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Personalised drawdown strategies and partial annuitisation to mitigate longevity risk

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ABSTRACT

Despite the importance of drawdown strategies under a defined contribution system with increased longevity risk, little guidance to retired and retiring members has been forthcoming from superannuation funds. This paper provides a do-it-yourself drawdown design for members of superannuation funds along with comparison studies on a range of retirement income strategies under an array of realistic scenarios. A stochastic economic scenario generator is used to simulate the uncertain outcomes of different drawdown strategies during retirement. The impact of annuitisation for mitigating longevity risk under government pension rules and the selection of personalised drawdown and annuitisation strategies for retirement are examined.

1. Introduction

The continuing maturity of the Australian superannuation system is noted by its high standings in the Melbourne Mercer Global Pension Index.[1] However, the retirement phase is underdeveloped, as noted in the Financial System Inquiry (Murray et al., 2014) which proposed the development of *Comprehensive Income Products for Retirement* (CIPRs).

One major challenge for the Australian superannuation fund industry, totalling A$3.0 trillion in assets,[2] is the design of CIPRs, or other retirement income solutions, for their retired and retiring members. Given the *Australian Prudential Regulation Authority* (APRA)'s member-outcomes rule will apply to all retirement products from 2020, superannuation funds need to develop a "best strategy" for their members. Currently there is little guidance on how this can be achieved. Utility frames have been proposed such as the *Member's*

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[1] Available at: https://www.mercer.com.au/our-thinking/mmgpi.html (Retrieved April 4, 2020).

[2] The Association of Superannuation Funds of Australia, available at: https://www.superannuation.asn.au/resources/superannuation-statistics (Retrieved April 5, 2020).

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Default Utility Fund (MDUF) (Bell et al., 2017; Callil et al., 2018) to help funds measure different drawdown strategies. For members, behaviour biases in retirement savings exist (Benartzi and Thaler, 2007), for example, decisions are often biased towards selecting fashionable or popular investment products of the day, investment strategies are not reviewed after market conditions have changed substantially (Hirshleifer, 2015; Frydman and Camerer, 2016). Retirement outcomes will only be known after or well into retirement and that is a long time away and too late to adjust. Longevity risk is another uncertainty in retirement planning (Cocco and Gomes, 2012), though annuitisation is one way to manage the risk (Benartzi et al., 2011). To decide amongst competing strategies, funds need to use stochastic models for economic scenario generations so as to incorporate uncertainty when assessing these strategies and selecting the "best strategy" (Hanewald et al., 2013).

Deterministic models fail to capture the uncertainties intrinsic to drawdown strategies, therefore stochastic models should be selected to represent future economic and superannuation outcomes. Here we use a multi-factor economic scenario generator: *Simulation of Uncertainty for Pension Analysis* (SUPA) model[3] developed by the Commonwealth Scientific and Industrial Research Organisation to project financial and economic factors which directly impact income, investment returns and withdrawal patterns (Chen et al., 2020) to guide the selection of personalised drawdown strategies during retirement based on retirees' financial profiles and their choices of annuitisation levels which impact retirement income and the remaining superannuation balance.

2. Retirement income drawdown strategies

We compare a range of retirement income strategies including: spending on the minimum drawdown requirement; a 4% sustainable withdrawal rate (Bengen, 1994); spending your decennial age (De Ravin et al., 2019); lifestyle choices; and partial annuitisation strategies including a layering approach of the Australian Treasury 2016 discussion paper.[4]

2.1. Assumptions for drawdown strategies

The Australian retirement system is based on a three-pillar policy of the Age Pension, compulsory superannuation and voluntary savings. Empirical evidence (Sneddon et al., 2016b) suggests that retirees do not spend their income at the rate suggested by the life-cycle hypothesis (Modigliani, 1966, 1986), thus not optimising benefit from their retirement savings. We make the following assumptions for modelling retirement income, although the machinery for analyses in the following section could accommodate personalised information under different economic scenarios. The individual is assumed to be aged 67, the pension age in Australia[5] from 2023, a single homeowning male with superannuation savings, additional assets of A$50,000 and no other testable assets. His-superannuation portfolio is comprised of 50% growth assets (Australian equity 25%, international equity 15% and property 10%) and 50% defensive assets (Australian fixed income 25%, cash 15% and international fixed interest 10%).[6] Further, the individual is entitled to the government Age Pension. The maximum age of the individual is 104 years.

