AN OVERVIEW OF THE TREASURY RIMHYPO-B MODEL

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ABSTRACT

This paper provides an overview of RIMHYPO-B, a model developed in Treasury as part of the Participation Modelling Project. RIMHYPO-B is a behavioural add-on to the established Treasury RIMHYPO model. This note describes how RIMHYPO-B calculates optimal retirement outcomes (including part-time pathways) based on lifetime utility measured in terms of consumption, leisure, preferences, discount rates and conditional survival probabilities. While RIMHYPO-B runs with 'hypothetical' households, a large number of simulations are run for each household in order to attribute a range of stochastic characteristics. This approach provides a more representative population cohort and therefore a more realistic distribution of retirement outcomes. While many models require significant simplification and linearisation of the tax and transfer environment, an advantage of RIMHYPO-B is that detailed policy changes in the area of superannuation, taxation and income support can be modelled.

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1. INTRODUCTION

RIMHYPO-B is a new addition to the suite of models used by Treasury to analyse retirement incomes policy. It was developed as part of the 2005-2009 Participation Modelling Project in Treasury which sought to enhance the capacity within government to identify likely labour market participation impacts of policy in a range of areas. The approach taken by the Participation Modelling Project with the retirement question was to develop a behavioural add-on to the established detailed hypothetical model RIMHYPO which had been developed by the Retirement Income Taskforce (now the Retirement and Income Modelling and Analysis Unit in Treasury). The 'B' in RIMHYPO-B is an abbreviation for RIMHYPO-Behavioural.

RIMHYPO-B supplements RIMHYPO with the facility to calculate optimal retirement outcomes based on lifetime utility measured in terms of consumption and leisure. It also extends RIMHYPO by adding a representation of population characteristics. In line with other 'hypothetical' or 'cameo' models, RIMHYPO typically models a single individual or couple. RIMHYPO-B, on the other hand, uses representative households to determine the relative impacts of policy changes on a stylised cohort. The households are comprised of both single and couple households with various permutations of three possible education levels. Numerous simulations are run for each household, each time adding stochastic elements in order to provide a representative picture of the population cohort and a realistic distribution of retirement outcomes.

Although many other models of retirement behaviour use reduced form equations with dynamic programming, such models typically require significant simplification and linearisation of the tax/transfer environment in order to solve the optimisation problem. While RIMHYPO-B abstracts from a lot of the variation experienced by individuals in the real-world, it is useful in describing the magnitude and direction of labour market responses implied by economic theory. A key advantage of RIMHYPO-B is that a very detailed account of superannuation, taxation and income support policy can be included in the modelling of retirement behaviour.

This overview of RIMHYPO-B begins in Section 2 with an outline of the underlying RIMHYPO model. The key features and structure of RIMHYPO-B are covered in Section 3, with further detail on particular elements of the model in Section 4. The paper concludes with a presentation of illustrative output in Section 5.

2. RIMHYPO

RIMHYPO is a projection model of superannuation accumulations, taxation, social security payments and retirement income — using historical, current and projected policy settings — for hypothetical individuals or couples. RIMHYPO only models defined contribution superannuation schemes, not defined benefit schemes.

RIMHYPO models every year from workforce entry to death for a single person or couple. It can incorporate any permutation of characteristics such as: employment experience and earnings; Superannuation Guarantee, member and salary-sacrificed contributions; episodes of unemployment; economic conditions; fund earnings and fee profiles; pre-retirement non-super savings; aged and disability retirement; and retirement benefit and income combinations such as lump sums, allocated pensions, life-time annuities, shares and fixed interest accounts.

Indexation modules convert the base year values for income support, taxation and superannuation into current price estimates for each projection year in the model. However output values are typically deflated to a base year set by the user.

While not used for overall distributional analysis, RIMHYPO is ideal for some forms of detailed policy analysis. It can show the effect of variations in a wide range of policy and personal characteristics on pre- and post-retirement income. It does not, however, tell us how many people are likely to be affected in a particular way by a policy change, nor what the likely impact on retirement decisions will be. RIMHYPO-B goes some way to filling these gaps.

Further information on RIMHYPO can be found in *RIMHYPO, A User's Guide*, 1995, or *RIMHYPO: An Outline of the Code*, Technical Paper 95/2 (see http://rim.treasury.gov.au/content/default.asp for details).

3. KEY FEATURES AND STRUCTURE OF RIMHYPO-B

3.1 RIMHYPO-B Components

RIMHYPO-B uses the detailed calculations from RIMHYPO for each year of an individual's life from workforce entry as input into determination of their optimal retirement age. The optimal retirement point is the age which maximises their individual discounted sum of lifetime utility, a function of consumption and leisure. In addition, an option to transition into retirement via part-time work is modelled. Due to computing limitations, an individual only has one opportunity during the retirement phase to drop to part-time work; a permanent reduction in hours until they exit the workforce at retirement.

RIMHYPO-B uses 10 stylised household types as the basis for representing a population cohort; with heterogeneity within each type then added to give a richer representation of the population. The basic household types (see Section 4.1) are defined by marital status and educational attainment. In order to estimate a distribution of retirement outcomes that reflects the heterogeneity observed in the real world, a number of simulations, or 'draws', are computed for each household. Heterogeneity is captured by adding stochastic components to variables such as prime-age hours of work; annual and lifetime earnings; superannuation contributions; non-super savings; age differences in couples; survival probabilities; and leisure preferences.

Although only one cohort can be run at any one time, the age of the cohort can be set by the user. In this way, short-, medium-, and long-term impacts of policies can be assessed by increasing or decreasing the commencement age of the cohort. The default commencement age is 40 years in 1992, equivalent to a retirement age range of 55 to 75 years between 2007 and 2027. The retirement age range can also be changed by the user.

