesser extent, by a falling male participation rate. Movements in the participation rates can be explained by both demand and supply effects. On the labour demand side there have been: attitudinal shifts by employers with regard to employing women, growth of industries which favour female employment and increased use of part-time (and casual) employment. On the supply side: the relative pay gap has narrowed between males and females, there is increased access to child care, along with smaller families, delay

[6] Ratio of 65 and over population to 15-64 year old population

in marriage, delay in child raising and changes in marriage rates. Further, the increased level of education of women has made them more competitive in the labour market. In total, these factors have significantly increased the benefits to women who enter the labour force which is directly reflected in their increasing participation rate.

Aggregate data can, however, mask the differences between males and females which are reflected in the changes that have occurred between full-time and part-time employment. In particular, male part-time employment has been increasing, admittedly from a low base, only partly offsetting the significant falls in full-time participation for males. Women on the other hand have increased their participation rates for both full-time and part-time work.

There appear to be four underlying mechanisms driving the observed labour force participation patterns which we classify as:

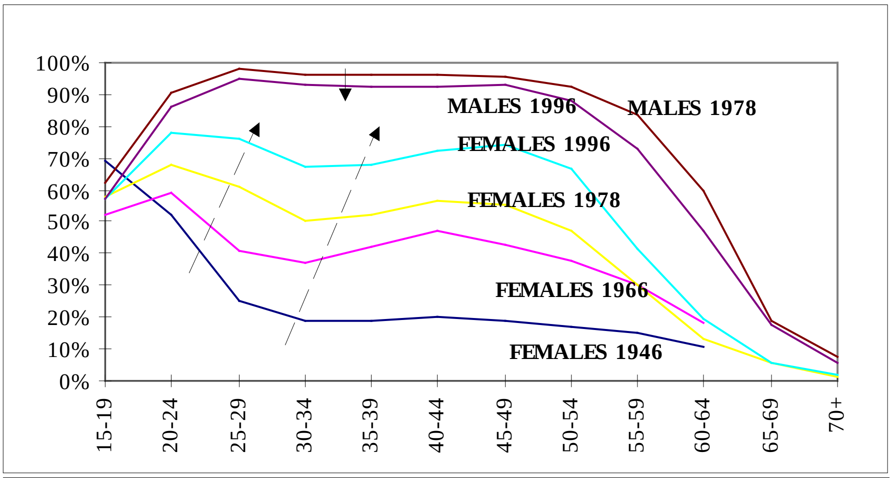
- Gender Shifting - more female employment at the expense of male employment,
- Part-time/Casual - the growth in part-time and casual employment,
- Early Retirement - cohorts which would normally retire at pension age now retiring before hand, and
- Female re-entry - more females re-entering the work force after child bearing/raising.

In general, these trends appear to be producing a convergence of males and female labour market behaviour. In particular, unmarried women are behaving more and more like men and married women are converging, albeit very slowly, towards unmarried women.

The convergence in labour force behaviour can be easily seen in Chart 2 which shows the age-specific participation rates of males and females over the last fifty years. Over this period female labour force participation has been, and will continue to be, dominated by child bearing/raising responsibilities, which currently accounts for over fifty percent of the spells out of the work force[7].

Chart 2. Labour Force Participation by Age Group

[7] Rimmer R. and Rimmer, S. 1994.



source: ABS 6203.0 and Young 1994

Using plausible gender convergence criteria, we project the labour force status of males and females down to full-time/part-time, public/private sector wage and salary components. Of particular interest are the age-specific participation rates used to construct the aggregate participation rate (Chart 3).

Even though female participation rates are projected to rise for all age groups (except 15-19 year olds), because of compositional effects, total female participation rate eventually falls. The resulting aggregate participation rate rises to 64% before falling to 54% in 2059.

Modelling of aggregate ratios can be misleading if the underlying compositional effects are not taken into account.

Analysis of cross country OECD tables of employment rates (Table 1) can help put Australia's participation rate movements into perspective. In particular, for males aged 55-59 years, Australia have shown the greatest fall in employment rate than any other OECD country.

Chart 3. Participation Rates - Total - MALES and FEMALES - Annual - Smooth Projection