The retirement income is categorised by the initial superannuation balance on retirement, annuitisation choices and drawdown strategies. The details of wealth dynamics can be found in Appendix 1 of the online supplementary material (OSM).[7] Two initial superannuation balances of A$300,000 and A$500,000 are studied. Different annuitisation choices are *no annuitisation* and 30% *fixed annuitisation* (LA); *income layering partial annuitisation* (LPA); and *deferred lifetime annuity* (DLA). We consider six drawdown strategies in total: four predetermined and two targeted consumption strategies. For the predetermined drawdown, four drawdown strategies are assessed: (1) the mandated age-related *minimum drawdown rule* for account-based pensions (ABP)[8]; (2) the *minimum drawdown plus 1%;* (3) *4%* of the initial balance in real terms (Bengen, 1994); and (4) the *rule of thumb* (*RoT*), which is the minimum of the first digit of the age of the individual as the drawdown rate plus 2% if the ABP is between A$250,000 and A$500,000 (De Ravin et al., 2019). For the targeted consumptions, (5) the Association of Super Funds Australia's (ASFA)[9] *Modest* A$27,913 and (6) *Comfortable* A$43,787 lifestyles in September 2019 are studied. (See Appendix 2 of OSM). The Australian Age Pension is means-tested: assets and income tests are used to determine a retiree's Age Pension entitlement. Details on how the assets and income tests are applied can be found in Appendix 3 of the OSM.

[3] For details of SUPA model, http://risklab1.it.csiro.au:5000/SUPA-model . It has a cascading structure (Sneddon et al., 2016a; Wilkie, 1984, 1995) to project financial and economic factors.

[4] Discussion paper is available at: https://consult.treasury.gov.au/retirement-income-policy-division/comprehensive-income-products-for-retirement/ (Retrieved June 4, 2020).

[5] Retirement age information for Australians is available at: https://www.ssa.gov/planners/retire/1960.html (Retrieved June 4, 2020).

[6] These weights reflect a lower exposure to both growth assets (50% v 66%) and international assets (25% v 36%) on the average APRA-regulated superannuation fund asset allocations as at December 2019, reflecting the conservative nature of typical retiree allocations. More information is available at: https://www.apra.gov.au/quarterly-superannuation-statistics (Retrieved June 4, 2020).

[7] The online supplementary material (OSM) for "Personalised drawdown strategies and partial annuitisation to mitigate longevity risk" is available at: https://research.csiro.au/risklab/publications/ (Retrieved June 4, 2020).

[8] The minimum withdrawal rate is available at: https://www.ato.gov.au/rates/key-superannuation-rates-and-thresholds/?page=10 (Retrieved June 4, 2020).

[9] The ASFA retirement standard is available at: https://www.superannuation.asn.au/resources/retirement-standard (Retrieved June 4, 2020).

