RETIREMENT INCOME MODELLING

AND POLICY DEVELOPMENT IN AUSTRALIA

Mr Phil Gallagher, Director, Retirement Income Modelling Task Force
c/- of Treasury, Parkes Place Parkes Ph (06) 263 3945. Fax (06) 263 2724.

Dr Alan Preston, Deputy Secretary, Treasury
Parkes Place, PARKES ACT 2600
(Chair, Steering Committee, Retirement Income Modelling Task Force)

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ABSTRACT

This paper examines recent attempts to model the long-term impact of retirement income policies in their demographic, economic and policy contexts. The paper particularly concentrates on the work of the Retirement Income Modelling Task Force which is jointly sponsored by the Commonwealth Departments of Treasury, Finance and Social Security.

The strengths and limitations of the microsimulation models of the Task Force are examined. The work of the Task Force is used to raise management issues central to any Government modelling of policy issues.

The policy significance of current and planned Task Force analysis is explained.

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Mr Colin Brown (06 263 3932)
Mr Bruce Bacon (06) 263 3935, and
Dr George Rothman (06) 263 3947.

NOTE

The views expressed in this paper are those of the authors and do not necessarily reflect the views of other members of the RIM Steering Committee, of the Departments financing RIM, or of the Ministers of those Departments.

Introduction

The ageing of the Australian population is a long term process which will have long term effects on the Commonwealth Government's capacity to fund an adequate age pension system. In June 1992 there were 2.0m persons aged 65 years and over, in 2031 there are projected to be 5.2m. The aged will increase from around 11.5% of the population to 20.1%. The Government's retirement income policy must be concerned with both short term and long term effects. Prior to the Treasurer's 1992 statement, *Security in Retirement* (Dawkins 1992), Government analysis had tended to concentrate on the short-term effects on the economy and the long term nature of the demographics. For example, the Government's 1989 statement on *Better Incomes: Retirement Incomes Policy into the Next Century* (Howe, 1989) and *Issues Paper No.6 of the Social Security Review* (Foster, 1988) did not present any long-term projection modelling of the effects of retirement income policies on individuals, on the population as a whole, on the fiscal balance or on the economy. More recently, however, a long term focus has increasingly become a feature of the Government's approach to retirement income policy.

The purpose of this paper is to describe current developments in models of the long term effect of retirement income policies and to place these developments in their demographic, economic and policy contexts. The major current development is the Retirement Income Modelling (RIM) Task Force, a two year cooperative venture begun last year involving three Commonwealth Departments - Treasury, the Department of Finance and the Department of Social Security. The paper focuses on the work of that Task Force including the strengths and limitations of its hypothetical, group and proposed microsimulation models. Management issues central to any Government modelling of policy issues are posed in the context of the work of the RIM Task Force. The policy significance of current and planned Task Force analysis is also explained.

The Demographic Context

Policy concern and analysis related to ageing of the Australian population date from 1984 when the Australian Bureau of Statistics (ABS) began producing regular demographic projections. Previous demographic reports such as the Borrie report (1975) had projected Australia's population up to 2001. The ABS projections went from 1984 to 2021 and showed the era of Australia's being a relatively young country by the standards of the industrialised world ending as the influence of high post war immigration and the post-war baby boom abated and the retirement of the baby boomers loomed on the horizon.

These projections kindled a lot of analysis of policy issues associated with the ageing of the population. Government analysts used the new data to project outlays using the static assumption of fixed expenditure per individual in a given age group (eg Social Welfare Policy Secretariat (1984), Office of the Economic Planning Advisory Council (1988)). These initial estimates were updated using later projections by the Department of Community Services and Health (1990) and by the National Population Council (1991). These simple projections made no allowance for policy effects, accumulation of retirement savings, labour force and economic changes.

The latest unpublished ABS data prepared for the Office of the Economic Planning Advisory Council extend the projections to 2051, about the time when a full generation will have benefitted from a fully phased in Superannuation Guarantee policy. Chart 1 shows the increases in Australian working age population with various plausible assumptions on fertility and migration. Chart 2 shows how the ratio of those aged 65 and over to those aged 15-64 varies for each of the ABS demographic projection series. For each scenario there is more than a doubling of the age dependency ratio. The slight decrease in the dependency ratio of the young offsets this to only a

small degree, particularly when account is taken of the relative per capita government outlay on the old - which is more than twice that for the young (Department of Community Services and Health (1990)). Chart 3 presents the projected age structure of the population in 2031 and 2051. It is also worth noting that the increase in the over 80 age group - the group making the highest demands on government outlays - is even higher than for the over 65 total.

Clearly, many of the institutional and other factors held constant in the earlier analyses are also changing rapidly, particularly labour force participation (of women and older workers) and the accumulation of retirement savings. It is to address these and other complexities that more complete models are needed, amongst them the models being developed and used by the Retirement Income Modelling Task Force described later in this paper.

Chart 1: ABS Population Projections: 15-64 years old (a)

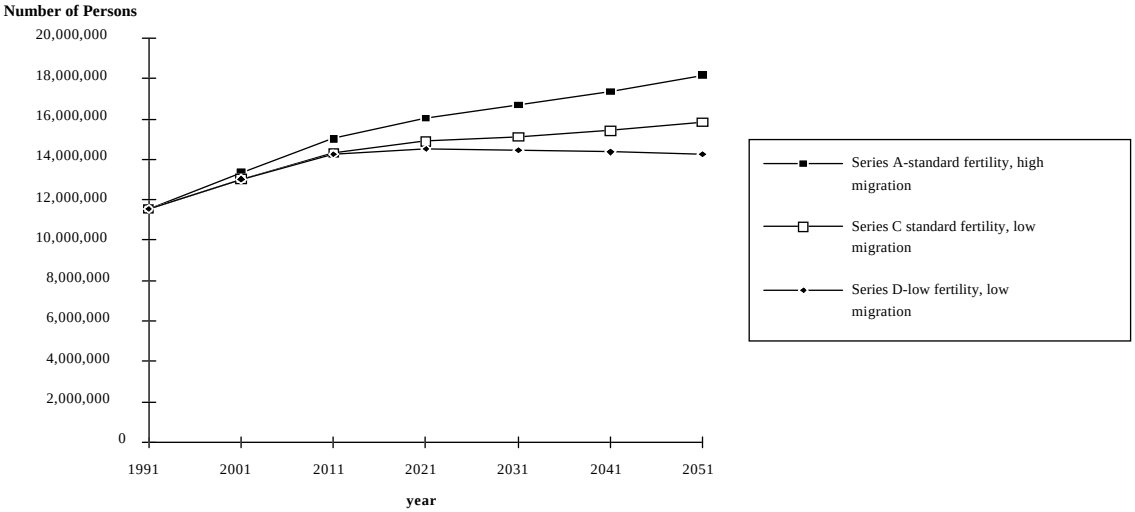
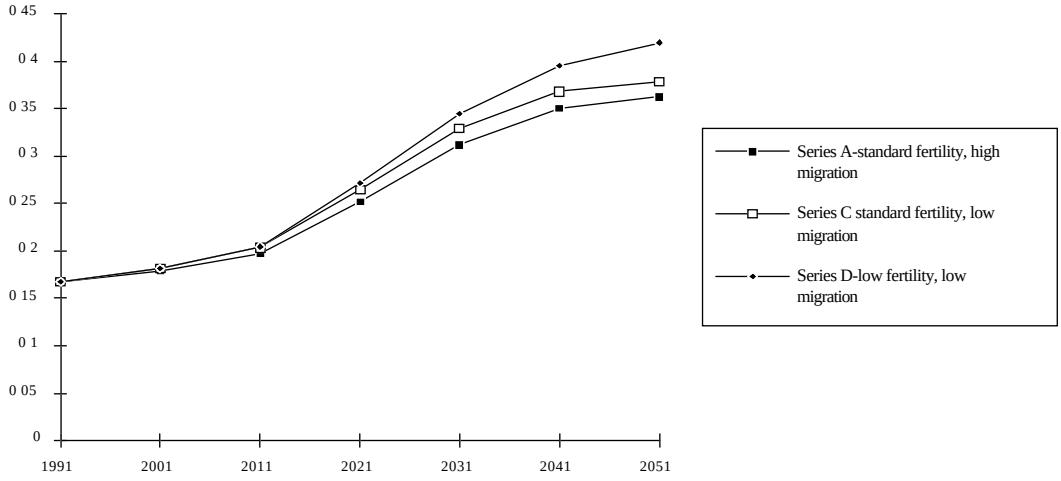
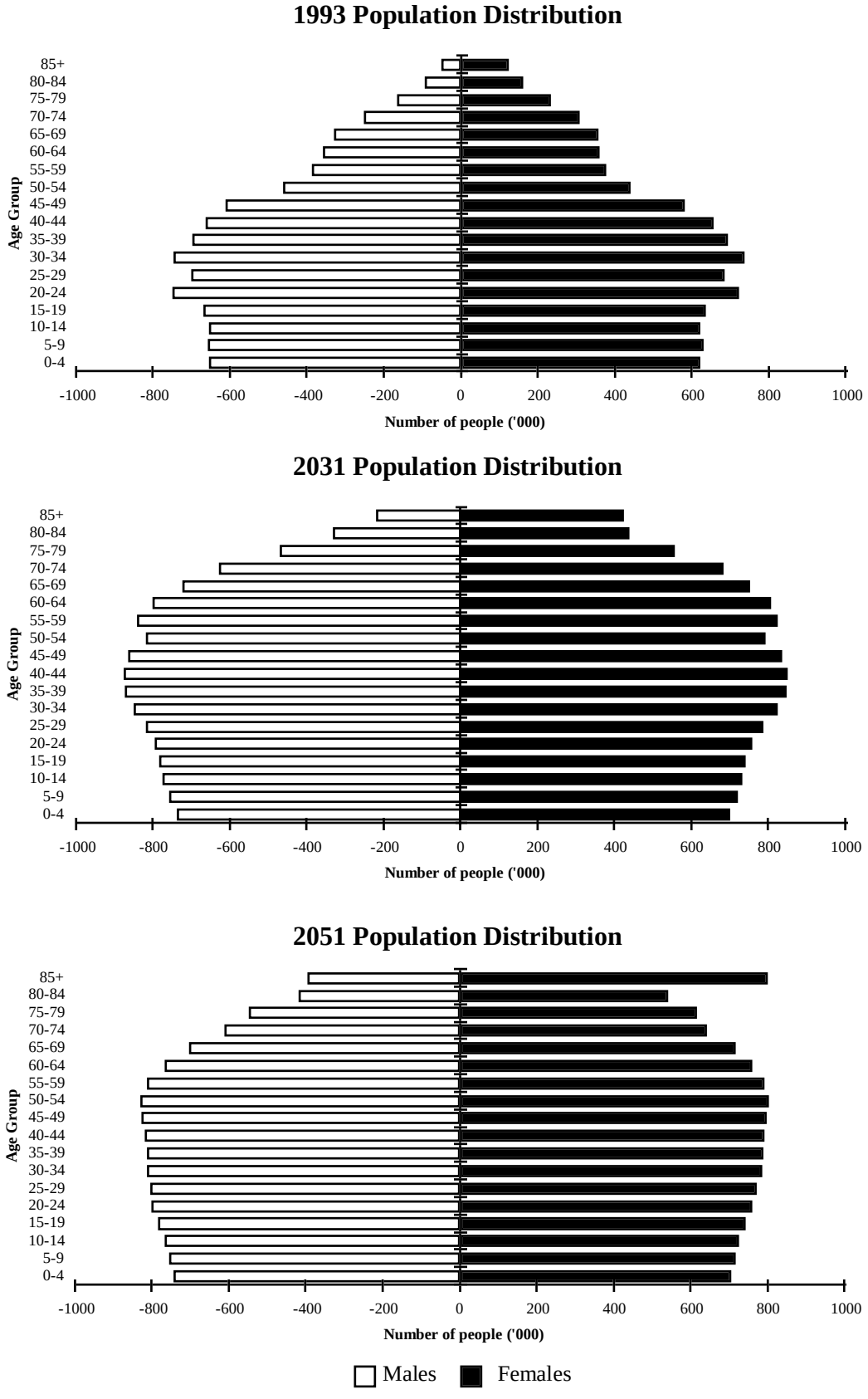


Chart 2: ABS Projection of Persons 65 and over as a Proportion of Persons 15-64 (a)



(a) Source: ABS Population Projections Prepared for the Office of EPAC

CHART 3: PROJECTED AGE STRUCTURE OF THE POPULATION



The Economic Context

As noted by Dr FitzGerald (1993) in his recent report to the Treasurer, Australia's national saving is now at its lowest level this century (other than in the "national emergencies of two World wars and the great depression"). He goes on to state that "*Prima facie,* Australia is not generating adequate saving...for the Australian economy to *continue* to grow...at rates which will deliver rising living standards, rising employment and a return to acceptable levels of unemployment, will require sustained strong flows of investment. This will in turn require strong flows of saving."