After the last set of calculations for a household have been performed (at age 99), the retirement/part-time combinations that maximise lifetime utility are appended to the output data set, weighted to reflect the number of draws with particular outcomes.

A summary of the main RIMHYPO-B components is shown in Table 1.

Table 1: Summary of RIMHYPO-B components

Modelling Aspect	Options[(a)]	Details
Retirement decision	Determined by the model	Utility function of consumption and leisure used to determine optimal retirement decision.
Number of Households	1 to 10	Up to 7 couple and 3 single households can be modelled in one run.
Number of draws per household	1 to 80	Stochastic components added to: wages (lifetime and annual); prime-age work hours; survival probabilities; leisure preferences; part-time transition to retirement; home-ownership, age difference in couples; and savings (non-super assets, member contributions and salary sacrifice).
Number of retirement age options per draw	1 to 21	Up to 21 different retirement scenarios can be considered, i.e. where an individual can retire between 55 and 75 years of age.
Number of part-time options per retirement age	1 to 2	As well as modelling a straight transition from work to full retirement, the model can also simulate retirement outcomes where individuals transition from full-time to part-time work at an individually assigned age between 55 and 65 before exiting the workforce completely.
Total number of scenarios	1 to 33,600	The outcomes of the model are based on the retirement/part-time combinations that maximise lifetime utility, weighted by draw and household.

(a) The figures indicate the range available based on the power of the computing environment in which RIMHYPO-B is currently run.

3.2 Utility function

The specification of the utility function is clearly central to RIMHYPO-B. Discounted annual utility (U_t) is calculated for each draw (k) for each household member (l) and for each retirement/part-time combination *(j)* where:

$$U_t^{jkl} = f\left(C_t^{jkl}, L_t^{jkl}, \rho, \alpha^{kl}, \beta, S_t^{kl}\right)$$

and C is consumption,[2] L is leisure,[3] ρ is the intra-temporal elasticity of substitution between consumption and leisure, α is the leisure preference,[4] β is the intertemporal discount rate and S is the probability of surviving to time *t* conditional on being alive at the first retirement age.[5]

Lifetime utility (U) is then calculated as the sum of the annual discounted utility values from commencement age to age 99:

$$U^{jkl} = \sum_{t=CA}^{99} U_t^{jkl}$$

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[2] Consumption is calculated as disposable income (employment and social security income minus taxes and saving — dissaving increases disposable income) as a proportion of average earnings at time *t*.

[3] The leisure variable takes a different value if the individual is in full-time or part-time work, on a disability support pension, on an unemployment benefit or retired.

[4] The leisure preference is randomly drawn for each draw from a normal distribution.

[5] Similar approaches can be seen in Sefton, van de Ven and Weale (2008) and Kudrna and Woodland (2009).

The optimal outcome for each household/draw is the retirement/part-time combination that maximises *U*. For couples, utility is calculated separately for each individual, added together and the combined utility is maximised.[6]

The utility parameters have been calibrated to produce results that fit with the observed data in terms of average hours worked by age, the retirement age distribution and work/payment status. Note that no utility from bequests is accounted for and that households are not able to borrow against future earnings.

3.3 Structure of RIMHYPO-B

RIMHYPO-B iterates through a set of nested loops which incorporate heterogeneity and all possible retirement outcomes for each household type.

The hierarchy of loops includes:

- the 'household loop' which specifies the basic household types to be covered by a simulation;

- the 'draw loop' which adds stochastic variation to a number of household characteristics;

- the 'retirement age loop' which covers the range of possible retirement ages being considered;

- the 'part-time loop' which covers the possibility of a step down to retirement through part-time work (and also covers receipt of disability support pension); and

- the 'policy loop' which performs the calculations used to identify the optimal retirement outcome.

A flowchart representation of the structure and iterations involved in RIMHYPO-B is shown in Figure 1.

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[6] Modelling the joint retirement decision for couples greatly increases the complexity of any modelling and models that focus on a joint decision often simplify other aspects of the work or hold one partner's behaviour fixed. The approach used in RIMHYPO-B simplifies the issue by requiring both members of a couple to retire at the same time (ie the same year, not necessarily the same age). This greatly reduces the number of possible solutions.