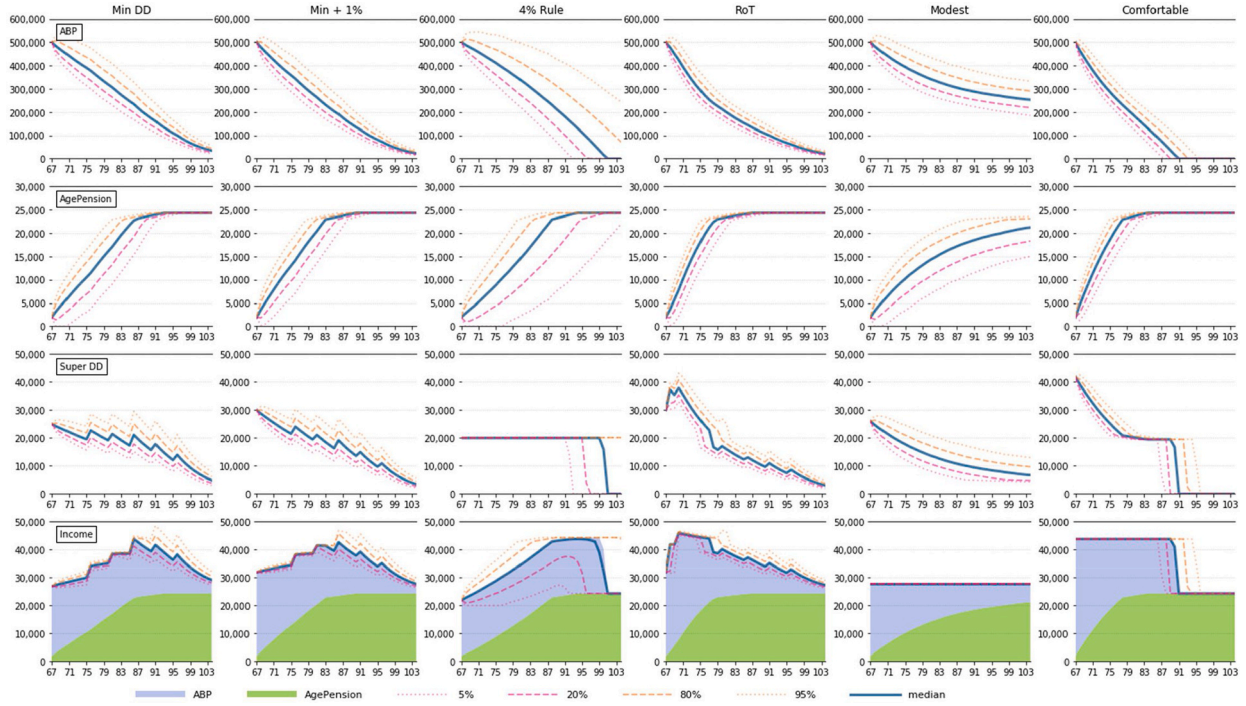

Fig. 1. The retirement outcomes (in rows): account-based pension or superannuation balance (ABP), Age Pension entitlement (Age Pension), superannuation drawdown (Super DD), and total retirement income (Income) which is the sum of Age Pension and superannuation withdrawal under six drawdown strategies (in columns): the minimum drawdown rule (Min DD), 1% above the minimum rate (Min+1%), 4% drawdown rule (4% Rule), the RoT, Modest (A$27,913) and Comfortable (A$43,787) target consumption strategies, without lifetime annuity for a retiree from age 67 to 104 (x-axis) with A$0.5 million initial superannuation balance (y-axis of the plots in the first row). In each subplot, the median (solid curve), 5th and 95th (dotted curve), 20th and 80th (dashed curve) percentiles of simulated uncertain variables are displayed.

2.2. *Analysis of different drawdown strategies*

We use 10,000 Monte Carlo SUPA simulation paths to project the possible outcomes of the drawdown strategies. The six drawdown strategies are compared in Fig. 1 for the case with 0% annuitisation and Fig. 2 with 30% fixed annuitisation when the retirement superannuation balance is A$0.5 m, where the horizon axis represents age. In both figures the columns represent the six strategies and the rows are: the account-based pension balance or the remaining superannuation balance; Age Pension entitlement; superannuation drawdown; and total retirement income. In each plot, the 5th, 20th, 80th and 90th percentiles represent major and moderate downside risks, and moderate and major upside potential, respectively.