Both private and public saving are at historically low levels. Apart from recent cyclical influences and other structural factors, it is arguable that retirement income policy to date has also had a significant impact on national savings. With an age pension policy which maintains the value of the pension at around 25% of Average Weekly Earnings (AWE), individuals have not been compelled to save as vigorously for their retirement, so lowering private saving, and there is concern that the ageing of the population could see age pension outlays putting further pressure on public saving.

Most Australians hold their assets in the form of housing and consumer durables, which do not readily provide a retirement income. The Treasury (1992) estimated that some 57% of private saving is in housing and another 6% in the form of consumer durables. Financial savings, such as superannuation and other investments, which could be used for retirement, have a very unequal distribution.

Prior to 1974 only 32% of all employees were covered by superannuation and the coverage only increased slowly to be around 40% in 1986. During this period, poor *vesting* and limited *preservation* requirements meant that the superannuation cover did not target the provision of retirement income well. The introduction of the 3% award superannuation [1]recognised that traditional tax incentives had to be complemented with other mechanisms. The move to some form of compulsion acknowledged the fact that an *incentive only* approach had not achieved widespread superannuation coverage - and could not be expected to do so. It was clear that, in general, individuals discount the future too heavily, and prefer to consume excessively now rather than save sufficiently for the future. This myopia is reinforced by a community reliance on the age pension to provide an appropriate retirement income. That the age pension may not provide an adequate replacement income (particularly as a proportion of pre-retirement income) seems often to be overlooked, and anecdotal evidence indicates that many Australians have been surprised at the drop in their living standards following retirement.

Further, low income earners, who face a significant constraint on discretionary saving, are unlikely to be able to access and hence respond to the superannuation tax concessions.

Although superannuation coverage doubled from around 40% in 1986 to 80.3% in 1992, most of the growth was in award contributions at 3%. However, as the Superannuation Guarantee Charge (SGC) [2] policy is progressively implemented, contributions and coverage will increase and superannuation will play an increasingly more significant role in retirement planning in Australia.

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[1]In 1986, the Government encouraged the extension of superannuation by supporting the Australian Council of Trade Unions case for employer superannuation contributions of 3% of wages to workers covered by awards. The Arbitration Commission endorsed the submission - the resulting contribtions were called 'award or 'productivity' superannuation.

[2] The Superannuation Guarantee Charge was announced by the Treasurer on 30 June 1992. The policy uses the tax powers of the Commonwealth to enforce compulsory employer superannuation at a minimum level for all workers with salary and wages over $450 per month. A non-deductible charge incorporating the minimum contribution is levied on defaulters. See the Policy Context section of this paper and Bateman and Piggot (1993) for further details.

The levels of non-superannuation financial savings are also too low to adequately fund retirement. Gallagher, Rothman and Brown (1993) have shown that most of the population covered by the SGC have quite limited financial assets (see Table 1). In fact only 30% of the SGC population have financial assets exceeding $2272, not even enough to pay for food for one year. The median level of imputed non-superannuation financial assets for those aged 55-64 is $2727 - patently not enough to retire on.

TABLE 1: DISTRIBUTION OF IMPUTED FINANCIAL ASSETS (a) IN THE SGC POPULATION(b) IN 1989-90.

	PERCENTILE (c)										
POPULATION	**25%**	**50%**	**60%**	**70%**	**75%**	**80%**	**90%**	**95%**	**MEAN**	**Standard Deviation**	**Estimated Persons**
	(Value of Financial Assets that Stated Percentage of Population is below)										
Total SGC (b)	$0	$454	$1,136	$2,272	$3,598	$5,522	$18,939	$50,136	$18,958	$142,372	6,304,947
INCOME GROUPS											
Below $20,000pa	$0	$189	$576	$1,515	$2,273	$3,788	$13,705	$39,371	$12,583	$68,930	2,414,886
$20K - $35K pa	$0	$477	$1,038	$2,083	$3,030	$4,545	$15,152	$37,288	$15,615	$138,988	2,715,587
$35K - $50K pa	$91	$1,136	$1,992	$3,788	$5,886	$8,530	$28,788	$75,758	$21,462	$91,374	838,120
Above $50,000 pa	$492	$3,788	$8,333	$16,393	$25,758	$41,667	$115,795	$350,924	$85,476	$405,284	336,354
AGE GROUPS											
17 - 24 YEARS	$0	$98	$326	$758	$1,136	$1,515	$3,788	$7,576	$2,180	$13,201	1,167,418
25 - 34 YEARS	$0	$379	$758	$1,515	$2,273	$3,598	$11,334	$25,417	$12,646	$133,669	1,833,742
35 - 44 YEARS	$0	$606	$1,439	$3,030	$4,545	$7,576	$25,076	$84,866	$23,944	$118,451	1,710,734
45 - 54 YEARS	$0	$1,136	$2,273	$4,848	$7,576	$12,121	$37,879	$122,164	$34,327	$240,976	1,111,607
55 - 64 YEARS	$91	$2,727	$5,303	$9,697	$15,152	$22,871	$60,606	$136,364	$30,478	$106,968	481,446

SOURCE: Analysis of the Unit Record Data of the 1989-90 ABS Income & Housing Survey

(a) Financial assets are ordinary savings plus shares. The value of ordinary savings was imputed by dividing interest income by the bond rate of 13.2%. The value of shares was imputed from dividends using a yield of 6 10%.

(b) Persons whose 1989-90 wage and salary income was over $5100 excluding those over 65 or under 18 years and part-time.

(c) This analysis was performed using PROC UNIVARIATE in SAS with the frequency of each observation set to the integer part of its weight. The analysis would vary slightly if full weights were used in a user written procedure.

Chart 2 illustates the extent to which financing retirement is an intergenerational equity issue. Currently those aged 65 and over are about 17% of the population aged 15-64. By 2031 they will be 32% and by 2051 they will be over 36%. That is, if other things remained equal, the relative tax burden imposed by the aged on those working would have doubled over the next four decades or so. Given that the baby boomers are the leading edge of the bulge in the population, and a group who have experienced on average better employment rates, it may well be appropriate for them to make greater provision for their own retirement than previous generations.

The Policy Context

The Government's retirement income policy is firmly based upon three principal elements. The first is the publicly provided age pension, set at around 25% of male average weekly earnings, which underpins Australia's retirement income policy and ensures all Australians receive a reasonable minimum level of income in retirement. The second element is the concessionally taxed voluntary superannuation system and the third is the concessionally taxed compulsory superannuation system for workers who receive employer contributions only at a prescribed minimum. The second and third elements are aimed at generating greater private saving for retirement so that people are able to enjoy a standard of income in retirement which is linked to their income while still working and which is well above that which would be possible from the age pension alone.

In the longer term, to the extent to which there is a net increase in national saving as a result of such induced superannuation saving, the increased private retirement saving will also assist in making the provision of an adequate standard of living in retirement affordable in the face of the demands placed upon the economy by an ageing population.

Since 1983, the Government has done much to transform the role of superannuation savings within Australia's retirement income policy framework. Prior to 1983:

- the majority of the workforce were not members of superannuation schemes;
- a very strong tax incentive existed to take superannuation benefits in the form of lump sums (only 5 % of which were taxable at marginal rates) rather than as regular income (fully taxed at marginal rates);
- there was little regulation of superannuation to ensure it was directed at saving for retirement; and
- there was no incentive, or opportunity, to preserve superannuation benefits received on change of employment until retirement and there was a lack of opportunities for portability of benefits. Consequently, superannuation mainly served to provide people with concessionally taxed windfalls on change of employment.

The Government's policy initiatives in 1983 commenced the reform process for overcoming these shortcomings:

- In 1983, the tax on that component of lump sum benefits relating to employment after June 1983 was increased to reduce the bias against people taking benefits as annuities and pensions and a higher tax imposed on benefits taken before age 55 to encourage benefits to be preserved until retirement after that age.
- Rollover vehicles, namely approved deposit funds and deferred annuities, were also created in 1983 to provide people with the opportunity to preserve their superannuation benefits within the concessionally taxed environment until retirement no later than age 65 and to facilitate the portability of superannuation benefits when people change jobs.

This system was still based solely on tax incentives for private retirement income provision. The relative failure of these concessions to achieve their desired result can be seen from the poor coverage of superannuation prior to the introduction of award superannuation when, despite considerable tax incentives, only around 40% of the workforce had superannuation cover, with these mainly being higher income earners and people employed in the public sector. The use of compulsion in retirement income provision arose from the failure of tax concessions by themselves to encourage voluntary savings at a level sufficient to provide reasonable levels of retirement income in the future for all but the very wealthy.

Table 2: Retirement Income Systems in Twenty-One Countries – Contributions and Benefits

	Compulsory Contributions for Retirement		Retirement Income Stream
Austria	Employer Employee	12.55% 10.25%	40-73% of actual final earnings
Belgium	Employer Employee	8.86% 7.50%	60% of career average earnings for single person
Chile	Employer Employee	Nil 20.6%	Government guarantees minimum pension
Denmark	Employer Employee	A$314 A$157	Minimum social security pension
Finland	Employer Employee	19.3% 1.55%	Up to maximum of 60% of earnings
France	Employer Employee	8.20% min 7.60% min	40-75% of career earnings
Germany	Employer Employee	9.35% 9.35%	40-45% of final earnings
Greece	Employer Employee	10.5% 5.25%	30-70% of final earnings
Ireland	Employer Employee	11.3% Nil	Flat social security benefit
Italy	Employer Employee	14.8%-30.43% 6.1%-10.79%	80% of final career earnings
Japan	Employer Employee	7.25% 7.25%	Flat benefit plus earnings related benefit
Luxembourg	Employer Employee	8% 8%	60-70% of final pay
Netherlands	Employer Employee	Nil 16.95%	60% of national average earnings
New Zealand	Employer Employee	Nil Nil	Flat rate pension
Portugal	Employer Employee	24.5% 11.0%	50-60% of final year salary
Singapore	Employer Employee	17.5% 22.5%	Depends on contributions
Spain	Employer Employee	24.0% 21.8%	76-85% of final earnings
Sweden	Employer Employee	28.45% Nil	66% of final pay
Switzerland	Employer Employee	11.8%-22.8% 4.8%	60% of final salary
UK	Employer Employee	av. 10.45% 2%-9%	20% of revalued earnings with effect from 2000
USA	Employer Employee	6.2% 6.2%	25-60% of assessable earnings

Source: Senate Select Committee on Superannuation (1992)

Supporting this, overseas experience has shown that achieving adequate provision for retirement income requires a compulsory system. Most OECD countries have compulsory levies to finance the provision of retirement income, whether through pay as you go schemes or through schemes that advance fund retirement benefits. Table 2, summarising compulsory arrangements in 21 countries, shows that compulsory contributions typically are in the range of about 15% of employee earnings, generally shared to some extent between employer and employee contributions, with countries such as Singapore and Spain having contribution rates as high as 40% of employee earnings.