Figure 1: Flow chart outlining the optimising model
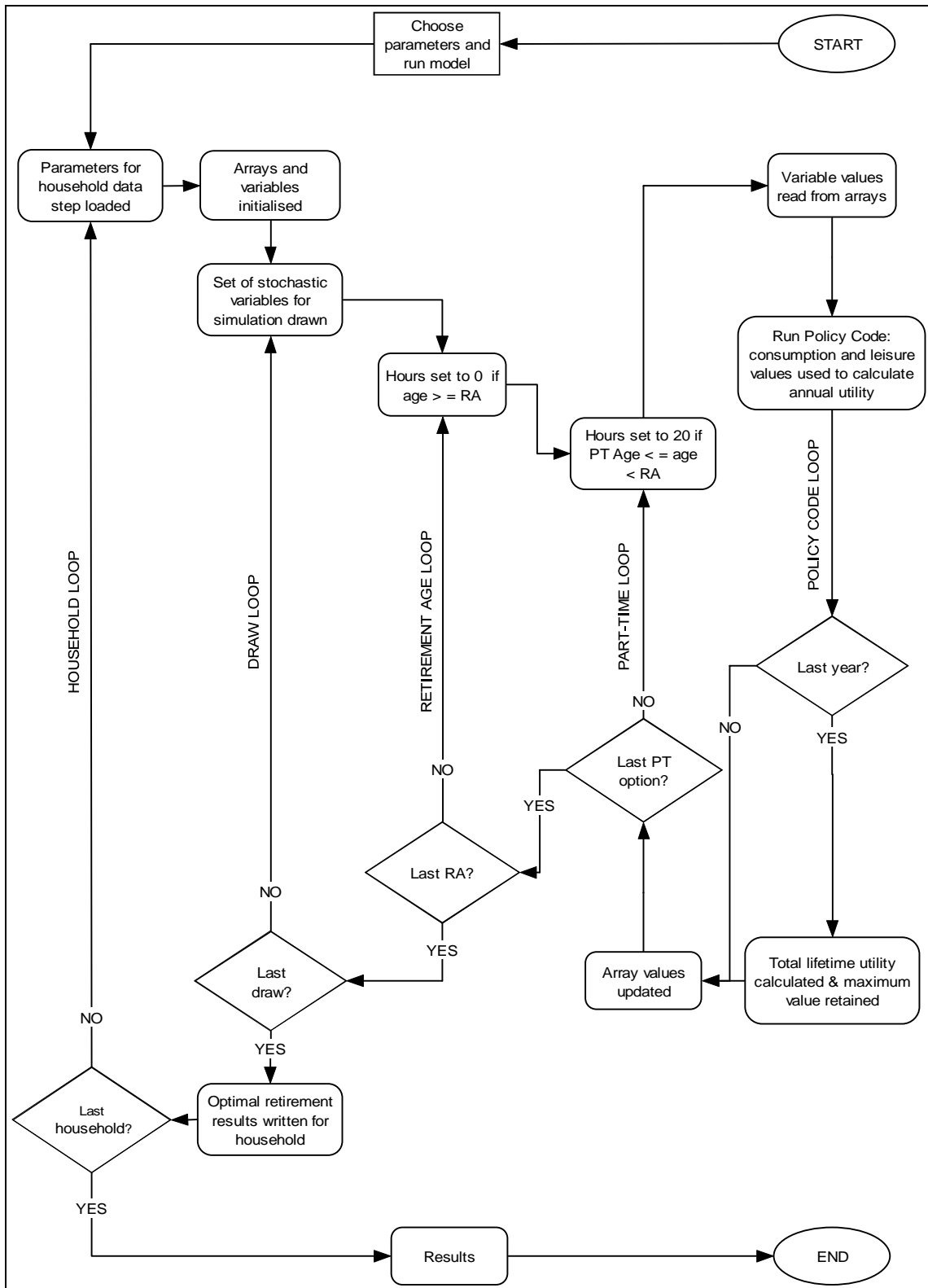
RA = retirement age, PT = part time

4. ELEMENTS OF RIMHYPO-B

This description of the elements of RIMHYPO-B is organised around the loops described above.

4.1 Household loop

The basic representative households in RIMHYPO-B are weighted to reflect the proportion of each household type in the cohort according to the 2005-06 ABS Survey of Income and Housing (SIH). The household types differ according to marital status and educational attainment.

Educational attainment determines which wage profiles are assigned to the household. There are three levels of educational attainment: high (bachelor or higher degree); medium (other non-school qualifications); and low (no non-school qualifications). There are three single households, representing each of the high, medium and low education levels, and seven couple households. For single households a subsequent distinction between males and females is handled by allocating gender specific characteristics. While there are nine possible educational attainment combinations for couples, two of the less common combinations have been modelled by switching which wage profile the reference person or spouse receives, rather than modelling each as a separate household type (see the description of wages in Section 4.2.2).

At the start of each data step, random number seeds are set by the household number. This ensures that model runs are reproducible, changes in retirement outcomes are solely due to user-specified parameter changes, and that different random number streams are used for each household.

4.2 Draw loop

For each household type, up to 80 draws can currently be simulated. At the start of each draw, stochastic variation is modelled in the following areas:

- hours of work for prime-age workers;
- wages;
- savings;
- age difference between members of a couple household;
- survival probabilities;
- leisure preferences; and
- home-ownership.

More detail on each of these areas is provided below.

4.2.1 Hours of work for prime-age workers

For the period up to the first specified possible retirement age, a multinomial logit model is used to estimate the probability of annual employment status for each gender as a function of marital status, education, age and lagged employment status. The estimation used the four most recent waves of the longitudinal HILDA survey available at the time, waves 4 through 7.

The dependent variable in our multinomial logit model is a categorical variable equivalent to 'not working', 'working part-time (PT)' or 'working full-time (FT)', determined using reported hours of work from wave 7 of HILDA.

The independent variables include marital status, education, age, age squared, age cubed and up to three dummy variables for 'not working' and 'working PT' at time t.

Dummy variables for 'not working' and 'working PT' were created for waves 4, 5 and 6. The 'not working' dummy is equal to 1 if hours equal 0 or 'not asked' (i.e. not in the labour force) and the 'working PT' dummy is equal to 1 if hours are greater than 0 but less than or equal to 30.

The marital status, education and age variables were calculated from wave 7. The education dummy variables (for high and medium education levels) match those used in the wage estimation for RIMHYPO-B (discussed below).

To allow estimation for individuals in RIMHYPO with no, or limited, work history, we estimated four separate equations for each gender; one with no lags of past work status, and the others ranging from one to three lags.