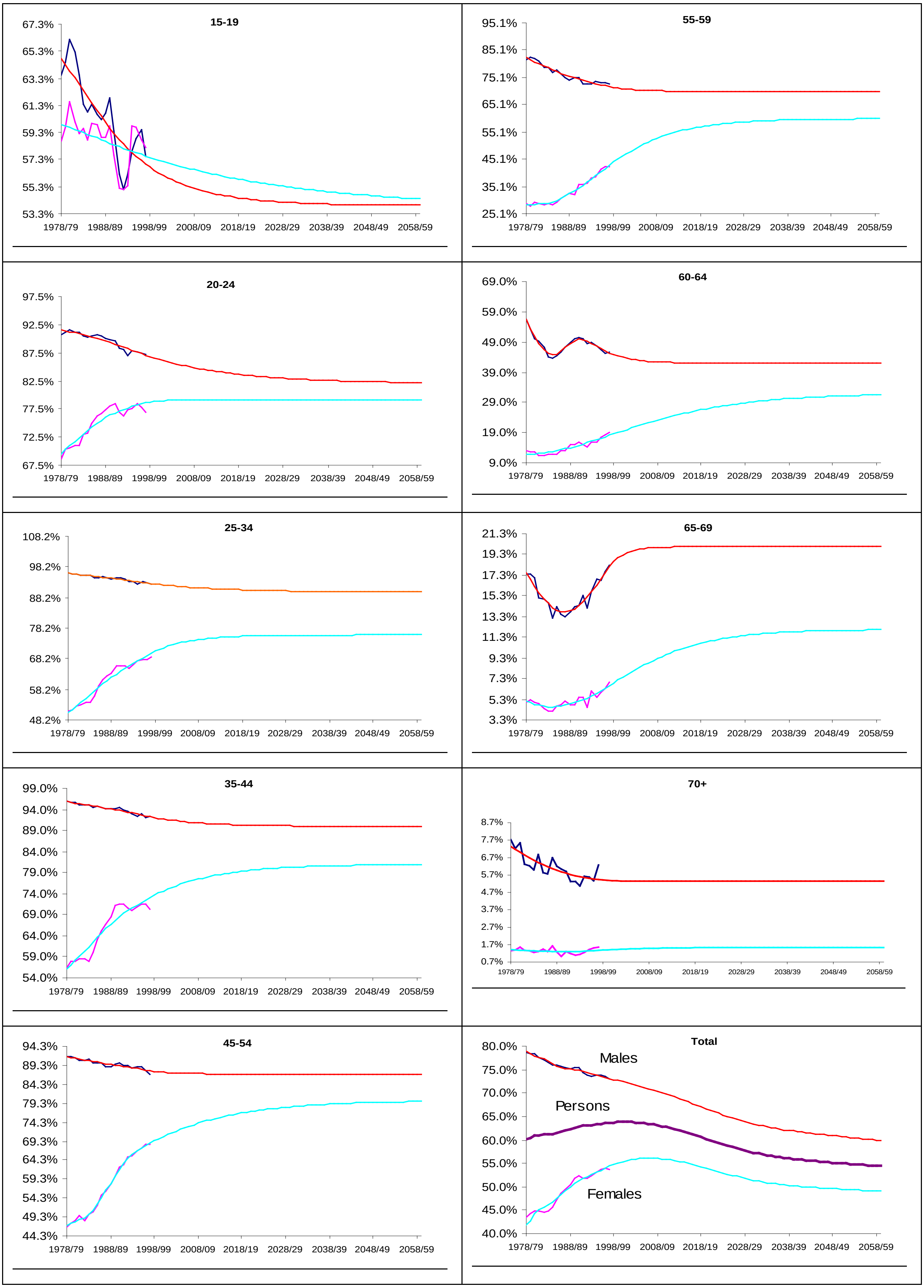


Table 1. Percentage Point Change in Employment Rates[8] - 1975 to 1991

	MALES			FEMALES		
	Aged 55-59	**Aged 60-64**	**Aged 65 +**	**Aged 55-59**	**Aged 60-64**	**Aged 65 +**
Australia	-20.2%	-22.7%	-7.6%	+3.1%	-1.0%	-1.5%
Canada	-14.2%	-23.6%	-6.8%	+8.5%	-0.9%	-1.6%
Finland	-16.8%	-27.1%	-22.3%	-0.9%	-8.1%	-5.6%
France	-17.1%	-36.0%	-10.1%	-0.7%	-13.6%	-4.2%
Germany	-12.5%	-23.3%	-6.2%	-2.0%	-5.4%	-2.4%
Ireland	n.a	-15.9%	-10.9%	n.a.	-0.8%	-3.8%
Italy	n.a.	-7.7%	-2.1%	n.a.	+1.4%	0.0%
Japan	+2.4%	-6.2%	-6.0%	+6.4%	+2.6%	+1.3%
Netherlands	-16.2%	-41.5%	n.a.	+4.8%	-2.9%	n.a.
New Zealand	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	-5.3%	-14.6%	-18.3%	+13.4%	+7.5%	-0.9%
Portugal	-6.5%	-19.6%	-13.8%	+5.2%	+0.8%	-2.2%
Spain	-14.5%	-25.6%	-15.0%	-5.3%	-4.4%	-4.9%
Sweden	-3.9%	-9.4%	-4.4%	+18.3%	+15.8%	-0.9%
United Kingdom	-18.1%	-23.6%	-7.2%	+0.2%	-4.5%	n.a.
United States	-5.4%	-9.6%	-4.8%	+7.3%	+2.3%	+0.3%

Source - OECD 1995 - pp18-19

Ageing and Early Retirement

Most analysis of early retirement, both in Australia and overseas, treats the changes in participation rate as a measure of early retirement. This is conceptually incorrect and in some circumstances totally misleading. Firstly, being classified as not in the labour force does not necessarily mean retired. Our estimates indicate that the retired only make up some 60% of those classified as Not in the Labour Force. Secondly, but more importantly, the movements in participation rates and retirement rates can be in the opposite directions. This is particularly true for females. In general, age-specific participation rates for females are rising at the same time as age-specific retirement rates are also rising.

To be more specific, RIM estimates that, since 1978, around 25% of the fall in participation rate for males aged 45-54 was due to early retirement. Similarly, for males aged 55-59, early retirement accounts for around 75% of the fall in their participation rate. Further, we estimate that the increase in participation rate of females aged 45-54 was reduced some 5% by early retirement and reduced by around 25% for females aged 55-59.

Analysis of early retirement has shown that it is a real phenomena for both males and females. The results suggest, however, that the increases in early retirement have slowed and might even have stabilised (Bacon 1997).

[8] For cross country comparisons Employment Rates are more appropriate than Participation Rates.

Participation rates should not be used as an indicator of early retirement as they capture other labour force phenomena.

Ageing and Economic Growth

It is a simple exercise to decomposes the growth of GDP into growth components

$$GDP = \frac{GDP}{Hours} \circ \frac{Hours}{Emp} \circ \frac{Emp}{LF} \circ \frac{LF}{Pop} \circ Pop$$

Where Hours= Total work hours
Emp=Employed
LF=Labour Force and
Pop=Population 15+

or

$$\%GDP = \%\Pr oductivity + \%AverageHoursGrowth + \%EmploymentRate + \%ParticipationRate + \%Population$$

If we compare the last 15 years with the middle of next century we have using the above demographic and labour force projections:

Table 2. GDP decomposition

Growth Component	Annual Growth 1983 to 1998	Annual Growth 2044 to 2059
Population	1.7%	0.3%
Participation Rate	0.1%	-0.1%
Employment Rate	0.2%	0.0% (stable unemployment rate)
Average Hours	0.3%	0.0%
Productivity	1.6%	1.6% (assumed constant)
GDP Growth	3.9%	1.8%

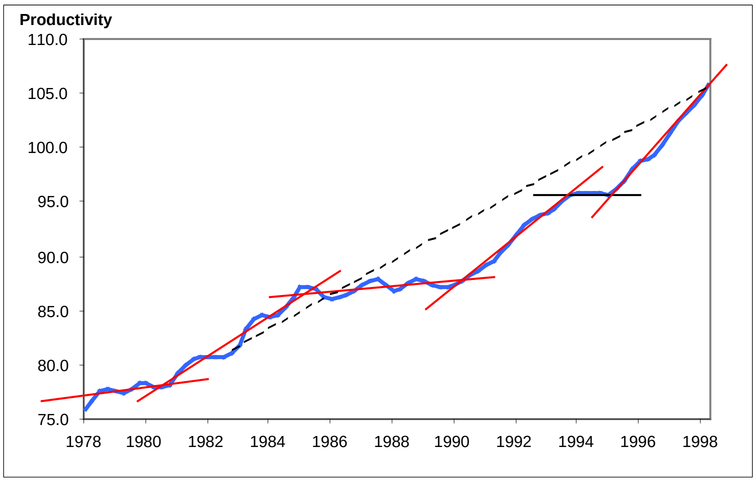
As noted above, ageing of the population and the consequential decline in population growth is largely unavoidable. The reduced population growth component of some 1.4 percent points, means that there will be significant downward pressure on the long-run GDP growth unless there is compensation in other growth components. Assuming that our projected population and labour force dynamics are of the right order, this leaves productivity as the component which must take up much of the slack[9].