In Australia, our recent attempt at a compulsory system of retirement saving began through the introduction of industrial award superannuation from 1986. The Government encouraged the spread of superannuation through the workforce by agreeing with the peak employee body, the Australian Council of Trade Unions (ACTU), to support 3% of wages being paid as new or improved superannuation as part of a productivity agreement. Award superannuation was fully vested in the member and subject to preservation until retirement after age 55. This agreement was subsequently endorsed by the Industrial Relations Commission and industrial award superannuation became the principal vehicle for increasing the superannuation coverage of wage and salary earners.

Such award superannuation involved involved a number of problems, including:

- the level of non-compliance with awards by employers and the cost of pursuing employers who are in breach of awards;
- the fact that not all wage and salary earners are covered by awards; and
- the time and difficulty in having award superannuation provisions reflected in awards in all jurisdictions, State and Federal, and the problems this system would pose for achieving increased superannuation contributions.

The Government's 1989 retirement income policy statement, *Better Incomes: Retirement Income Policy into the Next Century* (Howe, 1989), established a retirement income policy in Australia based on the "twin pillars" of the age pension and private superannuation, specifically rejecting the option of a National Superannuation Scheme. This statement affirmed the role of superannuation funds in retirement income policy and emphasised that the system was not subject to a Government guarantee. Essentially, the Government only underwrites the system to the extent of the publicly funded age pension and tax concessions on fund earnings. This made achieving higher levels of superannuation contributions for most wage and salary earners a matter of priority. At the same time, it became increasingly obvious that the initial 3% industrial award superannuation would be insufficient to have much impact on retirement incomes or on age pension outlays, even in the long term. With the refusal of the Industrial Relations Commission to readily grant further increases in industrial award superannuation and the problems with the award system outlined above, a more comprehensive system was clearly necessary to increase the level and coverage of superannuation contributions.

Accordingly, the Government announced the introduction of a **Superannuation Guarantee Charge (SGC)**, to commence on 1 July 1992, in the 1991-92 Budget. Final details were announced in the June 1992 *Security in Retirement* Statement (Dawkins, 1992), along with improved prudential supervision of superannuation and a number of measures to simplify the taxation and Reasonable Benefit Limit[3] treatment of superannuation benefits. Under the SGC, employers are required to

[3]Reasonable Benefit Limits restrict the amount of a superannuation payout which attracts concessional taxation. The Security in Retirement statement replaced limits based on a person's highest average salary with flat dollar limits.

make minimum contributions for their employees according to a scale that phases in contributions up to 9% of salary by 2002, with an "envisaged" 3% employee co-contribution also flagged for some time in that period to raise total SGC contributions to 12% of salary. These contributions would be sufficient to provide a gross superannuation income stream of around 40% of final salary on retirement at age 65 after around 40 years' contributory service.

As a result of the SGC proposal, the Senate Select Committee on Superannuation in April 1992 called for better modelling of the long term implications of the SGC. In response, estimates of the long term impact of the SGC on age pension outlays and national saving, generated using the National Mutual Retirement Income Policy Model (RIP), were included in *Security in Retirement*. Further in response to the Senate Committee, the Treasurer and the Ministers for Finance and Social Security announced the formation of the Retirement Income Modelling (RIM) Task Force, to enhance the Government's capacity to model the long term implications of retirement income policy, in May 1992.

The Retirement Income Modelling Task Force

Commencing operation in August 1992, the Retirement Income Modelling (RIM) Task Force is expected to finalise its work by September 1994. The Task Force is financed on an equal share basis from existing resources by the Departments of the Treasury, Finance and Social Security. The maximum staffing of the Task Force is seven officers and typical staffing up to recently has been four or five officers.

The Terms of Reference of the Task Force (see ATTACHMENT A) require it to develop computer models which project the comparative costs and benefits of alternative retirement income policies over the next fifty years. These costs and benefits are to be modelled at the individual and at the population (aggregate) level and include the improvement generated by those policies in retirement incomes, their effect on taxation revenue and social security outlays, as well as the potential effects on national saving and workforce participation. The sensitivity of model results to key demographic, labour force, saving behaviour and economic assumptions is to be analysed. The models are to be fully documented and staff in the sponsoring Departments trained in their use.

Effectively, the Terms of Reference of the Task Force require it to build hypothetical models for individuals and income units and disaggregated population models for aggregate results. The population models must be sufficiently disaggregated to handle:

- *"- 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."*

Types of Tax-Benefit Models

Four types of models can be used to address these terms of reference:

- **Hypothetical tax-benefit models** cover one individual couple or income unit. Hypothetical models can cover a short period such as a week or a year (eg the Department of Social Security (DSS) Hypothetical Policy Effects Model) or project incomes, taxes and benefits over a much longer period (eg the RIM Task Force's model INDMOD takes an individual or couple from work force entry to death).

- **Group tax-benefit models** disaggregate a population into a number of groups or cohorts and base their calculations on the means for these groups. Because the whole population is covered, group models can be used for costings to the extent that the group structure is sensitive to the parameters of the costing. For example, a coarse income distribution can lead to a poor costing of a new income test. Most costing spreadsheets could be said to be examples of short period group models. When group models are used for projections, insufficient or inappropriate group disaggregation can lead to inappropriate **pooling** of accumulations.

  - For example, the National Mutual Retirement Income Policy (RIP) model (Haebich and Todd 1989) used by the RIM Task Force accumulates superannuation for each age-gender cohort in the population at average weekly overtime earnings for that cohort. Superannuation assets are divided into employer, employee, personal and productivity (ie award) pools. New entrants to the labour market, such as migrants, gain a full share of the existing pool, thereby lowering the accumulation of existing beneficiaries. Those gaining SGC coverage for the first time share in the productivity pool. The unemployed are that way permanently and therefore share in no pools.

  - The SWPS Award Superannuation Projection Model (Dixon (1986), Gallagher(1987)) projected using an age, gender and tax-bracket group structure in order to overcome the inappropriate calculation and pooling of tax expenditures. However, the SWPS model did not separate the actual and counterfactual savings pools, which is a feature of the RIM Task Force's new methodology for the RIP model.

- **Cohort microsimulation models** obtain projections for a single age-gender cohort by dynamically ageing many unit records for individuals and by linking selected males and females into income units. The use of unit records means that much greater distributional analysis is possible (including the calculation of winners and losers) but the restriction to a single cohort means that aggregate costings are not possible. The dynamic ageing of the records is based on Monte Carlo simulation of life events whereby the value of a random variable determines whether a given life event occurs for a given unit record. The estimation of these transitional probabilities in Australia must often be based on cross-sectional data which makes it difficult to separate group, period and cohort effects. Examples of cohort models include the HARDING model of Australia in 1986 (Harding, 1990) and the model of retirement saving prepared for the New Zealand Department of Prime Minister and Cabinet (Rose and Stroombergen,1992).

- **Population microsimulation models** can be used for costings, distributional analysis and macroeconomic analysis of the household sector. Static microsimulation models such as the DSS Policy Effects Model (Gallagher and McDiarmid, 1993) "age" populations for up to five years either side of a population survey by reweighting unit records to reflect the current population and labour force structure and by indexing incomes. Dynamic microsimulation models (such as DYNAMOD, being constructed by NATSEM[4] (Antcliff, 1993)) dynamically age unit records representing individuals in all cohorts in a population and index the incomes of those individuals. The dynamic ageing process is considered to be more appropriate for periods approaching 50 years - as required by the RIM terms of reference - since the interactions between demographic, family, labour force and income related life events can be more effectively represented than in static reweighting methodologies. However, the complexity of these interactions and their derivation from cross-sectional data result in their estimation being far less certain and transparent than the estimation of a static reweighting system. Dynamic ageing of unit records provides much more detailed estimates of the distribution of lifetime income and accumulations (such as superannuation and other savings) than is possible from a group model. One of the major issues facing the RIM Task Force is whether the finer modelling of the distribution leads to more accurate aggregate outcomes. There is little doubt that the much greater range of variables allows a wider variety of policies to be modelled, including superior modelling of income tested rebates and benefits.

The computer software chosen for tax-benefit models reflects the size of the model, the speed of calculation required, portability, the availability of sufficiently skilled labour and ease of learning by policy analysts. Smaller hypothetical and group models are commonly written using spreadsheet packages (such as EXCEL, LOTUS 1-2-3) and PC languages (such as BASIC, PASCAL). Amongst Canberra-based policy analysts, spreadsheet skills are more common than training in PC languages. EXCEL is the more commonly used spreadsheet in the three RIM sponsoring Departments. In Australia, SAS (originally standing for Statistical Analysis System) has dominance in the large scale tax-benefit model market because of its capacity, portability, ease of use by policy analysts and cost-effectiveness for statistical applications development. SAS is already in use in the three RIM sponsoring Departments.

Development of Models by the Retirement Income Modelling Task Force

The Steering Committee for the RIM Task Force has decided that it is appropriate for the Task Force to develop hypothetical models and group models. Cost-effective strategies for developing and maintaining dynamic microsimulation models are still under review.

Currently the RIM Task Force uses two models for day to day policy analysis. These are:

- **INDMOD** (INDividual MODel) (see ATTACHMENT B) which projects superannuation, age pension, and tax concessions for individuals and couples and which compares the benefits of increased retirement incomes to changes in the cost to Government of tax concessions and age pensions. INDMOD is written in EXCEL4 which makes it suitable for implementation on PCs in each RIM sponsoring Department.

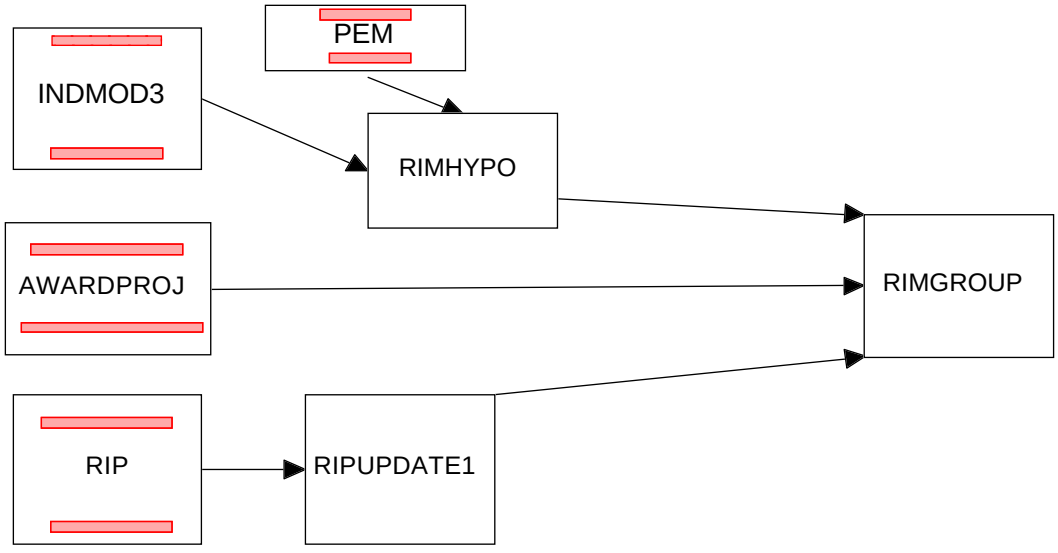
[4] The National Centre of Social and Economic Modelling (NATSEM) was set up at the University of Canberra in 1993. NATSEM receives general funding from the Department of Health, Housing, Local Government and community Services. The Centre is directed by Professor Anne Harding.