The full model with the maximum three lags is:

$$\Pr\left(hrs_t = j\right) = \frac{e^{s_j}}{\displaystyle\sum_{k=0,PT,FT} e^{s_k}}$$

$$j = 0, PT, FT$$

where:

$$s_j = \alpha + \beta_1 MS_t + \beta_2 Edhgh_t + \beta_3 Edmed_t + \beta_4 Age_t + \beta_5 Age_t^2 + \beta_6 Age_t^3$$
$$+ \beta_7 D\_0_{t-1} + \beta_8 D\_0_{t-2} + \beta_9 D\_0_{t-3} + \beta_{10} D\_PT_{t-1} + \beta_{11} D\_PT_{t-2} + \beta_{12} D\_PT_{t-3}$$

and MS = marital status; $Edhgh$ = high education dummy; $Edmed$ = medium education dummy; D_0 = zero hours dummy; and D_PT = part-time dummy.

Hours of work for each individual are estimated this way every year until the first retirement age option (typically 55). Beyond this, each individual has the option to retain their current hours, drop to part-time hours (if previously working full-time) or retire (if previously working), whichever scenario is optimal for their situation.

4.2.2 Wages

Estimating realistic lifetime wage profiles is clearly very important for modelling retirement income behaviour, and a good deal of effort went into this aspect of the modelling with a number of alternatives explored before settling on the adopted approach.

Since the main aim of the modelling is to determine hours worked at older ages we want to remove the hours effect from the earnings profile by using an hourly wage profile by age. Separate estimates were produced for males and females for each of the three levels of educational attainment.

The relative hourly wage rates were calculated as the hourly individual wage rate (weekly gross wage and salary divided by the number of hours per week usually worked in all jobs) in a given year divided by the average hourly wage rate for all workers in that year.[7]

The profiles were estimated with an age-quadratic function using data from the SIH, pooled for all available years over the period from 1982 to 2005. Inspection of the data shows that the relative age-wage profiles have not changed significantly over the last 20 years, indicating that there is no significant cohort effect.

Due to its nature, the use of an age-quadratic function results in decreasing relative wage rates at older ages. While there are some reasons why this drop at older ages could be expected, because of the relatively small number of workers at these older ages it is difficult to know how realistic this estimated decrease is. For this reason, sensitivity analysis was undertaken to ensure that the estimated decline in relative wages at the older ages did not have an undue impact on the model results. The relative age-wage profiles for each level of educational attainment are shown in Chart 1 for males and Chart 2 for females.
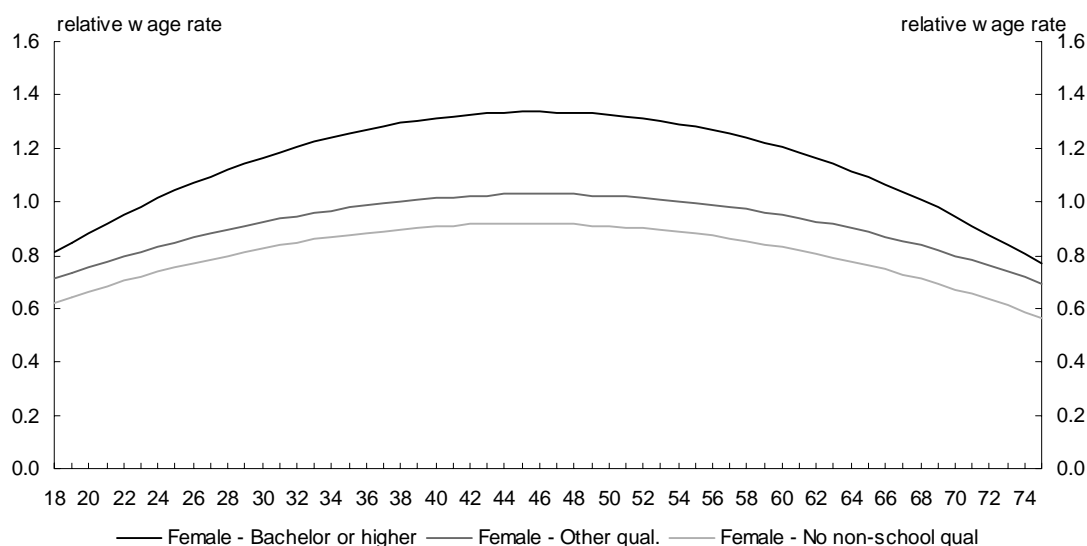
Chart 1: Estimated relative hourly wage rates by age and educational level — Males
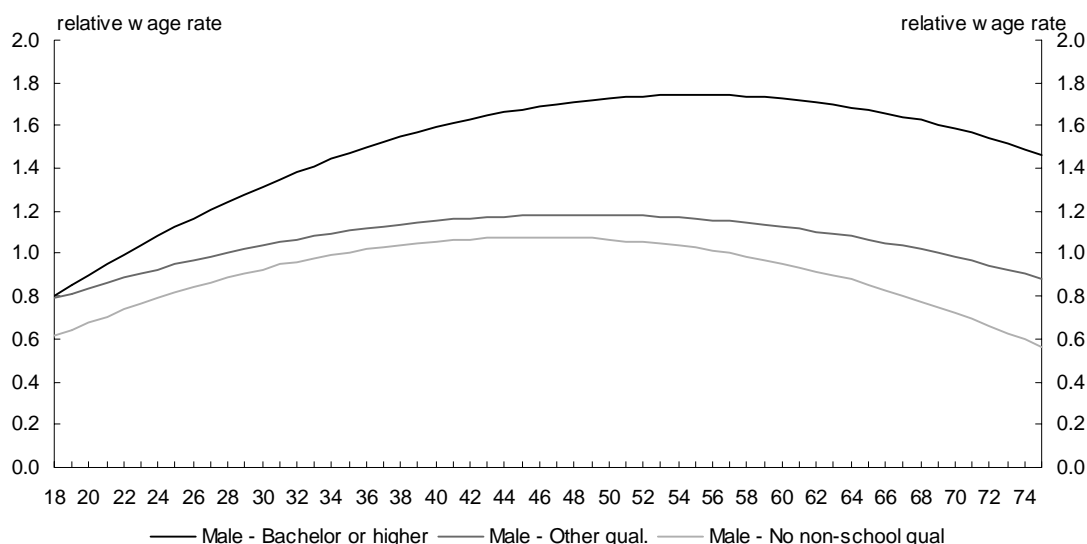
Source: see text

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[7] A benefit of using relative hourly wage rates is that they account for the trends in wages over time avoiding the need for the inclusion of year dummies in the estimation. Including year dummies in the estimation causes issues since they are highly correlated with the age dummies.