[9] Reversing all the falls in male participation rates back to 1978 values still results in a aggregate participation with negative growth in 2059

Ageing and Productivity

Chart 4 shows productivity defined as trend GDP (chain volume measure) per hour worked from 1971 to 1998. Annual growth in this measure of productivity from 1983 to 1998 was 1.6% (represented by the dotted line). This measure of productivity reflects the combined effect of labour, capital and other factors such as managerial efficiency and economies of scale[10].

Chart 4. Productivity Index – GDP to Hours worked



Source ABS Cat No5206.0

There is a widely held view that during the working life of an individual productivity peaks around mid life and then declines as one ages. Actual estimates of the age–productivity relationship are difficult and at best only show a weak relationship. There is a question of whether work performance (or potential work performance) does diminish as one approaches retirement age or whether the relationship simply reflects institutional age discrimination[11]? Answers to this question would give some insight into how increased labour demand flowing from ageing might influence the productivity growth path.

This is important because if productivity does decline with age, then with an ageing population average aggregate productivity would fall, exacerbating the pressure on economic growth. However, it is exceedingly difficult to directly measure age-specific productivity[12].

[10] Using a production function approach to separate the effects is an important research issue, but does not affect the growth story.

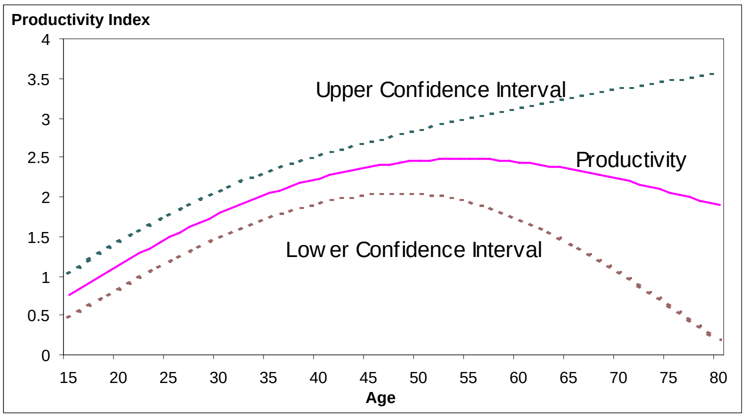
[11] See Jackson (1998) chapter 5, Disney (1996) chapter 6 and Johnson and Zimmermann (1993) chapter 1.

[12] Ditto

An alternate approach is to use age-earning profiles as a proxy for the age-productivity profiles on the assumption that labour earns its marginal product. However, it is also difficult to assess whether workers are receiving their marginal product or if older workers are receiving wages above their marginal product (Jackson 1998 p101).

Sarel (1996), estimates an explicit age–productivity profile from a macroeconomic cross-county growth model using data on population structure and growth rates of income per person (Chart5). This compelling result, however, rests on a number of restrictive assumptions and on the use of income as a proxy for productivity, the latter needing careful consideration.

Chart 5. Productivity by Age



Source: Sarel (1996)

Some important research questions are:

What factors drive the labour supply decisions of the elderly?

What factors influence the retirement decision - both for early and later retirement?

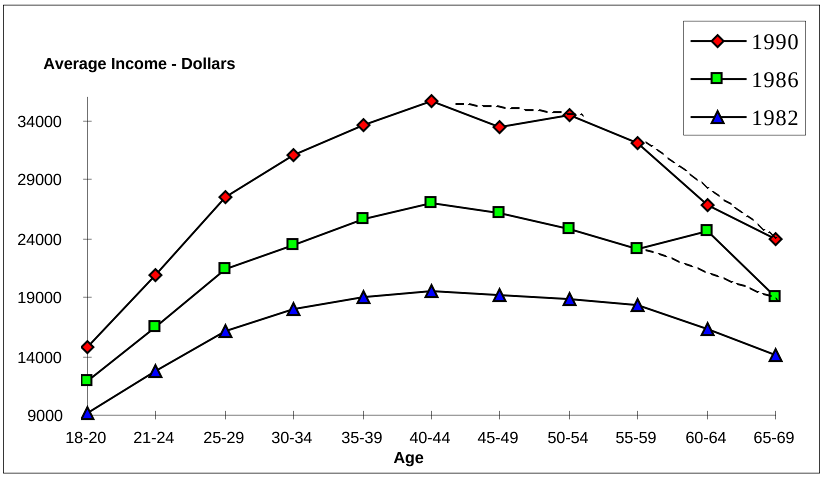
Will the shape of the profile change under demand/supply pressures?

How is total productivity affected by the ageing process?

Ageing and Earning Profiles

Cross-sectional analysis shows that for both men and women workers, average earnings follow an inverted U-profile with age (see Borland 1996). Casual inspection of the age-earning profile would suggest further support for a humped productivity profile (Chart 6).

Chart 6. Male Wage and Salary Income



Source: Income Distribution Surveys ABS

These earning profiles, however, represent average earnings for each age group of those still working. If the characteristics of those working vary systematically with income say, then these profiles will not reflect compatible cohorts for productivity analysis. For example, if people on high incomes with accumulated wealth retire early, then those left in the labour force will necessarily have lower earnings on average. Under this scenario estimates of the earning profile will suffer from selection bias and the average earnings profile would turn down at higher ages.

Apart from estimating productivity profiles, the measurement of the age-earning profile is central to modelling income and expenditure effects of ageing, superannuation and other wealth accumulations.

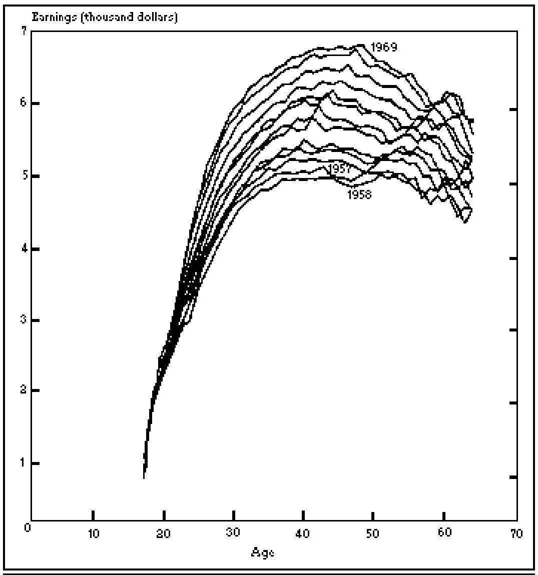
Previous studies have highlighted the difference in age-earning profiles from cross-sectional and longitudinal data. For example, Irvine (1981) notes that where ".. age earning profiles estimated from cross-sectional data are hump shaped .. the use of longitudinal data, however, yields a contrary result [in that] earnings never fall even though the rate of increase may slow down". Longitudinal data from the USA demonstrates this difference in Chart 7, Ruggles and Ruggles (1977).