- **The National Mutual Retirement Income Policy (RIP) Model**[5] (see Attachment C) which compares the potential aggregate costs and benefits of retirement income policies for each age-gender cohort and the population as a whole. RIP is written in an object-oriented language called SMALLTALK which is used by a small number of private systems developers in Australia. Although the object-oriented paradigm may be the way of the future, the model has imposed long learning curves for people used to thinking sequentially. SMALLTALK is not portable and has long run times. Since it is a language, rather than a package, there are no in-built facilities for the production of high quality output. The enhanced RIP model (RIPUPDATE1) remains the production aggregate model currently for the task force but is intended to be replaced by a SAS version in the new year.

Both INDMOD and RIP have been substantially enhanced by the Task Force and provide the basis for further modelling development. The Task Force has access to other modelling code, including:

- the DSS Policy Effects Model (PEM) code written in SAS; and
- the SWPS Award Projection model code (AWARDPROJ) written in SAS.

DIAGRAM 1: DEVELOPMENT SEQUENCE OF RIM MODELS



The Steering Committee has endorsed the development sequence of models shown in Diagram 1. The new models proposed are:

[5] National Mutual have provided the model to the Commonwealth for its use for two years on the condition that updates to the model during the period are provided to National Mutual. This has made a number of significant pieces of policy analysis possible.

- **RIMHYPO** which will be a hypothetical retirement income model written in SAS. The main purpose in writing RIMHYPO is to obtain SAS versions of the existing retirement income tax and social security code in INDMOD for use in RIMGROUP. Some elements of INDMOD will be replaced by code from the DSS Policy Effects Model (PEM). The other reason for writing RIMHYPO is to give a much faster model for multiple hypothetical cases used as the basis for graphical analysis of effective marginal tax rates and gains in disposable income. INDMOD runs can take in excess of 3.5 hours for this sort of analysis.

- **RIMGROUP** will be a group model, written in SAS, to improve on RIP by allowing better income distributions, better modelling of transitions into and out of unemployment and more facility for new types of superannuation which are not pooled with existing types. The model's accumulation phase will have groups for each age*gender*decile of taxable income for the employed/unemployed*public/private sector. Contributions will be modelled according to type of superannuation but it is not yet clear whether superannuation assets should be kept in separate pools. If there are too many groups in the model, it could be easier to set up a cut down version of a dynamic microsimulation model. The main advantages of RIMGROUP will be its capacity to model policies which vary by income and asset amounts, such as social security income and assets tests, as well as modelling tax expenditures and rebates for contributions. The modelling of accumulations within income classes which allow for different probabilities of becoming unemployed should also remove major pooling biases within RIP. The major limitation of RIMGROUP will be its inability to cope with marriage and divorce dynamically and the roughness of marginal costings from ten income classes.

The RIM Task Force is investigating the feasibility and cost-effectiveness of moving beyond RIMGROUP using DYNAMOD (the dynamic microsimulation model being developed by the National Centre for Social and Economic Modelling (NATSEM)) as a base. This would certainly add to the range of policies and life event scenarios which could be modelled but at the cost of the size and run time of the model. DYNAMOD may well be too large for convenient Departmental use if the requirement is annual snapshots of the population over a sixty year projection period.

The RIM Parameter Research Program

Development of INDMOD, RIMHYPO and RIMGROUP requires specific research into the most plausible parameters, assumptions and scenarios (consistent parameter sets) for the models. Apart from the demographic parameters (fertility, mortality, migration), the major requirement is for a specification of the following parameters as a function of age, gender, sector and taxable income/unemployment group:

- labour force participation and permanent retirement for age, disability, family and structural reasons;

- mean earnings for superannuation purposes and mean taxable income (and therefore the promotion profile);

- mean vested superannuation contributions or unfunded liability accrual (especially if this is not a simple function of earnings);

- mean accumulated superannuation assets (or unfunded liabilities) especially where these are of existing assets (which cannot be imputed from the build up of contributions);

- earnings rates for superannuation funds and charges levied on members (and whether these differ by type of superannuation eg industry funds versus employer funds or defined benefit versus defined contribution schemes);

- mean non-superannuation financial savings and the relationship between these and superannuation savings and taxable income;
- earnings rates for non-superannuation financial assets and incidence of charges;
- dissipation of lump sums and other liquid assets[6];
- form, or combination of forms, of retirement benefits; and
- price indices for consumer prices and wages (and therefore productivity).

In estimating lifecycle parameters, the major problems for any model are that the available data are from cross-sectional surveys (eg the Income and Housing Survey), or from time series which have been disrupted by structural change (eg superannuation coverage) or from short time series (eg labour costs). The cross-sectional data provide the distributional detail but lifecycle effects will be indistinguishable from period and cohort effects. Time series data do not provide the distributional detail and major parameters not incorporated in a projection model may be the cause of observable change.

One major choice facing model developers is whether to model macroeconomic variables endogenously or exogenously. Many macroeconomic models estimate GDP as a function of population growth and productivity. These parameters are in RIMGROUP and it is therefore possible to model GDP endogenously. However, the estimate will be inconsistent with short and medium term forecasts because of cyclical factors not included in RIMGROUP. Hence medium term projections of GDP should be exogenous but longer term projections could well be endogenous. Similar arguments apply to the projection of non-superannuation assets - should they just be a constant proportion of GDP or should they be estimated endogenously and therefore responsive to changing demographic and labour force scenarios?

There is also a need to estimate important **endogenous feedback loops** such as that between demographic profile and demand for labour and, in relation to total labour costs, between increases in compulsory superannuation and the level of wages and employment.

Perhaps even more importantly there is a need to understand the relationships between **superannuation and the macroeconomy.** Population projection models such as RIP, RIMGROUP or DYNAMOD essentially model accumulation processes in the household sector without modelling significant positive and negative feedbacks with the macroeconomy. They tend to treat the budget deficit as a "sink". For example, rising superannuation savings will spur investment, which will not only affect the need to borrow from overseas but also adjust the relative factor inputs from capital and labour in the longer term. In fact, this change in relative factor contributions is a major reason for having a funded retirement income policy. There can also be negative feedbacks. For example, rising tax expenditures from superannuation will require higher taxation of individuals or companies if the fiscal balance is to be maintained. This could act as a disincentive to investment or work, and higher employer contributions may suppress wages and therefore consumer demand.

Management Issues in Public Policy Modelling

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[6] Dissipation refers to the use of lump sums for purposes other than generating a retirement income. This can include "legitimate" transactions which lower the need for retirement income (eg paying off debt) as well as "double-dipping" - the squandering of a lump sum in order to obtain a higher age pension.

Management of the development and use of government policy models presents problems somewhat different from those of academic models. The first group of problems revolves around ensuring cost-effectiveness in a public service environment. The second group of problems lies in balancing the need for peer review and disclosure in the public interest with the need not to inordinately disrupt the workings of government and the bureaucracy.

Public service policy areas tend to be staffed with motivated graduates with a broad variety of technical skills and high turnover. Computer programming skills have not traditionally been common in such staff. However, overseas experience with microsimulation has been that it is better to train the policy experts in computing (especially in easy to use packages) than it is to train computer programmers in the policy. To train policy experts, and maintain adequate continuity and facility in model usage, comprehensive training documentation, external systems documentation and internal systems documentation are required. The **RIM Protocols** (Attachment D) seek to define such standards and have been insisted upon by the RIM Steering Committee as essential standards for a public policy modelling area.

In this respect, microsimulation modelling of United States public policy has recently been reviewed by the U.S. National Research Council, a group of distinguished scholars (Citro and Hanushek, 1991). The review identified two major problems with microsimulation of public policy in the United States - underinvestment in regular and systematic model validation and underinvestment in the input data for policy models.

Action on input data will take longer than the intended life of the RIM Task Force. The Task Force has approached major superannuation companies for data on the distribution of superannuation assets by age, gender, income and type of superannuation and the industry is being extremely helpful. New tabulations of ABS and other Commonwealth data have also been commissioned. Attempts to explore the limited number of existing Australian longitudinal databases will be made.

Validating model input parameters and equations poses problems in an environment where quick modelling of today's policy option is required. The appropriate safeguard is the publication of underlying equations, assumptions and methods. This is required by the RIM Terms of Reference. Treasury (1993) has attempted to set a standard for openness to peer review by its full publication of the equations of its new macroeconomic model TRYM. It also subjected them to review by a full conference. RIM output is intended to be exposed similarly and it is hoped that other bodies such as NATSEM will follow this lead in disclosure and in validation effort.

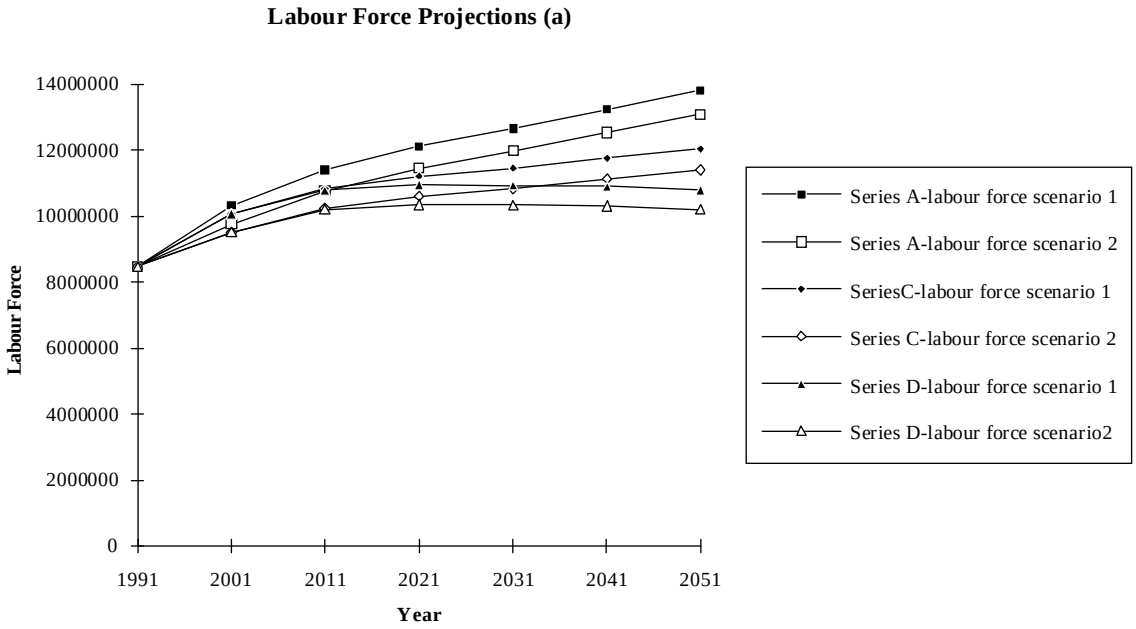
In public policy, the cost and impact of changes in single policy parameters can often be estimated from a good spreadsheet or directly from unit record administrative data. The policy measures or proposals which require modelling with population tax-benefit models are those involving structural change and new interactions between programs. Such modelling can only be done when the analyst has access to the full code. Since modelling of Budget options must be done within public service Departments, in order to preserve Cabinet confidentiality, it is imperative that Departmental analysts have access to well documented "glassbox" models rather than "blackbox" models which only allow limited parameter change and no respecification of the policy equations.