Chart 2: Estimated relative hourly wage rates by age and educational level — Females

relative wage rate   relative wage rate

——— Female - Bachelor or higher   ——— Female - Other qual.   ——— Female - No non-school qual

Source: see text

At the start of each iteration, wage profiles are assigned to members of a household based on educational status. Whether single households receive the male or female wage profile is determined by random allocation based on the observed proportions for each household type. For couple households the reference person is assigned a male profile and the spouse is assigned a female profile. The [High, Medium], [Medium, High], [High, Low] and [Low, High] educational attainment combinations are not modelled as separate household types. Instead these households are modelled by switching which wage profile the reference person or spouse receives.

To mimic unexpected changes in wages, variation is added to wages by multiplying the wage rate by an annual wage shock drawn from a random normal distribution with mean of one and a standard deviation of 10 per cent.

A lifetime wage shock is also added to the wage rate to allow for variation in individuals' average career earnings. An individual's lifetime wage shock is randomly drawn from the error distribution associated with the wage profile estimation.

It should be noted that while wage profiles were estimated for each household type, the error distributions were similar and only one was estimated in the model.

4.2.3 Savings

In order to recreate the observed distribution of superannuation balances, Superannuation Guarantee and voluntary superannuation contributions were modelled including salary sacrifice and post-tax member contributions. The probability of salary sacrificing was estimated using a probit model and the salary sacrifice amounts were estimated using an ordinary least squares (OLS) regression. Since the majority of large post-tax member contributions are made by a small number of contributors and the majority of contributors make relatively small contributions we decided to model these two groups separately: that is, those making regular annual contributions and those making a larger lifetime contribution. An annual probability of making a $1,000 contribution was modelled in addition to the probability of making a large lifetime contribution.

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4.2.3.1 Salary Sacrifice

The probit model used for salary sacrifice contributions is:

$$prob\_SS = \Phi(\beta_0 + \beta_1 \cdot age + \beta_2 \cdot income + \beta_3 \cdot married)$$

$$where \ \beta_0 < 0, \beta_1 > 0, \beta_2 > 0, \beta_3 > 0 \ .$$

Income is measured in relative terms as salary divided by average weekly earnings (in line with the modelling approach in RIMHYPO-B).

The equation shows that people who are older, have higher earnings and are partnered are more likely to make salary sacrifice contributions. However, since this relationship also depends upon unobservable factors an error term is added to the estimated probability for each individual.

The percent of salary contributed to superannuation via salary sacrifice arrangements is estimated (on the subset of those with positive contribution values) using the OLS regression:

$$\ln(SSamt) = \beta_0 + \beta_1 \cdot age + \beta_2 \cdot income + \beta_3 \cdot married$$

$$where \ \beta_0 < 0, \beta_1 > 0, \beta_2 > 0, \beta_3 > 0 \ .$$

Income is again measured in relative terms as salary divided by average weekly earnings.

4.2.3.2 Member Contributions

The probit model used to estimate annual member contributions is:

$$prob\_mc = \Phi(\beta_0 + \beta_1 \cdot age + \beta_2 \cdot age^2 + \beta_3 \cdot income + \beta_4 \cdot income^2 + \beta_5 \cdot married)$$

$$where \ \beta_0 < 0, \beta_1 > 0, \beta_2 < 0, \beta_3 > 0, \beta_4 < 0, \beta_5 > 0$$

Income is salary divided by average weekly earnings.

An annual error term is again added to the estimated probability for each individual and the resulting probability estimate is compared to a cut off. If an individual has a probability greater than the cutoff, is aged less than 70 and is working in the year then they are assigned an annual member contribution of $1,000.[8]

RIMHYPO-B also models large one-off member contributions to take into account the individuals that have made large voluntary contributions over their lifetime. 40 per cent of individuals were randomly assigned a large lifetime member contribution drawn from a log normal distribution.

The large member contribution enters the superannuation account the year before the first retirement age. The value of large member contributions is not indexed over time. A justification for this is that the younger cohorts will not have to contribute as much post-tax money to their superannuation in a mature superannuation system.

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[8] Individuals in the model can therefore make multiple contributions of $1,000 over their lifetime.

4.2.3.3 Non-superannuation assets

Non-superannuation assets are also estimated as they have a significant impact on retirement patterns and pension entitlement. Data from the 2005-06 SIH was used to estimate non-superannuation assets for households where the reference person was aged between 45 and 55.[9] Assets included financial and own-business assets but excluded property — both owner-occupied and investment.[10]

Non-superannuation assets *NSA* are assigned to households in the year before the first retirement age and are estimated separately for each draw *k* and each household *l* using the following equation:

$$NSA_{FRA-1}^{kl} = (1 + r_{year})^{(year-2005)} \exp(\beta_1 + \beta_2 \cdot incomeS_{FRA-1}^{kl} + \beta_3 \cdot incomeR_{FRA-1}^{kl} + \varepsilon^{kl})$$

Where:

• r is a year specific bond rate used to adjust *NSA* for different cohorts;[11]

• ε is a household and draw specific error drawn from a random normal distribution with a mean of 0 and standard deviation σ;

•   and *incomeS* and *incomeR* equal salary, earned by the spouse and reference person respectively, divided by average weekly earnings.[12]

Note that it is household assets that are estimated, so for couple households the non-superannuation assets are divided equally between the reference person and the spouse.