The general pattern is that while longitudinal data have age-earning profiles increasing through time in real terms, the corresponding cross-sectional data decreases in later life. It is clear that directly using cross-sectional data to capture longitudinal effects can be misleading. Unfortunately Australia has little longitudinal data to address this issue and we must resort to using cross-sectional data[13].

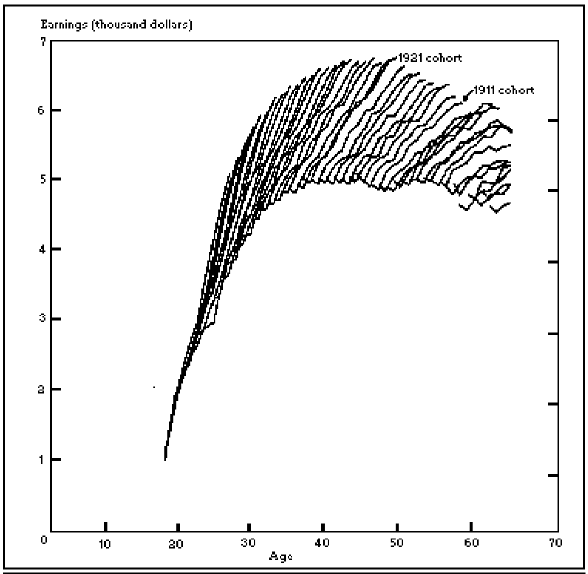
Chart 7. USA Age-Earning Profiles 1957-1969 (1957 dollars)

[13] RIM has developed techniques for estimating consistent single year of age longitudinal profiles from group cross-sectional data.

Cross Section Data



Longitudinal Data



Source: Ruggles and Ruggles 1977

Cross-sectional earning profiles do not reflect the earning profile of the average individual. Economic analysis employing a typical individual with a humped earnings profile may give misleading results.

Ageing and Career Earnings

RIMGROUP ages cohorts through time on the basis that there is no swapping of individuals between cohorts. That is, superannuation is accumulated within a cohort and is dissipated by that cohort. The approach adopted for RIMGROUP is to use wage and salary earnings (and business income) as a proxy for life time career earnings and uprate these age-specific earnings to capture longitudinal behaviour. Conceptually, one would like to group the population into career earning deciles such that the top decile contained wage earners who will accumulate the greatest superannuation over their life time and the bottom decile those who will accumulate the least.

Constructing age specific deciles based on ranking wage and salary directly from an Income Distribution Survey (IDS) would result in full-time workers being placed in the top deciles, part-time workers in the middle deciles and those who are unemployed, students or NILF (Not In the Labour Force) in the bottom deciles.

The approach we have adopted allocates every person in the population to one of ten earnings profiles base on their expected lifetime career earnings. That is, a "decile" will contain full-time, part-time , unemployed and those not in the labour force such that individuals may move between these labour status but maintain the average income profiles (full-time or part-time) for the decile over their lifetime.

Using cross sectional data from three IDS's to estimate career earning profiles by decile, the allocation procedures consist of two main objectives:

- Remove selection bias and place full-time workers into their correct decile,
- Allocate all other individuals to one of these career earning deciles.

The first objective is addressed by estimating the number of individuals who have left full-time wage and salary employment and putting them back into the sample[14]. If appropriate incomes can be allocated to each pseudo person, then ranking will force the real people into their correct decile. Using the three IDS's, observations were stochastically sampled for each cohort based on education and occupation profiles to construct pseudo populations along with their likely incomes. Particular attention was paid to occupational reclassification, as many individuals change their occupation with age.

Studies which use occupation as an explanatory variable (or regressor), and which do not adjust for occupation reclassification, may introduce significant bias into their estimates.

Fortunately the IDS carries both current and period labour force information. To capture labour force movements, we map individuals who are working part-time, self employed or not in the labour force to respective full-time deciles by estimating **Transition Probability Matrices** (TPMs).

The transition probability matrices from current to period labour force status may be particularly noisy, with many age-specific matrices having a small number of observations. We have employed a regression analysis using an inverted quadratic to smooth these data.

Two examples illustrate these estimated TPM's and the small sample problem.

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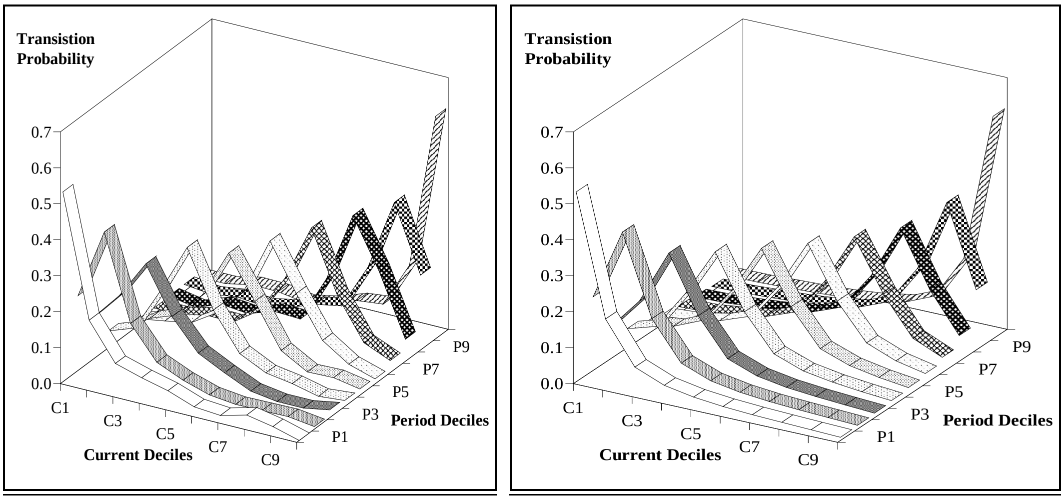
[14] Thanks to Bruce Chapman for suggesting this as a possible approach.

An example demonstrating results with a reasonable sample is the TPM for females in FT employment in both current and period terms (Chart 8). The chart indicates how well the model fits the data.