Projection modelling is a highly uncertain activity. Charts 1 and 2 show the error cones in demographic projections which result from similar underlying parameters estimated by the same data. Labour force projections diverge further. Chart 4 shows that this error cone further diverges when different labour force participation scenarios are used. Scenario 1 assumes the continuation of 1989 participation rates while Scenario 2 uses the Department of Employment, Education and Training (DEET, 1991) projections for 2001. The estimates of the size of the labour force in 2051 range from 10.2m to 13.8m. The multiplicative nature of estimates of superannuation contributions in the RIP model (projected cohort population * proportion employed above SGC threshold *

average earnings * contribution rate) means that superannuation asset projections will diverge further than the labour force projections.

It is important to remember that the objective of modelling is to show the relative effects of different retirement income policies, not to forecast the actual accumulation of superannuation funds in fifty years' time. Since the effects of most superannuation policies are period and cohort dependent, long term modelling is required irrespective of the error cone. The appropriate response to the error cone is to do sensitivity testing of plausible scenarios.

CHART 4: Variations in Labour Force Projections With Population Projection and Participation Scenario



(a) Based on the ABS Population projections prepared for the Office of EPAC and DEET (1991) labour force projections up to 2001.

Long term modelling of retirement income policy can only be done using projections and these cannot be treated as predictions. The relative impact of two policies can remain invariant over a range of demographic and labour force scenarios. In many cases, however, this invariance will not hold - the difference between policies will interact with elements of the scenario. Sensitivity testing is essential for projection modelling. The number of parameters and groups in a model make it more difficult both to estimate the relevant equations and to sensitivity test the result. This suggests that great care should be taken in drawing conclusions from models as complex as RIMGROUP or DYNAMOD where sensitivity analysis has not been undertaken.

The interpretation of results from public policy modelling needs to be both transparent and appropriately qualified. The significance of underlying assumptions and data limitations must be apparent to potential users and the analyst. Although numbers can acquire a life of their own in public policy debate, the prudent analyst should act on the expectation that appropriate decisions are more likely to be made if the basis of the estimates is understood. In this respect, public policy analysts attract a very onerous (and non-transferable) duty not to over-reach the legitimate boundaries of their models and databases. That burden is all the heavier where projections of a fundamental structural nature like retirement income policy are being undertaken over a period of no less than half a century in duration.

RIM Task Force - Examples of Current Results

Demonstrating progress with its work program, the Retirement Income Modelling Task Force has produced two recent conference papers :

- Brown, C. (1993) *Tax Expenditures and Measuring the Long Term Costs and Benefits of Retirement Incomes Policy*, Paper to Colloquium of Superannuation Researchers, University of Melbourne, 8 July.

- Gallagher, P., Rothman, G. and Brown, C.(1993) *Saving for Retirement: The Benefits of Superannuation for Individuals and the Nation*, Paper Presented to the National Social Policy Conference, University of New South Wales, 14 July.

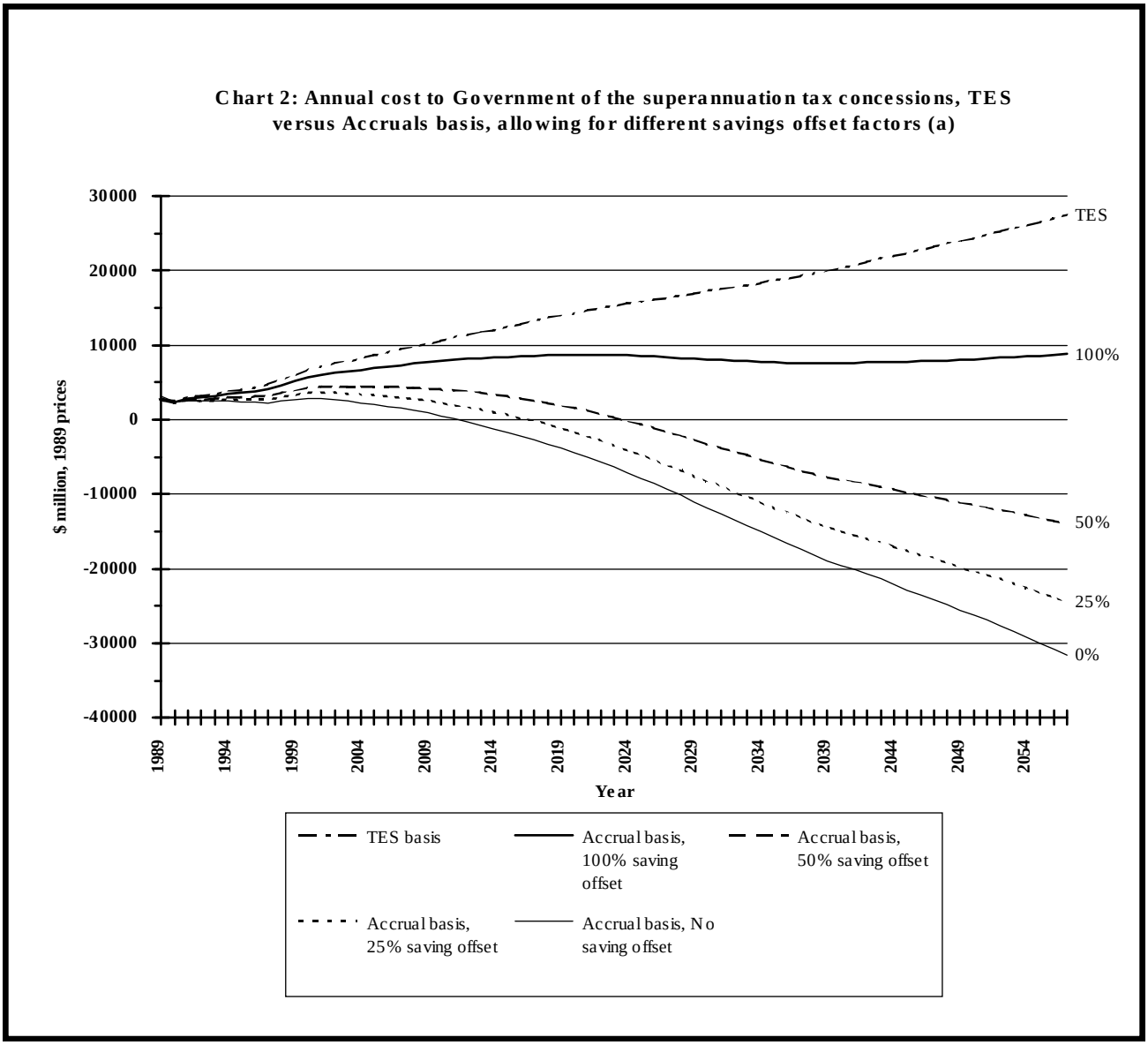
New results from the Task Force's modelling were also a major feature of Chapter 4 of the FitzGerald report on *National Saving* (1993). Further research will be published in a Research Paper Series and a Technical Paper Series.

Perhaps the most fundamental change that the Task Force has made has been to introduce a **new cost-benefit methodology** for assessing retirement income policy. Brown (1993) outlines this methodology, explains how it differs from the methodology used in the *Tax Expenditures Statement* (Treasury, 1992) and in *Security in Retirement* (Dawkins, 1992), and demonstrates the sensitivity of the methodology to core assumptions such as the discount rate and savings replacement rate.

The methodology defines the **benefits** of retirement income policy as the increase in the present value of disposable income in retirement for a couple or individual. This definition reflects the Government's stated objective for retirement income policy. **Costs** are measured as the present value of costs to Government. In a single year, the costs to Government will be:

1. Tax on non-concessionally taxed superannuation contributions and earnings in the year
2. *less* Tax on concessionally taxed superannuation contributions and earnings in the year
3. *plus* Tax on retirement income in the year with non-concessionally taxed accumulation
4. *less* Tax on retirement income in the year with concessionally taxed accumulation
5. *plus* The age pension payable in the year with a concessionally taxed accumulation
6. *less* The age pension payable in the year with a non-concessionally taxed accumulation.

CHART 5 (from Brown 1993)



(a) Chart takes account of the impact of retirement savings on age pension outlays and taxes payable in retirement and assumes all savings are fully taxed under the alternative savings benchmark. TES refers to Treasury's annual Tax Expenditure Statement, in which superannuation tax expenditures are costed.

This present value methodology requires superannuation accumulations and payouts to be measured using current tax concessions on superannuation (15% tax on employer contributions offset by a 15% rebate on payout, 0% on after-tax employee contributions, 15% tax on fund earnings) and in a counterfactual world where the employer superannuation contributions are paid as wages (taxed at marginal rates) of which a proportion is then saved. The interest on these savings is also taxed at full marginal rates. One major issue is how much of the rise in disposable income would be saved in an account taxed at full marginal rates. The *Tax Expenditures Statement methodology* assumes that all would be. FitzGerald and Harper (1993) use a factor of 50% (chosen because it is half way between 0 and 1 which they saw as the least likely values for the offset). Gallagher, Rothman and Brown (1993) suggest that non-superannuation financial savings data, such as that in Table 1 of this paper, warrant a factor closer to 30%. Interestingly, Feldstein (1974) concluded that U.S. social security retirement policy had depressed personal saving by 30-50%. Chart 5 shows the sensitivity

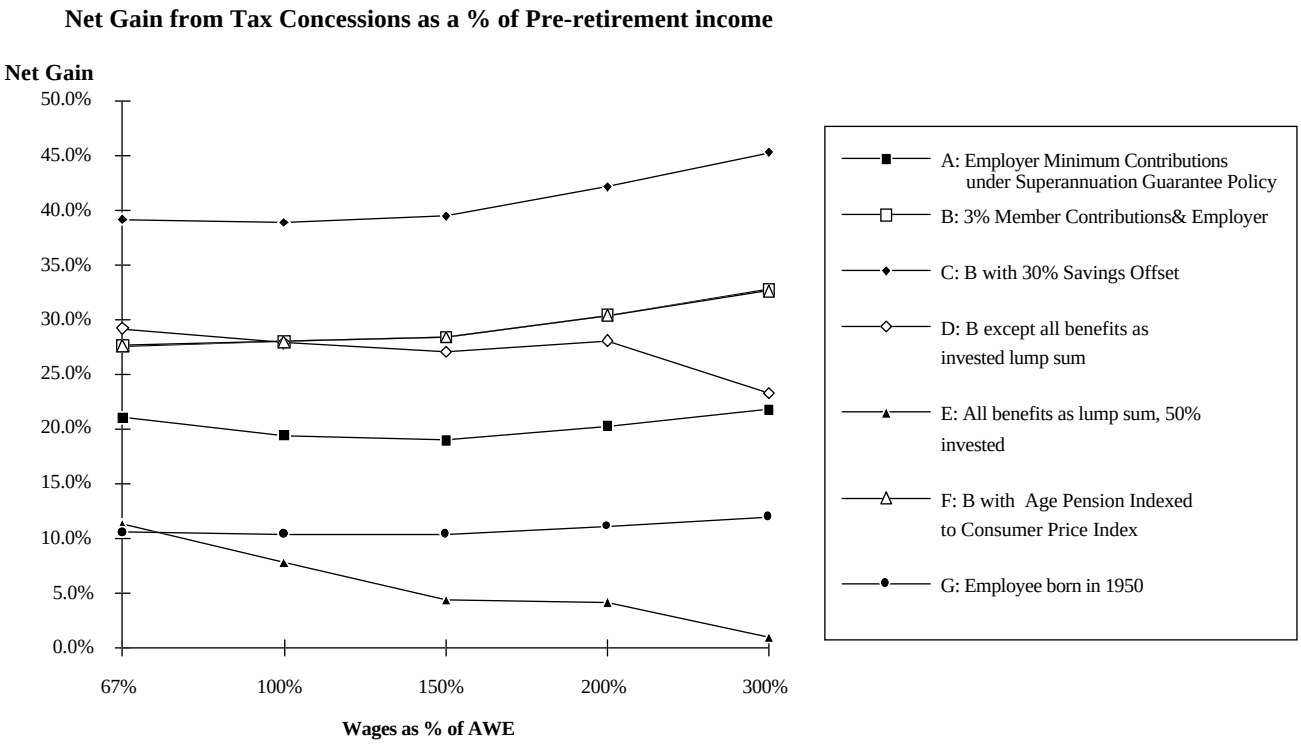
of RIP measures of the annual fiscal cost of superannuation tax concessions to different values of this savings offset factor.