The non-superannuation assets are placed in a fixed interest investment account. They grow each year until retirement and are drawn down once retirement age is reached.

4.2.4 Age difference between members of a couples

An age difference between 0 and 5 years is assigned to the two members of a couple. The age difference is randomly assigned and added to the age of the reference person. The distribution of age differences was estimated from the 2005-06 SIH. Due to modelling restrictions, the reference person, or male, is always the elder member of the couple.

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[9] This age range was used to ensure a sufficient sample size was used in estimation and to avoid issues associated with the dissipation of assets post retirement.

[10] RIMHYPO does not model assets or income from investment property and due to some uncertainty about the extent to which retirees drawdown on such assets it was decided to exclude them at this stage. However, because RIMHYPO distinguishes between home-owners and non-homeowners in the application of the assets test for pensions and allowances and for rent assistance, home ownership rates were estimated for each household type using the 2005-06 SIH and randomly assigned.

[11] This adjustment is necessary to run the model for different cohorts as the estimation uses asset information for 45-55 year olds in the year 2005 and different cohorts will be assigned their assets in different years.

[12] Note that salary refers to the wage rate that could be earned during employment, salary is not set to zero if hours worked are zero. Spouse income is set equal to zero in single households.

4.2.5 Survival probabilities

At least in theory, individuals with short life expectancies need fewer years of work to accumulate sufficient retirement assets and/or need a younger retirement age in order to exhaust their assets (assuming they derive no utility from making bequests). Individuals with long life expectancies need more years to accumulate assets and/or need an older retirement age to avoid prematurely exhausting their funds. Using average survival probabilities for males and females would thus tend to compress the estimated optimal retirement age distribution.

While all individuals are modelled with scope to live to age 100, conditional survival probabilities taken from the 2000-02 Life Tables are used to discount annual utility. By adding some variation, individuals with shorter life expectancies receive heavier discounting for utility derived in later life, and vice versa. From the life tables it was estimated that the standard deviation around the central life expectancy estimate at age 55 was around 10 years.

The drawdown of financial assets in retirement is also adjusted based on an individual's life expectancy. For individuals with substantially shorter life expectancies (at least four years less than average) the maximum age-based drawdown factor is used. The minimum age-based factor is used for individuals with substantially longer life expectances (at least fours years greater than average). The default drawdown uses the midpoint of the maximum and minimum drawdown factors.

4.2.6 Leisure preferences

Because Age Pension receipt is automatic once an individual has reached Age Pension age (subject to means testing and residency requirements), any loss of payment due to continued employment can be viewed as a significant opportunity cost. In terms of the optimal retirement outcomes this would result in an excessively large peak in the retirement distribution at age 65. While this may be optimal in the consumption-leisure sphere, it is not what, at least for now, is observed in the data.

To account for this, a stochastic component is added to the relative weight placed on leisure in the utility equation.[13] This reflects the fact that different individuals have different leisure/consumption preferences. That is to say that some people gain personal satisfaction from their job and prefer to delay retirement, while others prefer to retire at the earliest possible point, even if it means forgoing optimal financial outcomes.

4.3 Retirement age loop

To calculate the optimal retirement age the policy code is run for each retirement age option.[14] The first retirement age can be set by the user but the default value is 55. Outcomes are calculated for up to 21 retirement ages with a default range of 55 to 75 years.

At the beginning of the loop, retirement age and year are adjusted and hours are set to zero once retirement age is reached. Since some individuals stop work before the retirement age loop their last year of work is retained and used in the retirement age distribution.

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[13] The same weight is used for both members of a couple.

[14] To increase the efficiency of the model, the policy code is only called once per year where individuals are aged less than the first possible retirement age.

Note that for couple households both the reference person and the spouse must retire in the same year. This year is determined by the retirement age and part time option that maximises lifetime utility of the couple.

4.4 Part-time loop

Besides covering the possibility of part-time transition to retirement, the part-time loop also covers the possible receipt of disability support pension.

4.4.1 Part-time hours

Due to computing limits on array elements, we could not model all part-time possibilities for all retirement age options. The approach developed allows for a choice in terms of moving from full-time to part-time hours, but this choice is only available at one particular age for each individual. The individual's part-time age is randomly assigned, with cumulative take-up between 55 and 65 years of age.

The retirement age options are modelled under two scenarios:

- The no part time scenario: hours worked in the year before the first retirement age are retained until retirement and then set to zero.

- The part time scenario: people working full-time in the year just prior to the first retirement age move from full-time to part-time employment at their randomly assigned part-time age. When they reach retirement age their hours are then set to zero.

4.4.2 Disability

The receipt of disability support pension (DSP) is also calculated in the part time loop. Following an approach described by Low, Meghir and Pistaferri (2009) we require people in the model to be unemployed for at least one year before being able to take-up DSP. The combination of lower payment rates and job search requirements associated with receipt of unemployment benefit, means that this restriction presents a hurdle and limits take-up of DSP.[15]

The default action in the RIMHYPO model is that eligibility for DSP is also associated with access to superannuation assets (irrespective of preservation age) and receipt of an insurance payout (worth around $45,000 in today's dollars). In RIMHYPO-B, on the other hand, it was decided to split the eligibility for DSP from superannuation access and insurance payments. The DSP and preservation rules seem to support this and ABS data suggest that very few individuals report both DSP receipt and income from a superannuation annuity or pension.