From Fig. 1, we observe that in the early years the superannuation balance is reduced fastest for the *RoT* and *Comfortable* consumption, but the *Comfortable* target strategy is first to deplete superannuation, and the *4% Rule* is also likely to deplete the superannuation balance. The other drawdown strategies come close to depleting the superannuation balance by age 104, whereas for the *Modest* lifestyle approximately A$250,000 will remain by age 104. By mid to late 70 s total retirement income on the *RoT* begins to decline and soon after is below all other strategies other than that for the *Modest* lifestyle. The *Comfortable* lifestyle continues to draw the highest income until around 90, and thereafter drops to the Age Pension. From around 90 until the late 90 s, the *4% rule* strategy has the highest income on average, but with high uncertainty.

The annual payment for 30% fixed annuitisation is A$8193 in 2019. Fig. 2 reveals similar profiles to the no annuitisation cases of Fig. 1, with superannuation balance depleting fastest for the *RoT* and *Comfortable* strategies, and the former most likely to deplete the superannuation balance in the late 90 s.

The *RoT* and *Comfortable* strategies have substantially higher total income than the other strategies. The *Comfortable* lifestyle continues to have the highest income until the mid-80 s when the *minimum* strategy has the highest income for most of the remaining age period examined. Around the mid-90 s all the strategies, except for the *Modest* lifestyle, display declines in income, particularly for the *Comfortable* lifestyle. The *4% Rule* displays the greatest uncertainties for both annuitisation cases. The targeted consumption strategies also show uncertainty in the timing of when the superannuation will run out.

Annuitisation is a straightforward way to tackle post-retirement longevity risk. For older years, 30% annuitisation results in a greater income than zero annuitisation for all drawdown strategies except for the *Modest* consumption which is below the income of other strategies at all ages (see Fig. 2).