Of clear policy significance, the annual cost to the Government of current retirement income policy is estimated to be negative - by around 2015 if a 25% offset is chosen, and later with a 50% offset. The analysis shows that the tax expenditures statement methodology - which applies to a single year rather than to the difference in accruals over a period of years, and imposes a 100% saving offset - produces remarkably higher estimates of cost to Government in the longer term. Neither of these assumptions is appropriate for long term analysis of the kind RIM is charged with under its terms of reference.

The foregoing is not an argument against the use of the *Tax Expenditures Statement* methodology for assessing tax expenditures in a single year. Because the savings offset factor applies only to counterfactual savings on a single year's contributions, it is small in any given year when compared to the tax expenditures on employer contributions and those on fund earnings. The Treasury single year tax expenditure methodology is consistent with international methodologies and, like outlay costings, most directly measures the budgetary impact in any given year of removing existing tax concessions in that year.

Gallagher, Rothman and Brown (1993) applied the RIM cost-benefit methodology to a range of scenarios for a single male. Chart 6 shows that benefits exceed costs for the seven scenarios for a single male used in their analysis. The analysis includes those males dissipating 50% of their retirement payout and baby boomer males. It does assume full-time continuous work, which is no longer typical for many males and which has never been typical for many females. Intermittent and part-time work remains an issue for future analysis as does specific analysis for females, who also face higher annuity costs.

CHART 6 (from Gallagher, Brown and Rothman (1993))



Important for economic policy is the enhanced RIP model analysis of changes in the components of national savings arising from the current Superannuation Guarantee Charge (SGC). Chart 7 has also

appeared in the FitzGerald report (1993) and Gallagher, Rothman and Brown (1993). Using the standard RIP assumptions outlined in Attachment C, the Superannuation Guarantee is projected to:

- increase superannuation saving, net of benefit payments, by about 1.4% of GDP within ten years and by about 1.7% of GDP within twenty years;
- increase total private saving by about 0.8% of GDP within ten years and by about 1.1% within twenty years;
- have little impact on age pension outlays until about 2015, then reduce their costs by amounts rising to about one half of one per cent of GDP by the middle of the next century;
- increase superannuation tax concessions by 0.2% of GDP over the next decade before a slow decline to around 0.1%; and
- increase annual national saving by almost three-quarters of one per cent of GDP over this decade, gradually rising to around 1.25% of GDP by 2051.

CHART 7 (from Gallagher, Brown and Rothman (1993))

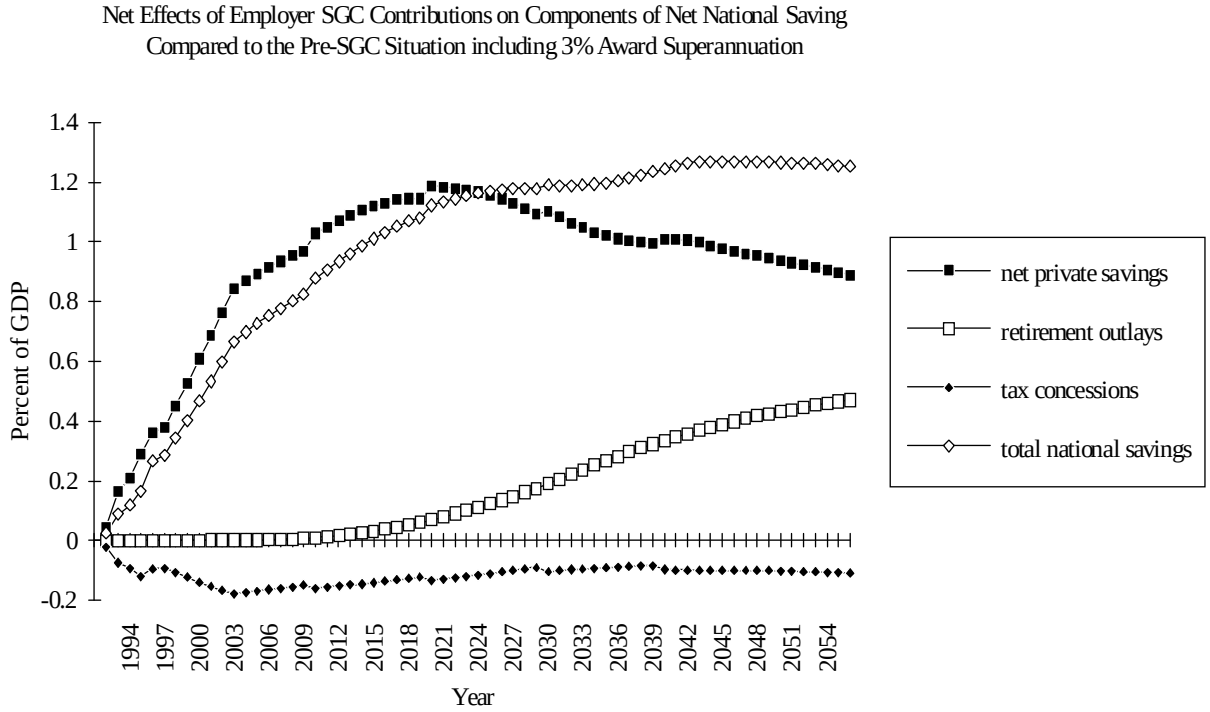
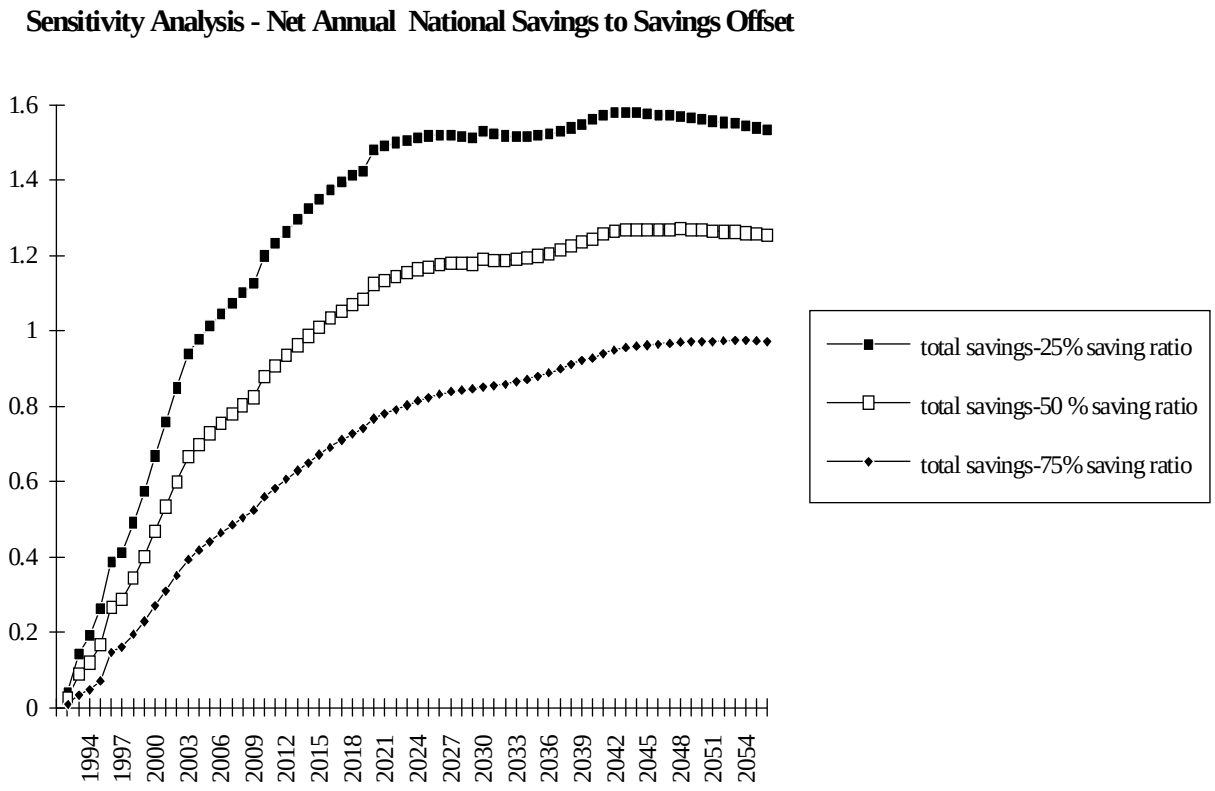


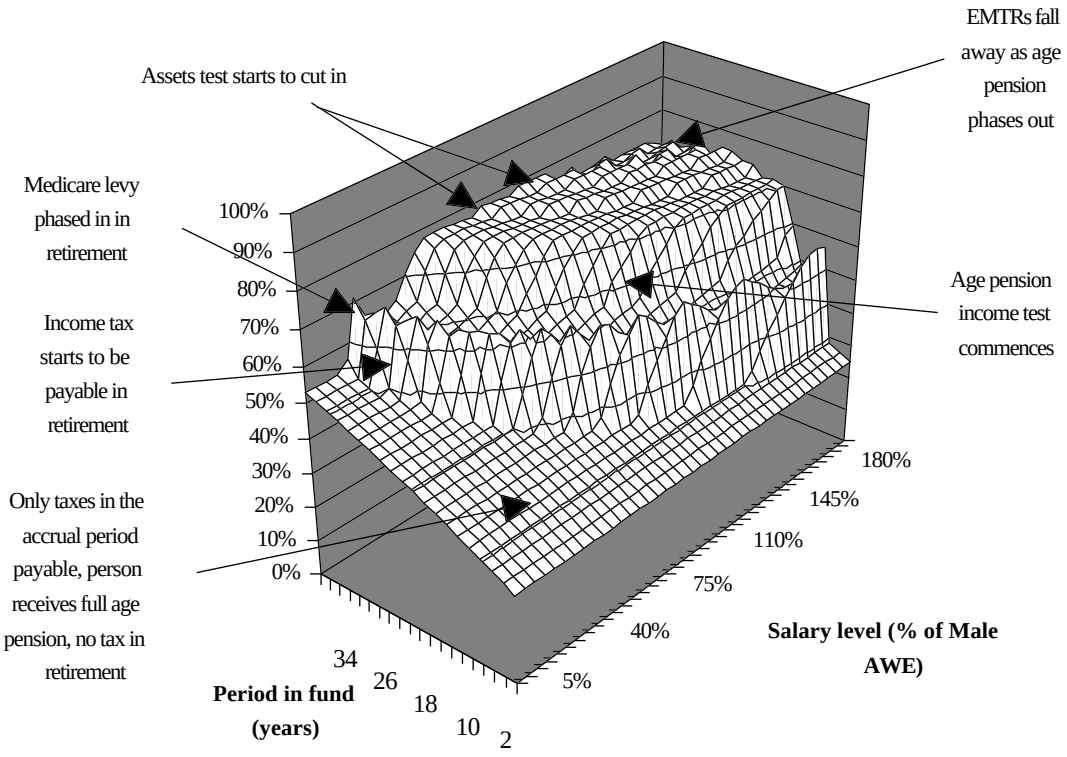
Chart 8 shows the sensitivity of the results for net national saving to the saving offset. Clearly the pattern of the growth is similar but levels differ. The RIM Task Force believe that a saving offset of 25% may be closer to the actual value than 50%. There is therefore a possibility that the estimates published in the FitzGerald report (1993) of the additions to national savings from the superannuation guarantee are conservative.