Chart 8. Female Full Time Current Wage and Salary to Full Time Period Wage and Salary

Actual Data *Smoothed Data*

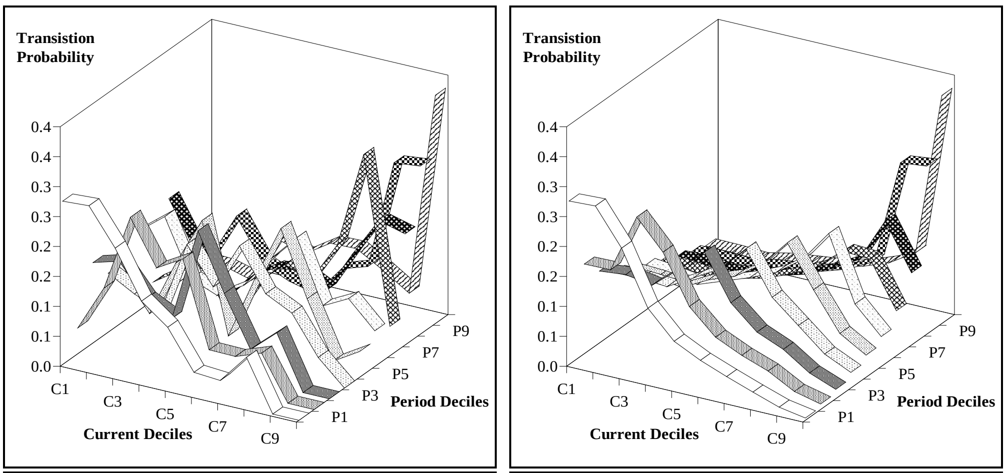


source: RIM Unit

At the other end of the spectrum we have, however, an example with a small number of observations. This example shows how the model extracts the underlying signal from noisy data (Chart 9).

Chart 9. Female Part-time Current Wage and Salary to Full Time Period Wage and Salary

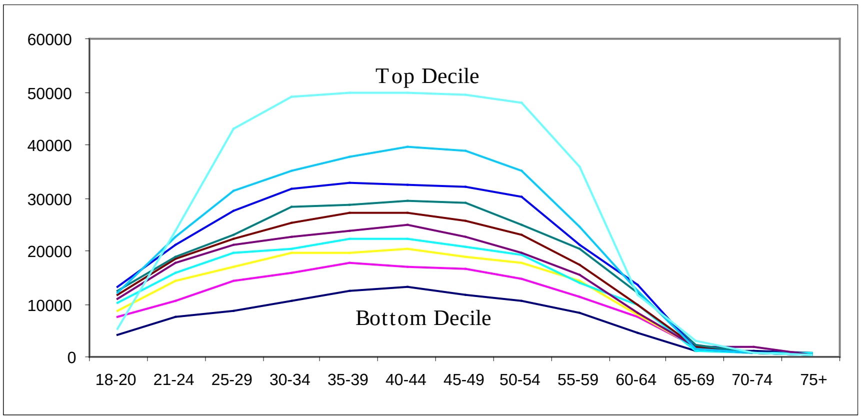
Actual Data *Smoothed Data*



source: RIM Unit

By placing full-time wage and salary earners into their correct career earning decile and allocating all other individuals to one of these deciles via appropriate transition probability matrices, total career earning profiles are estimated for each decile. Chart 10 shows the estimated total career earnings profile for each decile for males.

Chart 10. Total Male Career Earnings by Age - $/year - 1990



source: RIM Unit

Ageing And Public Expenditure

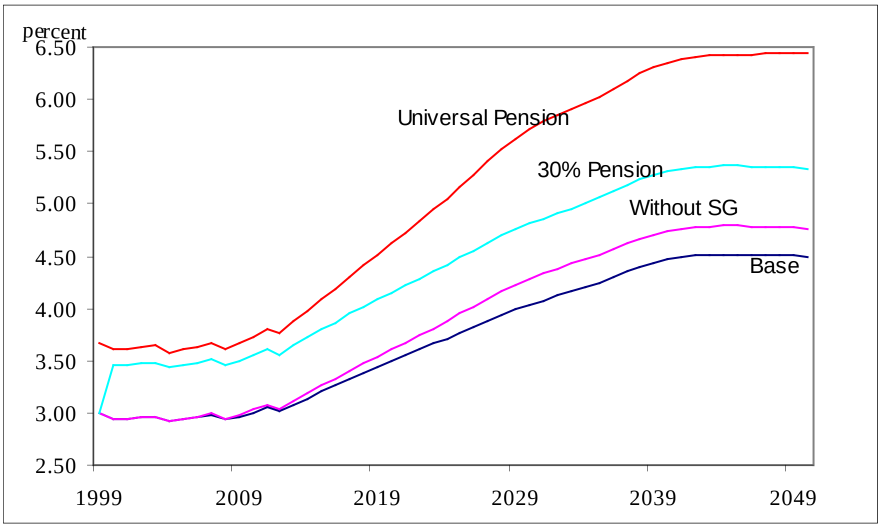
A major issue associated with ageing is the pressures it may place on the public purse. RIMGROUP is designed to answer ageing questions like: the sustainability of age pensions, the impact of compulsory superannuation and the proportion of aged that is expected to receive some pension. Further, the comprehensiveness structure of RIMGROUP means that it can serve as a framework for other longer term modelling such as projecting dependency ratios and the longer term costs of the health system. Two concrete examples using RIMGROUP from Rothman (1998) and used by the OECD (1999) special feature on population ageing, are instructive.

Pensions

The first example looks at the long term costs of age and veterans pensions, under different policy settings. The base RIMGROUP scenario is the continuation of voluntary superannuation saving and the Superannuation Guarantee (SG), with pensions indexed to AWOTE, but with threshold levels for income and assets tests indexed to CPI.

Chart 11 shows that the estimated costs of aged and veterans pensions will rise as a proportion of GDP. The base case has the percentage of GDP increasing by 1.5 percentage points in 2050 compared to a universal pension which increases public outlays by an extra 3.5 percentage points of GDP. Two other senarios, namely no SG system and a rise in the full age pension from its current benchmark of 25% of average male wages to 30%, are also shown for comparison.

Chart 11. Pension Costs – Percentage of GDP



source: RIM Unit

Health

The second example is that of health expenditures. RIM have produced projections of health outlays consistent with our GDP projections as input to the Government's Commission of Audit (1996).

The RIM projections are of total public plus private health costs for the years 2031 and 2041. The methodology used is an extension to that used by EPAC (1994). The basic methodology is to apply age-specific health expenditure per person to the projected numbers in that age.

Over the 14 years to 1997 health expenditure per capita increased by 2.8% in real terms. Ageing contributes some 0.6% and technology and demand 2.2%. That is 2.2% in age-specific terms, and on the assumption that this trend continues, rounded to 2%, health costs as a proportion of GDP would range between 15% and 19% by 2041 depending on the productivity assumption [15](Table 3).

With total health costs currently about 8.5% of GDP, and using the lower projection associated with productivity growth of 1.5%, the increase of 6.6 percentage points of GDP by 2041 could be compared with the projected base case increase in pension costs of 1.5 percentage points[16]. The

Table 3. Projected Health Costs as a proportion of GDP

Year	**2031**	**2041**

15 The Commonwealth's share of total health expenditure is currently around 45%. However, Commonwealth health expenditure per capita has been rising on average at 4.1% in real terms over the 5 years to 1997.