4.5 Policy Code Loop

For each year of age, the detailed RIMHYPO policy code makes calculations of earnings, superannuation, taxation, and income support for each draw, retirement age, and part-time option selected in RIMHYPO-B. This results in a large number of values which need to be stored for each of the iterations. There can be up to 3,360 values for each stored variable, for

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[15] The job search requirements are reflected via lower leisure values of the unemployed relative to DSP recipients.

each year of age, and for each household member. To handle this large amount of data, an array structure is used.

At the beginning of each policy code loop, the values referring to that particular draw/retirement/part-time iteration are read into the RIMHYPO variables by a macro using the draw/retirement/part-time counters to point to a particular element in a multi-dimensional array. Once this is done, the policy code modules are run, annual consumption and leisure values are determined and annual utility is calculated. The updated variables are written back to their place in the arrays before moving to the next draw/retirement age/part-time iteration.

After the last set of annual calculations for a household have been performed (ie at age 99), the retirement/part-time combination that maximise the lifetime utility function for each draw is determined. Weights are assigned to each optimal retirement outcome, taking account of the household weight and number of draws, and the results are appended to an output data set.
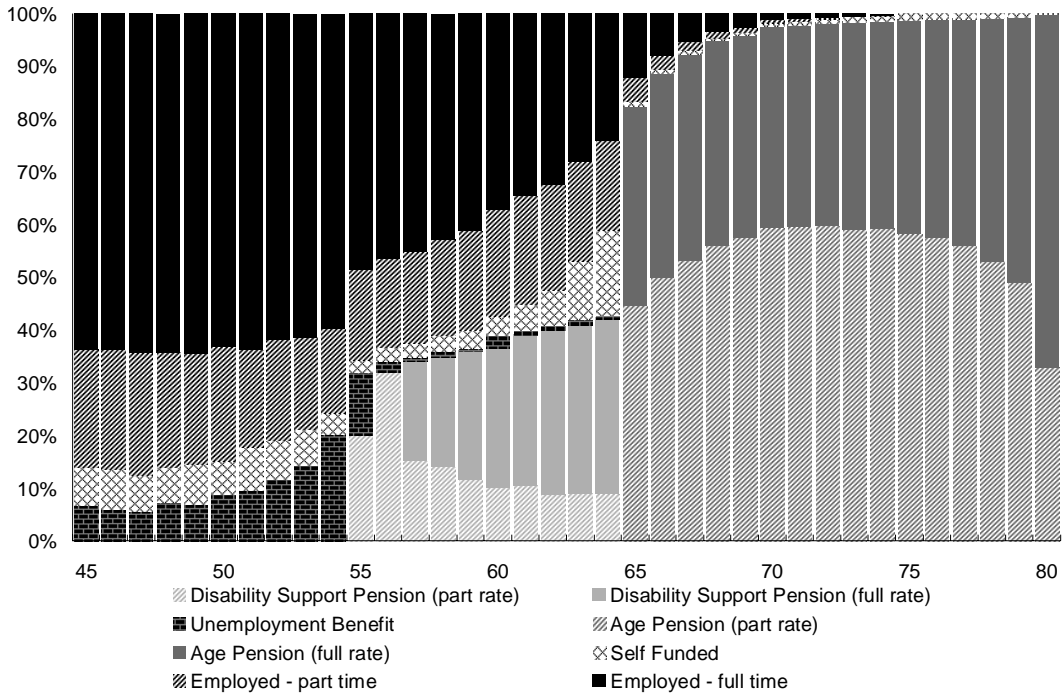
5. ILLUSTRATIVE RIMHYPO-B OUTPUT

The model cycles through the draw, retirement age and part-time options until all the optimal outcomes have been calculated for the first household. The household's optimal outcomes are then appended to a data set and the model is run for the next household. Once all the households selected by the user are complete, output tables are produced which summarise information on the optimal retirement outcomes. These tables are usually exported to Excel where the following four key charts can be produced.

- Status by age – the proportion of people working full-time and part-time, receiving full-rate or part-rate pensions, receiving unemployment benefit or completely self-funded (Chart 3)

- Income source by age – the weighted income averages by age and source. The four sources of income include salary and wages, income support, allocated pension drawdown and interest account drawdown (Chart 4)

- Retirement age distribution –the proportion of people that retire by age (Chart 5)

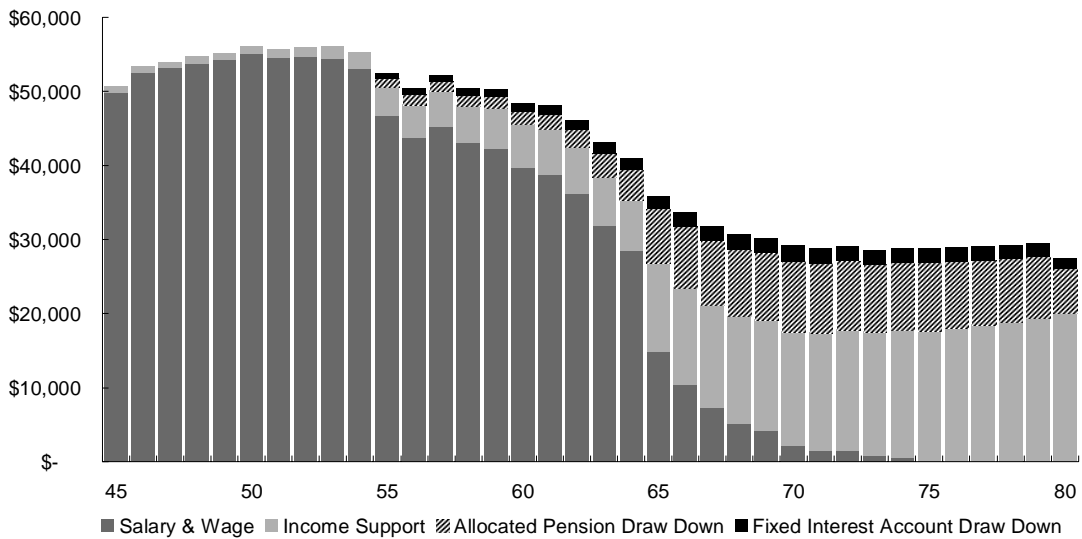- Average hours by age – the weighted average hours worked per week by age (Chart 6)

These charts can be produced separately for males and females or the combined total. They can also be produced for any combination of households. The following output is for the cohort aged 40 in 1992 for the maximum number of options currently possible.