CHART 8 (from Gallagher, Brown and Rothman (1993))



This aggregate analysis above is an excellent example of how the models of the RIM Task Force have already been used for long term analysis of issues currently confronting Government. The models can also be used for far more theoretical analysis. Chart 8 is taken from a draft RIM paper by Mr Colin Brown on the effective marginal tax rates (EMTRs) of different savings vehicles over a life time - an analysis adding a whole new dimension to the analysis of effective marginal tax rates.

Chart 8: Lifetime EMTRs for Employer Superannuation Contributions



RIM Task Force - Forward Work Program

The main priorities on the forward work program of the RIM Task Force are:

- benchmarking of current RIP model parameters and results, addition of accounts which handle new types of superannuation without pooling this with existing types, and the development of parameter sets which provide estimates for particular income groups within a cohort;
- the implementation of INDMOD3 in each of the sponsoring Departments so that they are better equipped to undertake their own hypothetical analysis;
- participation in the two reviews of superannuation and age pension policy announced in the Treasurer's response to the FitzGerald report, released on Budget night (17 August 1993);
- preparation of material for the Senate Select Committee on Superannuation;
- extending its work on demographic and labour force projections and their inter-relationships;
- extending its research on the accumulation of non-superannuation savings and relating that to superannuation;
- extending its research on lifetime income profiles from cross-sectional and longitudinal databases where available;
- further researching the distribution of superannuation contributions, assets and unfunded liabilities;
- creating RIMHYPO;

- doing design research on RIMGROUP prior to implementing that design;
- finalising its cost-effectiveness analysis of strategies for pursuing dynamic microsimulation and pursuing the selected strategy;
- doing sensitivity analysis on its modelling equations and policy results;
- investigating the relationship between its modelling results and the macroeconomy; and
- using its models, data and literature collection to produce research on some of the major issues in retirement income modelling including -
    - adequacy of retirement income benefits, particularly for women and those with intermittent or part-time labour force participation
    - intragenerational equity
    - intergenerational equity
    - dissipation and double-dipping, and
    - trends in early retirement and determinants of the retirement decision.

Conclusion

Retirement income policy has long-term effects which require long-term modelling, particularly since most policies are neither period nor cohort neutral. The projection modelling of the long-term effects of different retirement income policies requires population models which are sensitive to both the quantum and distribution of those effects. These models must be well documented, user friendly, transparent (ie glass-box), and be sensitivity tested on parameters, assumptions and modelling equations. It is desirable to test the nature of links with the macroeconomy and the Task Force will seek volunteers for this collaboration.

The Retirement Income Modelling Task Force has substantially enhanced its hypothetical model (INDMOD) and National Mutual's existing aggregate model (the Retirement Income Policy Model (RIP)) and used both to substantially improve existing research. Its parameter and methodology research program has also produced valuable products. The extension of these models will involve research on fundamental model design issues (such as the extent to which pooling distorts distributional results and totals in group models) and assessment of the costs and benefits of elaborate household population projection methodologies such as dynamic microsimulation modelling.

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ATTACHMENT A

Task Force on Retirement Income Modelling

Terms of Reference

General

To develop a capacity for modelling the impact of retirement income policies over the next half century and to provide advice to departments and Ministers as required on policy options affecting retirement incomes.

Specific

1. The RIM Task Force will construct state-of-the-art computer based dynamic simulation models, of both an aggregate and individual-based (hypothetical) type capable of providing quantitative answers to the following issues:

1.1 The impact over a fifty year time horizon of various retirement income policies (in the taxation, social security, labour market and superannuation regulation areas) on:

- 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

1.2 The sensitivity of model results to key parameters, including:

- 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

2. The technical aspects of the construction of these models will be supervised by a RIM Steering Committee (comprising officers of the Treasury, the Department of Finance, the Department of Social Security, the Australian Government Actuary, Dr Vince FitzGerald, Professor Adrian Pagan and Professor John Piggott) which will approve model specifications and development timetables, and regularly review progress.

3. While the development of the models is proceeding, the Director of the Task Force will be required to ensure that each of the Departments referred to in 2. above has access to confidential advice on the longer term implications of policy options under consideration, on the basis of the models as they stand, together with adequate explanations of the capability and limitations of the models as at the time the advice is provided.

4. The models will be fully documented on an ongoing basis, and the Director of the Task Force will be required to ensure that at appropriate stages of the models' development, and on completion of the development work, each of the Departments referred to in 2. has full access to models and associated data and training in the use of the models.

5. The Task Force will have regard to the relevant academic and official work in the retirement incomes area. It will be expected to establish contacts with others working in the area, including overseas, and to publish details of modelling methodologies employed in its work.

6. The progress of the Task Force will be reviewed at the end of its first year of operation when these Terms of Reference may be amended.

Notes

It is noted that the Task Force will have access to the National Mutual Retirement Income Policy Model on terms set out in an existing agreement of 1 May 1992 between National Mutual Life Association and the Department of Finance and will therefore be responsible for ensuring that the terms of the agreement with National Mutual are complied with.

ATTACHMENT B

THE INDIVIDUAL HYPOTHETICAL MODEL, INDMOD

INDMOD is a hypothetical model of individual households that projects the accumulation of superannuation assets and the payment of benefits over a person's lifetime. The model deals with a single household at a time and is able to model single person households, single income couples and two income couples taking account of different lifetime earning profiles, earning levels and labour force participation patterns. The rates of employer and member contributions are accumulated at an assumed fund earning rate, taking account of taxes on contributions and fund earnings and fund administration charges to determine superannuation benefits at retirement.

The accumulated benefits are then used to determine a retirement income stream, taking account of the mix of benefits chosen - whether a superannuation pension, rollover annuity, lump sum or allocated pension. Lump sum benefits may be dissipated or invested and the type of drawdown of invested lump sums specified. Annuity factors are calculated within the model, consistent with the modelling parameters chosen. Users can also incorporate assumptions concerning the amount of non-superannuation savings a person has available to provide retirement income, as at retirement.

The model calculates the amount of lump sum tax payable by a person, the person's age pension entitlement under the age pension income and assets tests and the income tax payable on the person's total income, taking account of entitlements to the superannuation pension and annuity rebate, age pensioner rebate and the spouse rebate.

This allows the model to calculate the person's net retirement income over the expected retirement period.

Finally, the net present values (NPV) of these income streams, as at the date of a person's retirement, are calculated and the net retirement income compared against the value of the household's projected pre-retirement disposable income to determine the replacement rate of retirement income. The NPVs of all components of the household's retirement income are also calculated.

The model also includes an alternative, non-concessional savings benchmark. Under this benchmark, the amount that would have accumulated in the absence of tax concessions is calculated and used to derive a corresponding retirement income stream. The benchmark is calculated using assumptions concerning the proportion of a superannuation benefit that a person would save without the tax concessions and the extent to which such alternative savings would be included in the person's assessable income.

ATTACHMENT C

The National Mutual Retirement Incomes Policy (RIP) Model

The Retirement Incomes Policy Model (RIP) is a model to estimate stocks and flows of superannuation funds and the impact on savings and costs to the Government's budget of various retirement income policy options. It was developed by National Mutual Operations Research and made available to the Retirement Incomes Modelling Task Force. The Task Force has used the model for policy analysis and has also substantially developed its capability.

The RIP model is based upon *person cohorts* (people of common sex and age) which are aged a year at a time and their superannuation benefits accumulated taking account of parameters such as wage levels, employment rates, inflation and rates of return on assets. At retirement the detailed interaction with the Tax and Social Security systems is accounted for.

The model incorporates three major phases:

- a population phase based on ABS data which project the total Australian population by age and sex for each year in the future, allowing for births, deaths and immigration;
- a superannuation dynamics phase which takes output from the population projection and projects:
  - the number of people employed in each year;
  - the number of people in each type of superannuation fund modelled (public and private sector, categorised by the type of superannuation contributions concerned); and
  - the numbers retired because of death, disability or age retirement for each person cohort for each year of the projection; and
- an accounting phase which uses the outputs of the first two phases of the model to keep track of the total superannuation assets of each person cohort, allowing for contributions, earnings, benefit payments and tax. It calculates the relevant cash flows for each person cohort in each year and stores the results. On retirement, the model splits up the accumulated superannuation benefits of each age cohort according to an income distribution and calculates the tax payments arising, the age pension payable, and the continuing retirement income stream from superannuation.

Aggregating the results in each year across all the person cohorts allows calculation of total stocks and flows for the Australian population within the model. The model also estimates the tax expenditure on superannuation for each year.

Recent Developments

Key developments of the model have been:

- An improved estimation of tax expenditures, using extra model runs initially but upon further development through incorporation of additional accounts.

- The facility to model the accumulation of non superannuation assets endogenously, with accumulation rates as a function of age sex and time (good data for the rates are not yet available).

- A considerable extension of the time scale of the modelling to 2056 (rather than 2029).

Strengths and Weaknesses

The strengths of the RIP model are:

- Its completeness, particularly the detailed modelling of superannuation processes including different account types and preservation and vesting rates and the modelling of disability and death benefits as well as age retirement.

- The very extensive parameter set, which gives the facility to access a wide range of policy options without modifying the model's structure.

The weaknesses of the model are seen as:

- The very limited ability to allow for variation within an age, sex cohort:

    - specifically there is only a limited 4 point, exogenously supplied, salary distribution which will give only a crude interaction with eg. the complex Social Security income and assets tests;

    - the model does not include a married, not married variable; and

    - similarly, there is effectively no ability to allow for variability in labour force experiences.

- The 'tontine' or pooling effect: even if a member of a person cohort joins the group later e.g. a migrant, they share equally upon retirement with all others in the group. This can also be a significant problem where, for a new policy, a new group starts contributions at a specified time and is mixed in with existing contributors (some development work is under way to try to overcome this).

- The model is deterministic and does not allow for stochastic variations in outcomes (due to random fluctuations in, say, earning rates).