16 Around 60% of health costs flow from persons over 65 years of age in 2041.

Technology and Demand	1% pa increase	2% pa increase	1% pa increase	2% pa increase
1% productivity	10.7%	15.9%	11.7%	19.1%
1.25% productivity	9.8%	14.5%	10.4%	17.0%
1.5% productivity	8.9%	13.2%	9.3%	15.1%

difference in scale of the rise in health costs vis a vis pension costs is reasonably easy to understand in broad terms. As noted by Rothman (1998, p17)

> "… a pension costs much the same for an 85 year old as for a 65 year old [and are capped]. On the other hand, health costs [which are basically uncapped] rise rapidly with age, and the group with the largest growth rate is expected to be those aged over 80…."

These comparisons, however, must be made with care. On the one hand, there are a number of other social security costs which have seen significant growth in recent years which could be modelled[17], and on the other hand, the above health projections capture total health expenditures[18] not just government outlays.

Ageing and Saving

The life-cycle hypothesis suggests that wealth should decline after retirement. In fact rational behaviour implies that retirees should run down their assets to zero at the end of their lives. The hypothesis leads to the conclusion that individuals dissave in retirement and as the population ages the increasing proportion of retired households implies that aggregate saving will fall. Cross-sectional studies, however, suggest that the life-cycle model does not reflect reality and in fact the retired save as high a proportion of their income as the rest of the population.

A recent paper entitled "Is there a retirement-saving puzzle" (Banks, Blundell and Tanner 1998) used data from the UK Family Expenditure Surveys over the last twenty five years to investigate consumption, income and employment status across retirement years. They observe that:

> "For households in the oldest cohort there is some evidence of a divergence between income and consumption as households age further. It is not surprising that income falls after retirement….. What is surprising, however, is that consumption falls and that it appears to fall faster than income does. This means that cohorts are not running down their financial assets, and may even be re-saving some of their income"

[17] Disability support pension, newstart allowance, sole parent allowance, family payments.

[18] Public sector outlays on health for those over 65 increases by around 3.5 percentage points by 2041.

One reason for the large fall in consumption is that many of the expenditure items are employment related and that there is a large reduction in the consumption of these work-related goods at retirement.

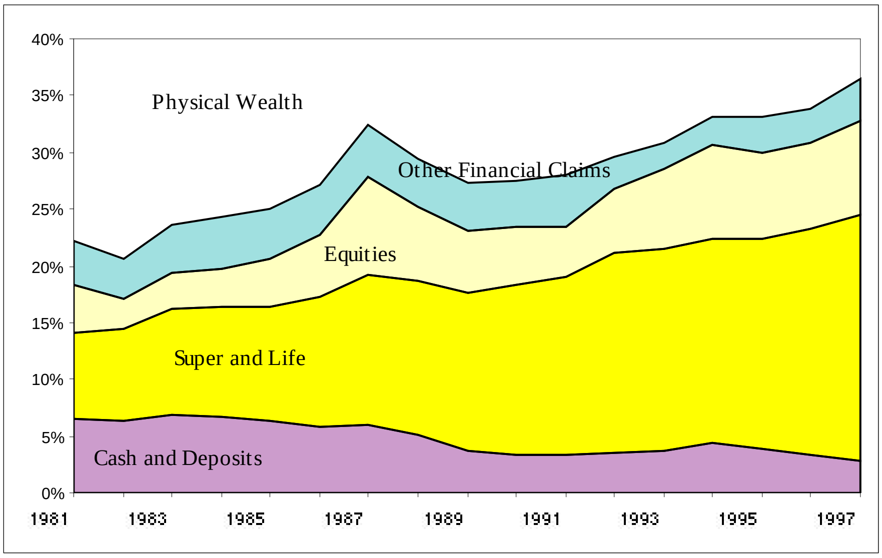
The resolution of the retirement puzzle rests to some extent on the definition of saving. Miles (1999) argues that " … saving rates that are normally constructed from micro data sets do not properly account for the declining value of pensions assets in retirement … the impact of this can be very substantial"

RIMGROUP models the asset accumulation on an accruing accounts basis which not only captures the run down in superannution accounts in retirement, but captures valuation effects throughout the accumulation process.

Ageing and Wealth

RIM has made estimates of the net wealth of households (Bacon 1998). These imply an average annual growth rate since 1971 of some 11% in nominal terms or 9.7% per capita. Dwellings are the most significant component of wealth for most Australians at around 50-56% of total wealth. Financial Assets have grown as a proportion from around 22% in 1981 to some 35% in 1996, with households increasingly holding wealth as superannuation and as equities (Chart 12).

Chart 12. Household Financial Assets – Proportion of Total Wealth



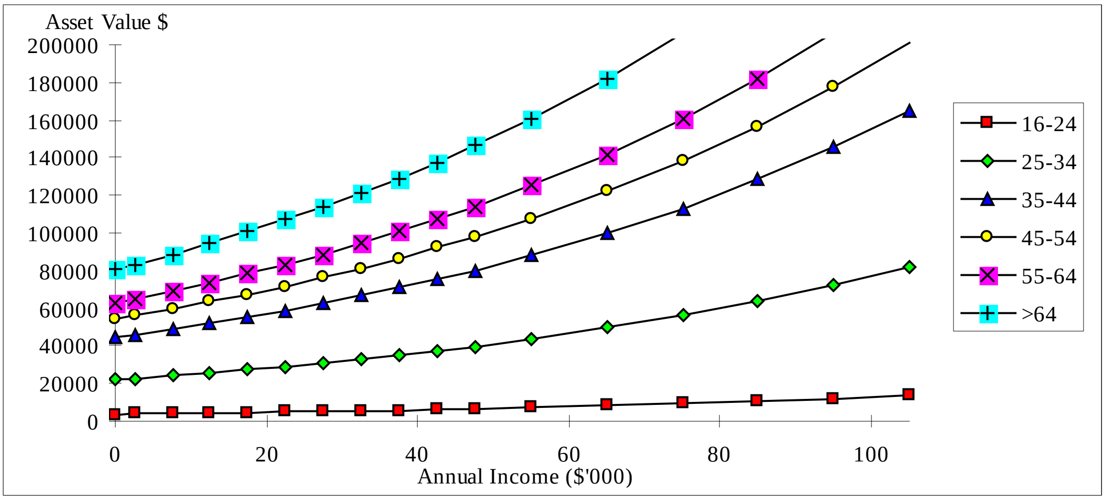
source: RIM Unit

Savings Functions

In this case we are interested in how asset values are related to income. To get a handle on saving elasticities we estimated smoothed age-specific savings functions from the 1989/90 IDS using a log-linear model specification. The results show how the value of asset held and the elasticity vary with income and age, and how they vary with the type of asset.