Chart 3: Work and income support status by age[a]

Legend:
- Disability Support Pension (part rate)
- Disability Support Pension (full rate)
- Unemployment Benefit
- Age Pension (part rate)
- Age Pension (full rate)
- Self Funded
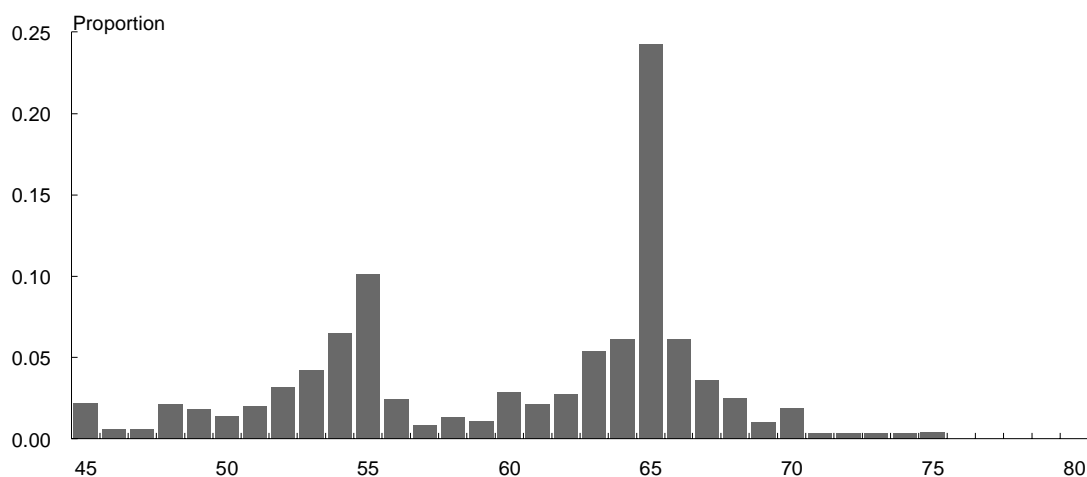- Employed - part time
- Employed - full time

(a) States are mutually exclusive for the purposes of this chart, and identified in the following order: full-time employment; part-time employment; full-rate DSP; part-rate DSP; unemployment benefit; full-rate age pension; part-rate age pension and individuals that are completely self-funded.
Source: RIMHYPO-B, see text

**Chart 4: Weighted average income by age and source (2008 dollars)**

Legend:
- Salary & Wage
- Income Support
- Allocated Pension Draw Down
- Fixed Interest Account Draw Down

Source: RIMHYPO-B, see text

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Chart 5: Retirement age distribution

As well as showing the model results, Chart 6 compares average hours worked per week by age from RIMHYPO-B to the 2005-06 SIH. The results are comparable although some difference is expected due to the fact that the SIH is a cross-sectional data set and RIMHYPO-B follows a single cohort aged 40 in 1992.

Chart 6: Weighted average hours worked per week by age
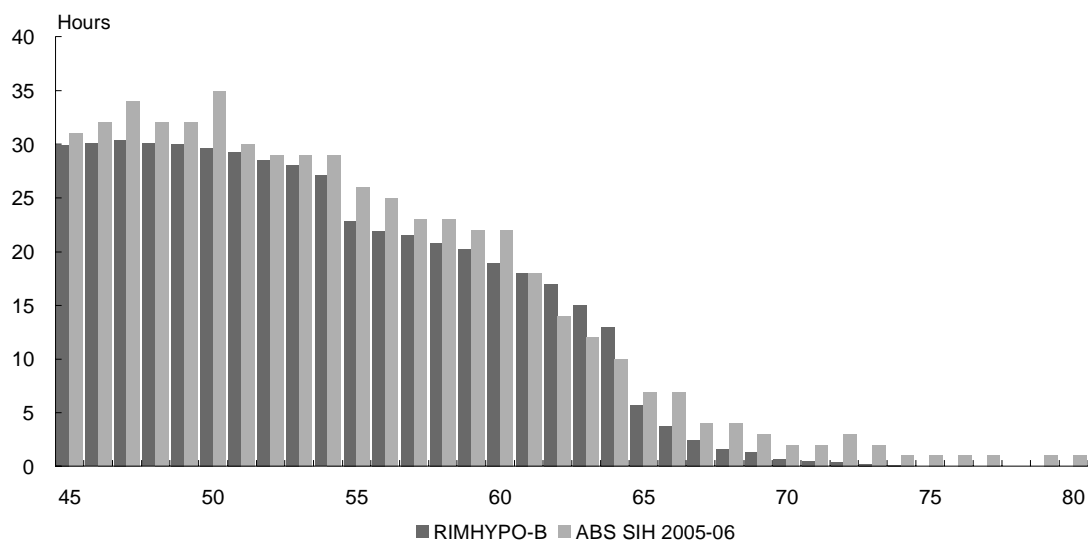
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