- The unusual object oriented language Smalltalk in which the code is written. While this is intrinsically a powerful and versatile modelling language, it is:

    - not well known and takes a lengthy period to master; and
    - uses extensive computing resources and time.

Apart from the last point, the weaknesses of RIP are intrinsic to grouped models. Finer scale subdivision of the group is required and this is envisaged in a model being designed by the Task Force. Alternatively, dynamic microsimulation techniques can be used which focus on tracking the experiences of individuals or very small groups.

Base Parameter Assumptions

Population: Rates underlying ABS Series A (projected through PEOPLE model).

Economic: Current and recent rates projected from 1995 on, at:

- 4% inflation;
- 8% earnings rate for superannuation funds (after costs but before tax);
- 5 1/2% growth in Salaries and AWE.

Taxation

- Current income taxation rates, changed in 1996 to Government indicated rates.
- 15% earning tax on superannuation funds - assumed to be an effective 7% rate.

Savings Replacement

- 50% of available funds released in the absence of compulsory and concessional superannuation would be saved.
- These alternative savings to superannuation taxed at 24% marginal rate.

Retirement

- Pension rates and tests for income and assets tests indexed to AWE.
- Retirement stream comprises 20% non indexed annuity and 80% conversion of lump sum to simple interest income stream earning 7 1/2% pa. Nil dissipation of lump sums in base case.

ATTACHMENT D

RIM MODELLING PROTOCOLS

As at 28 January, 1993

This paper sets out protocols for RIM to follow in model development to ensure the quality of RIM's modelling work and that the sponsoring Departments are able to make full use of RIM models in policy development work. The modelling protocols cover three areas:

(a) Documentation protocols to ensure that users of the model both understand the modelling processes and are able to use the model for their own analysis. Model documentation should cover:

  (i) user documentation, covering the structure, content and assumptions made in models and information necessary to load and use models produced by RIM; and

  (ii) management documentation of a project, recording the broader modelling issues involved in a project, options, plans and resource needs.

(b) Benchmarking protocols setting out steps to follow in order to ensure RIM models produce reliably accurate results.

(c) Training protocols setting out the types and standard of training RIM should provide to potential users of its models.

2. The purpose of these protocols is to set out guidelines for RIM to follow in developing models to ensure that people outside of RIM can use those models to produce reliable results on an ongoing basis. RIM will update these protocols as the project proceeds.

RIM Task Force

(A) DOCUMENTATION

Objectives

The objectives of documentation are to:

(i) ensure users of models and modelling results have a complete understanding of the basis of those models, their assumptions and associated limitations;

(ii) provide people who have not been involved in the development of RIM models with sufficient guidance to ensure that they can fully utilise those models;

(iii) provide detailed assistance to model users in the use and, where relevant, modification, of particular elements of models (eg "on line help" or detailed notes on particular processes used in a model); and

(iv) provide a basis for further development of models within RIM.

Protocols

1. The developer of a model should document that model on an ongoing basis, either *concurrently* with work being undertaken or *as soon as each component is complete*. This applies both to the development of new models or modules and to modifications of existing models. Ongoing documentation should include:

    (i) notes and diagrams on the structure of the model, assumptions and processes;

    (ii) notes on how to implement the model; and

    (iii) a record of changes made.

System Documentation Protocols

2. Simple computer programs (less than 1000 lines) or single spreadsheets can be documented at one level. Most RIM models will be sets of linked modules or spreadsheets. Programs require documentation at the system level; at the module level; and at the section and line level. Coding and naming standards will apply but their exact nature will depend on the language. For spreadsheets, the total system or workspace requires documentation separate from that for each spreadsheet, sub-table and cell. Any documents produced will require appropriate filing. Circulation is discussed under item B2(vi) in 'Benchmarking'.

3. <u>System level documentation</u> should include:

    (i) Levelled (hierarchical) diagrams on the main data flows and data structures of the model. Possible methodologies include data flow diagrams, module hierarchy charts, logical data models, object oriented analysis diagrams, and spreadsheet maps.

    (ii) Notes on the sources and transformation of any input data, program design, any major assumptions, any menuing system and on the choice of and nature of outputs.

    (iii) How to access on-line help data sets giving the meaning of variable names and error codes.

    (iv) How to run the model and make appropriate parameter or modular choices.

4. Module/Spreadsheet documentation should include:

   (i) Text details on the origin and modification of the module spreadsheet and on how to edit it. This will include title, purpose, original authors and date completed; modifying authors, dates and purpose; outline of sections in the code; names of the standard immediate input and output modules for this module/spreadsheet, how to make parameter changes, where to find alternative modules/spreadsheets for other scenarios.

   (ii) Lists of input variables required from other modules/menus and of output variables for use in subsequent modules.

   (iii) Notes on major assumptions/parameters used in the code, their origins and alternatives.

   (iv) Flow charts of non-trivial internal logic.

5. Section/sub-table/method and cell/line documentation should include:

   (i) Title and purpose of Section/sub-table/macro/method.

   (ii) Reference to legislation or other documentation on which section is based.

   (iii) Notes on assumptions/parameters used in the code, their origins and alternatives.

   (iv) Flow charts of non-trivial internal logic.

6. Output documents should include:

   (i) title and date;

   (ii) notes on group/policy selections;

   (iii) settings of major parameters for the run;

   (iv) request or other reference number/title for the run;

   (v) the names of the officers who did the run and those that checked it.

7. Coding and layout standards will vary with the software chosen but should cover:

   (i) naming and type conventions for variables and arrays;

   (ii) layout standards for nested do groups and complex logic;

   (iii) formatting conventions for the values of variables;

   (iv) highlighting conventions for titles and comments.

8. Filing Protocols.

   (i) Full magnetic copies of completed and tested modules/spreadsheets/documentation are to be transferred to the appropriate Task Force document library once they have been evaluated by a walk through and then signed off.

   (ii) Paper copies of the approved code/spreadsheets/documentation are to be kept on Treasury files.

(iii) Request and output documentation for all material leaving the Task Force is to be kept on the appropriate Treasury file.

Management Documentation Protocols

Issues, options, plans and resources are much more likely to be covered in management documents than in system documents. Each phase of the systems development cycle will require one or more management documents. Some of the likely management documents are tabulated below.

PROJECT PHASE	**MANAGEMENT DOCUMENT(S)**
Project Justification	Terms of Reference Overall salaries and administrative budget Overall timetable
Requirements analysis	Requirement analysis report
System Description	Analysis of existing system logic, assumptions, processes, and data. New system logical specification.
System Selection	Cost-benefit analysis for alternative software and hardware configurations. New project plan and budget.
Detailed design	System and module documentation(see above). Implementation Strategy Testing strategies(see 'Benchmarking below).
System Construction	Modules/Spreadsheets and their internal documentation. Users Guide Maintenance Guide

PROJECT PHASE	**MANAGEMENT DOCUMENT(S)**
System Testing	Evaluation report Management endorsement record
Implementation	User/Trainee evaluation report
Post-implementation review	Review report Maintenance/minor enhancements checklist

(B) BENCHMARKING

Objectives

The purpose of benchmarking is to test that models are reliably producing accurate results and to determine the sensitivity of modelling results to the assumption made in the model. The benchmarking protocols listed below set out the types of tests that RIM should apply to ensure that users can place the maximum degree of confidence in RIM models.

Protocols

1. RIM personnel should test models on an ongoing basis during their development and should not consider those models complete until they obtain satisfactory results in the benchmarking tests. This process should also apply to any amendments to a model.

2. Models may be benchmarked against a number of tests, including:

   (i) Comparisons with known results (such as those produced from other models or earlier benchmarked versions of the same model) or statistical information. Such testing should also test to ensure that modelling results are within reasonable bounds;

   (ii) Testing by entering null values (eg zero or 1) or out of range values (to test whether error values are correctly returned) for particular variables to see whether the model returns the anticipated results (eg zero superannuation contributions should yield no superannuation accumulation and a full age pension);

   (iii) "White box" testing and other internal consistency checking, whereby the developer checks a process arithmetically and logically step by step from start to finish to see that it is returning correct results at each stage of a calculation. This checking should include testing the results at various stages for internal consistency with the results obtained at other stages. Where a number of settings are possible, the developer should perform these tests against each possible setting to ensure that model is producing reliable results for all settings;

   (iv) Where possible, developers should build error checking into programs so that where an error is made, for instance in entering parameters, an error signal is sent (eg, the #REF! message on a spreadsheet or an error dialog box). Such checks should check parameter entries to ensure that they are internally consistent (eg probabilities or proportions sum to one) and allow the operator to identify the source of an error. *Where automatic error checking is not built into a model, parameter entries will need to be checked on each model run to ensure the operator has entered them correctly.*

   (v) Where error checking is built into a model, the developer will need to check the correct operation of those checks as part of the benchmarking process;

   (vi) Sensitivity analysis, which examines the sensitivity of the model to parameter changes to see how the model behaves and to test its sensitivity to changes in key assumptions (eg changes in the underlying economic assumptions such as the discount rate, wages growth, inflation rate or real rate of return of funds or changes in policy settings such as the SGC contribution rates). Such testing should examine whether the model behaves in a logical manner, in accordance with expectations and other analysis. If it does not, the developer should examine the reasons for any departures from the expected results to check whether a mistake has been made and, where the results are correct, to ensure that the processes involved are fully understood.

(vii) Testing how well the model is able to reproduce actual history. A comprehensive and correct model should, when provided with a full set of historical data, reproduce the history of its key dependent variables. Failure to do so would indicate either incomplete data or that the model has not accurately represented key relationships and requires amendment.

(viii) Subjecting methodology and results to peer review. Within RIM, system and module documentation will be reviewed using walk through. Larger scale changes whose results have been subject to sensitivity analysis will also be circulated within the Departments and to selected experts as Working Papers. Papers for general comment will be circulated as Discussion Papers. Reports will summarise major pieces of work and have general circulation.

3. Developers should record the benchmarking tests performed on a model against a benchmarking "checklist", noting the benchmarking tests performed, the results obtained and any action required to correct discrepancies or weaknesses shown up by those tests. These checklists should be retained on file as part of the model documentation.

C TRAINING

Objectives

The purpose of Training in respect of RIM models will be to ensure that people, both within the Task Force and outside, are able to quickly acquire the skills necessary to utilise those models.

Protocols

1. Training modules for RIM models for potential users should be developed as soon as possible following the completion of a model.

2. Training could take the following forms:

   (i) Specific self contained training modules containing a number of case examples and step by step explanations of a model, separate to the user documentation of a model, which individual model users could use to self familiarise themselves with a model. *Such self contained training modules would have the advantage of being available to users as required on a demand basis, ensuring greater flexibility in meeting the training needs of users.*

   (ii) Instructions contained in user documentation that take the user through the steps necessary to run a model on a "step by step" basis. Such documentation should include detailed notes on the model and an on line "help" function. *As a rule, the user documentation prepared for any model, or amendment of a model, should be sufficient for a person unfamiliar with the model to make use of it.*

   (iii) Training courses/seminars at which users can be made more familiar with a model. Such sessions could be pitched at a number of levels, including:

      (a) broad introductory sessions on a model and its capabilities aimed at providing a general introduction to a model to users;

      (b) more detailed structured training sessions at which users are formally trained in the use of a models; or

      (c) broader seminars dealing with modelling approaches or results more generally.

      Sessions such as (a) and (b) generally be appropriate following the release of a new model or major revisions to an existing model while (c) would be a more general opportunity for RIM to present results or discuss modelling issues in a broader forum that provided by the Task Force alone.