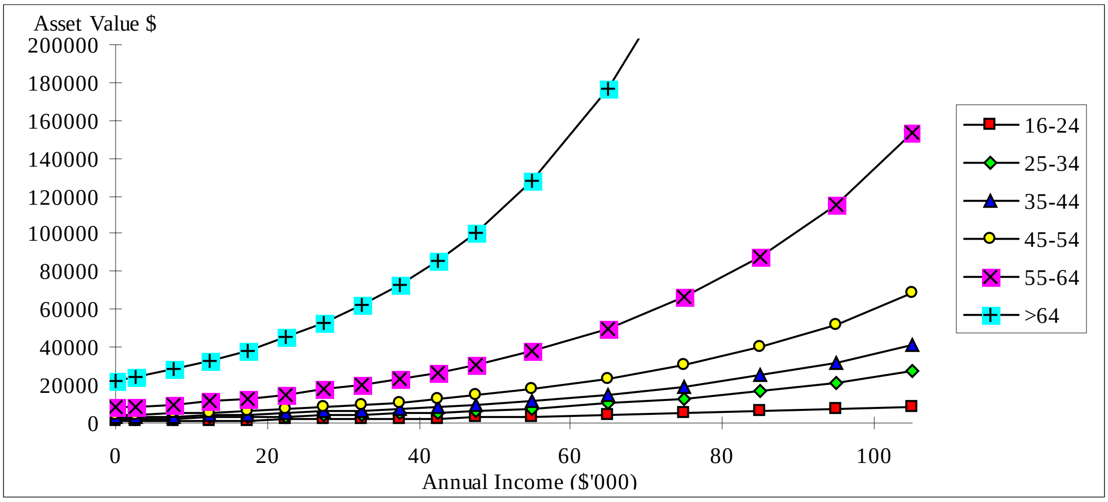
Dwelling elasticities, for example, are relatively flat and constant across age (Chart 13). The value of the dwelling asset increases dramatically with age as the housing mortgage is paid off.

Chart 13. Dwelling Assets



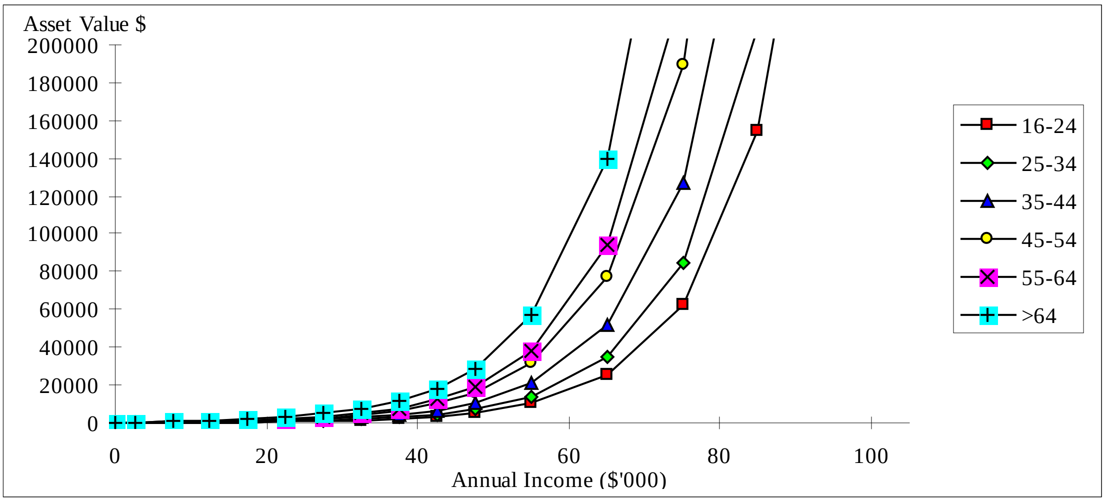
Savings elasticities for interest bearing assets show greater growth with income (Chart 14). The functions are tightly bunched at younger ages and only show significant growth after 55 years of age, possibly reflecting greater liquidity as homes are paid off and or mortgage repayments decrease.

Chart 14. Interest Bearing Assets



Lastly we see that the savings elasticities for equities grow exponentially at around an annual income of 60 thousand dollars (chart 15). Again the effect is more pronounced at higher ages but the income effect is more sensitive than the effect with age.

Chart 15. Equities



The significant observation to make from these charts is the amount of assets held by those over 65 years of age. RIM estimates that, for these three assets, people over 65, who made up some 14% of the population, held some 27% of wealth in 1990.

These estimates give a static picture and do not address the dynamics of saving and wealth. To fully understand saving behaviour of the retired detailed dynamic analysis is required.

Ageing and Bequests

There is some indirect evidence that the desire to leave a bequest is an important motive for saving throughout a persons life. On the other side of the coin, if the young anticipate receiving bequests they might under save (Jackson 1998 p55). The resultant aggregate saving outcome is then not clear.

Unfortunately, Australia only has limited data to analyse bequest motives. Anecdotal evidence suggests that although Australians, might be prepared to run down financial assets in retirement, they do not, and will not, run down their capital assets (housing). This is often explained by the desire of Australians to leave their wealth, which is primarily held as housing, to their children and by their aversion to longevity risk.

To make RIMGROUP balance and hit external benchmarks, however, the model must assume that retirees run down their financial assets at a slower rate than that implied by an annuity pattern. Although not based on quality data, this does suggests that Australian’s do not dissave at anywhere near the rate implied by the life cycle hypothesis.

The Survey of Families in Australia 1992 records some quantitative information on the incidence of inheritance and support for home and land purchase over the ten years before the survey for amounts over $10,000. 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 families 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 an inheritance at some time in their lives 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. In particular, a full cohort model of saving and bequests might give considerable insight into the distributional effects.

Pulling It All Together

Although the analysis presented above only represents part of the story, it is instructive to pull these results together to identify tensions which might develop by the middle of next century.

As noted above, household wealth per capita has been growing at almost 10% per annum. Falling fertility and the consequential decline in the number of children per family, implies that these children will be receiving larger bequests/inheritances. This increasing individual wealth should lower labour supply through the work/leisure tradeoff.

At the same time, the ageing population is reducing the potential size of the work force creating excess demand for labour which should manifest itself as a reduction in unemployment and pressure on wage outcomes. The later would of course increase the incentive to enter or stay in the work force.

Further, the pressure on the public purse, which the paper suggests will come more from health expenditures than the age pension, will create tension between raising tax revenues and reducing other government outlays.

Only considerable more quality data and research, particularly longitudinal data and analysis, will enable quantification of these interacting tensions

Summary

This paper raises some broader economic issues of how Australian society might look like in say sixty years time based on plausible assumptions underlying RIM's demographic, labour force, earning and asset accumulation modelling. Sixty years is a long time horizon and any projections will be subject to considerable uncertainty. There are, however, a number of strong underlying long-run trends which might give us a handle on the economics of the ageing process and the possible economic environment Australia might face in the next century. This paper, through a discussion of the modelling of these forces, highlights a number of tensions that could come into play.

The paper illustrates the potential of RIMGROUP to provide a useful general analysis tool for a range of longer term studies, drawing on the strength of the population and labour force projections, the extensive study of retirement, the inclusion of superannuation and other savings and the wide coverage of government payments to beneficiaries and pensioners, all within a strong distributional framework distinguished by age, income and gender.

SUMMARY OF RIM DEMOGRAPHIC MODELS

MIGMOD – Migration Model

The overseas migration model projects annual and quarterly profiles of permanent and long-term arrivals and departures by age and sex from exogenous aggregate projections.

POPMOD - Population Model

POPMOD provides annual projections of Australia's population 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 (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

The long-run version of this model is an annual model of the Australian labour force to capture structural (trend) behaviour at fine detail. 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 into employed/unemployed, full-time/part-time, public/private, and wage and salary earners/employers/self employed groups. Persons not in the labour force are split into retired/never in labour force/permanently disabled/temporarily not in the labour force groups. 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-liner 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 a user supplied aggregate unemployment rate. The model is available in EXCEL.

RETMOD - Retirement Model

This model provides annual projections of retirement by gender, age and income decile. More details of this model can be found in Bacon (1997).

SUPERANNUATION MODELS

RIMHYPO - Retirement Income Modelling Hypothetical Model

RIMHYPO - which is a very detailed lifecycle projection model of working life incomes, superannuation, other savings and retirement incomes for hypothetical individuals and couples.

MEMSUPER - Member Superannuation Model

MEMSUPER is a static microsimulation model of employee personal superannuation based on a highly disaggregated summary file from the ABS Superannuation survey 1993.

SEMSUPER - Self Employed Member Superannuation Model

SEMSUPER is a static microsimulation model of self employed personal superannuation based on a sample file of personal income tax returns from 1995-96.

RIMGROUP - Retirement Income Modelling Group Superannuation Model

RIMGROUP is RIM's 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 to aggregate at a level 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.

RIM Modified STINMOD Out-Years Model

RIM has substantially modified STINMOD, the static microsimulation model of personal incomes developed by NATSEM. The two major modifications are its conversion to an out-years model running each year to 2001-02, based on RIM's projection models and the inclusion of superannuation contributions.

REFERENCES

Alvarado, J. and Creedy, J. 1998, *Population Ageing, Migration and Social Expenditure*, Edward Elgar, Cheltenham, UK.

Bacon, B.R. 1998, *Household Wealth and the Aged*, Conference Paper 98/3, Retirement Income Modelling Unit, Treasury.

______ 1997, 'Work, Retirement and Dependency', People and Place, Vol. 5, No. 2, pp. 26-39.

______ 1994, *RIM Population and Demographic Modelling*, Working Paper 94/2, Retirement Income Modelling Task Force, Treasury.

______ and Miners S. 1994, *Career Earnings and Labour Force Status*, Unpublished Paper, Retirement Income Modelling Task Force, Treasury.

Banks, J., Blundell, R. and Tanner, S. 1998, 'Is There a Retirement-Savings Puzzle?', The American Economic Review, Vol. 88, No. 4, pp. 769-788.

Börsch-Supan, A. 1996, 'The Impact of Population Ageing on Savings, Investmment and Growth in the OECD Area' in OECD, Future Global Capital Shortages, OECD, Paris, pp. 103-141.

Borland, J. and Wilkins, R. 1996, 'The Age-Earning Structure in Australia', Australian Economic Papers, Vol. 36, pp. 69-84.

Bös, D., and von Weizsäcker, R. 1989, 'Economic Consequences of an Ageing Society', Eurpean Economic Review, Vol. 33, pp. 345-354.

Commission of Audit 1996, Report to the Commonwealth Government, AGPS, Canberra.

Disney, R. 1996, *Can We Afford to Grow Old*, MIT Press, Cambridge, Massachetts.

EPAC 1994, *Australia's Ageing Society*, Background paper No 37, AGPS Canberra.

Gallagher P. 1995, *The Policy Use of the Products of the Retirement Income Modelling Task Force*, Conference Paper 95/3, Retirement Income Modelling Task Force, Treasury.

Hurd, M. 1990, 'Research on the Elderly: Economic Status, Retirement, and Consumption and Saving', Journal of Economic Literature, Vol. XXVII, pp. 565-637.

Irvine I. 1981, 'The Use of Cross-Section Microdata in Life Cycle Models: An Application to Inequality Theory in Nonstationary Economics', Quarterly Journal of Economics, Vol. 96.

Jackson, W. 1998, *The Political Economy of Population Ageing*, Edward Elgar, Cheltenham, UK.

Johnson, P. and Zimmermann, K. 1993, *Labour Markets in an Ageing Europe*, Cambridge University Press, Cambridge.

Masson, P. and Tryon, R. 1990, ‘Macroeconomic Effects of Projected Population Aging in Industrial Countries’, IMF Staff Papers, Vol. 37, No. 3, pp. 453-485.

Miles, D. 1999, ‘Modelling the Impact of Demographic Change upon the Economy’, The Economic Journal, Vol. 109, pp. 1-36.

OECD 1999, *OECD Economic Surveys – Australia* – 1999, OECD, Paris.

_____ 1995, *The Transition from Work to Retirement*, Social Policy Studies No 16., Paris.

Rimmer, R. and Rimmer, S. 1994, *More Brilliant Careers: The effect of career breaks on women's employment*, DEET, Canberra, AGPS.

Rothman, G. 1998, *Projections of Key Aggregates for Australia's Aged*, Conference Paper 98/2, Retirement and Income Modelling Unit, Treasury.

______ 1997, *Aggregate Analyses of Policies for Accessing Superannuation Accumulations*, Conference Paper 97/2, , Retirement Income Modelling Task Force, Treasury.

______ 1996, *Aggregate and Distributional Analysis of Australian Supperannuation using the RIMGROUP Model*, Conference Paper 96/3, , Retirement Income Modelling Task Force, Treasury.

______ 1995, *The Distribution of Private Sector Superannuation Assets by Gender, Age, and Salary of Members*, Conference Paper 98/2, , Retirement Income Modelling Task Force, Treasury.

Sarel, M. 1995, ‘Demographic Dynamics and the Empirics of Economic Growth’, IMF Staff Papers, Vol. 42, No. 2, pp. 398-410.

Saunders, P. 1996, *Dawning of a New Age? The Extent, Causes and Consequences of Ageing in Australia*, SPRC Discussion Paper No 75, University of New South Wales.

Turner, D., Giorno, C., De Serres, A., Vourc'h, A. and Richardson, P. 1998, *The Macroeconomic Implications of Ageing in a Global Context*, Economic Department Working Paper No. 193, OECD, Paris.

Young, C. 1994, ‘The Future Population and the Future Labour Force’, People and Place, Vol. 2, No 4, pp. 15-21.