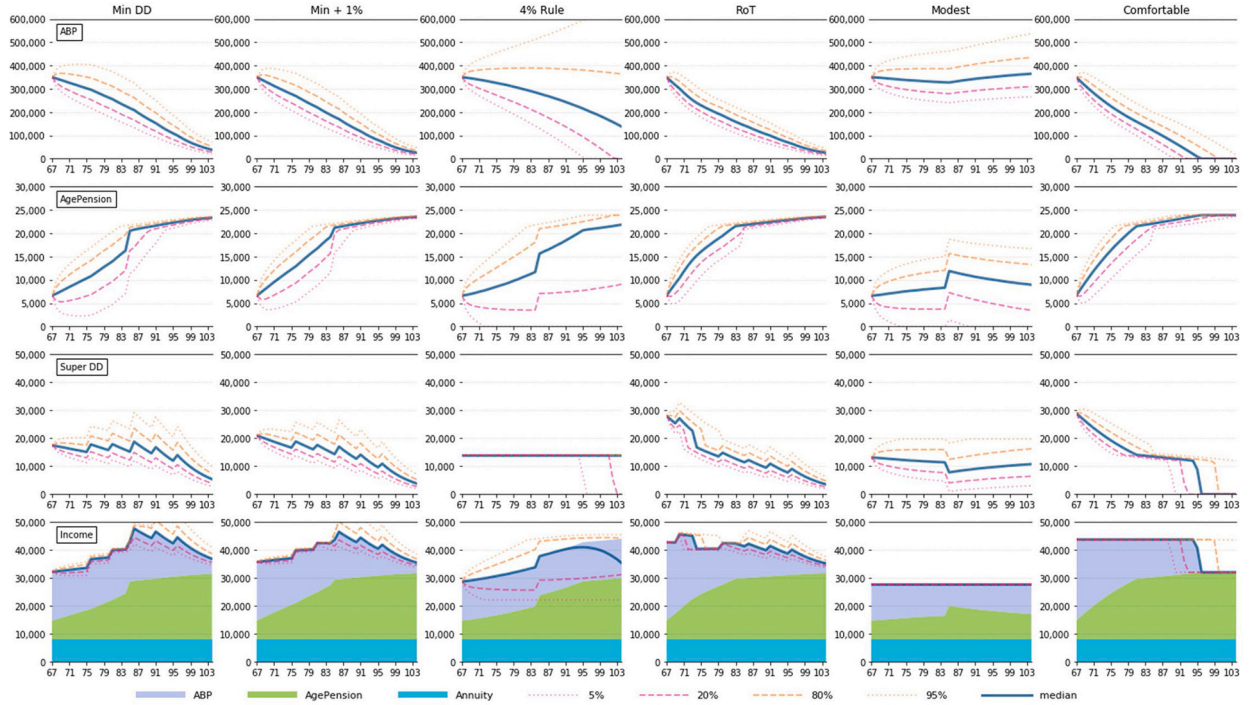

Fig. 2. The retirement outcomes (in rows): account-based pension or superannuation balance (ABP), Age Pension entitlement (Age Pension), superannuation drawdown (Super DD), and total retirement income (Income) which is the sum of Age Pension, superannuation withdrawal and annuity payment under six drawdown strategies (in columns): the minimum drawdown rule (Min DD), 1% above the minimum rate (Min+1%), 4% drawdown rule (4% Rule), the RoT, Modest (A$27,913) and Comfortable (A$43,787) target consumption strategies, without 30% annuitisation for a retiree from age 67 to 104 (x-axis) with A$0.3 m initial superannuation balance (y-axis of the plots in the first row). In each subplot, the median (solid curve), 5th and 95th (dotted curve), 20th and 80th (dashed curve) percentiles of simulated uncertain variables are displayed.

2.3. Annuitisation strategies

Further exploring the impact of differing annuitisation levels, Figs. 3 and 4 provide projected outcomes for the annuitisation levels of 0%, 30%, 50% and 100% for initial superannuation balances of A$500,000 and A$300,000 respectively. We use total income with 100% annuitisation for consumption targets A$44,860 and A$37,823. The simulations incorporate recent changes to the means-testing of annuities, with 60% of the original investment to the age of 84 and thereafter 30% of the original investment being included in the Age Pension asset test. This feature is evident in Fig. 3 with the rise in total income at 85 years of age for the 100% annuitisation.

Fig. 3 also reveals that by approximately 90 years of age with zero annuity, an individual with a A$500,000 superannuation balance will become solely dependent on the Age Pension, which is not the case for annuity of 30% or more. For the A$300,000 balance, sole dependency on the Age Pension is likely by age 85 (Fig. 4). Interestingly, for both superannuation balances, generally the higher the percentage of annuitisation the more income is derived from the Age Pension at an earlier age. Full annuitisation with a A$500,000 balance ensures that total income is equal to or greater than that for the other annuitisation strategies for the age years examined, but for the A$300,000 balance it is below the other annuitisation strategies until the early to mid-80 s, after which it is greater.

Layering can be used to guarantee a desired income for a retiree that reduces the longevity risk. Using the new 60% annuity income test, A$7540[10] can be earned annually from annuity and guarantee full entitlement to the Age Pension, assuming no other income. For a A$500,000 superannuation balance, 27% annuitisation ensures that once the account-based pension is exhausted, the "desired" income strategy of maximising total income while being eligible for the full Age Pension is attainable, as evident from Fig. 5. An initial income of A$38,000 is likely to ensure no change over all ages modelled, but higher initial income results in a fall to the "desired" income in later age years, with desired income reached earlier for strategies with higher initial income.

A DLA that provides an income at a predefined time in the future until the death of the purchaser can also deal with longevity risk. Assume a retiree with superannuation balance of A$500,000 purchases a DLA at age 67 for payment to commence at age 87, the outcome for four annuitisation strategies of 0%, 5%, 10%, 15% and 20% are depicted in Fig. 6 and Fig. 7 for the *Comfortable* and *Luxury* lifestyles, respectively where *Luxury* lifestyle is an annual income of A$50,000. For the *Comfortable* lifestyle no annuitisation by the mid-90 s results in relying only on the Age Pension but increasing annuitisation results in an income above the Age Pension for the ages considered, with higher annuitisation maintaining a higher income (see Fig. 6). For the *Luxury* lifestyle, the annuitisation strategies see

[10] The income applies from January 2020.

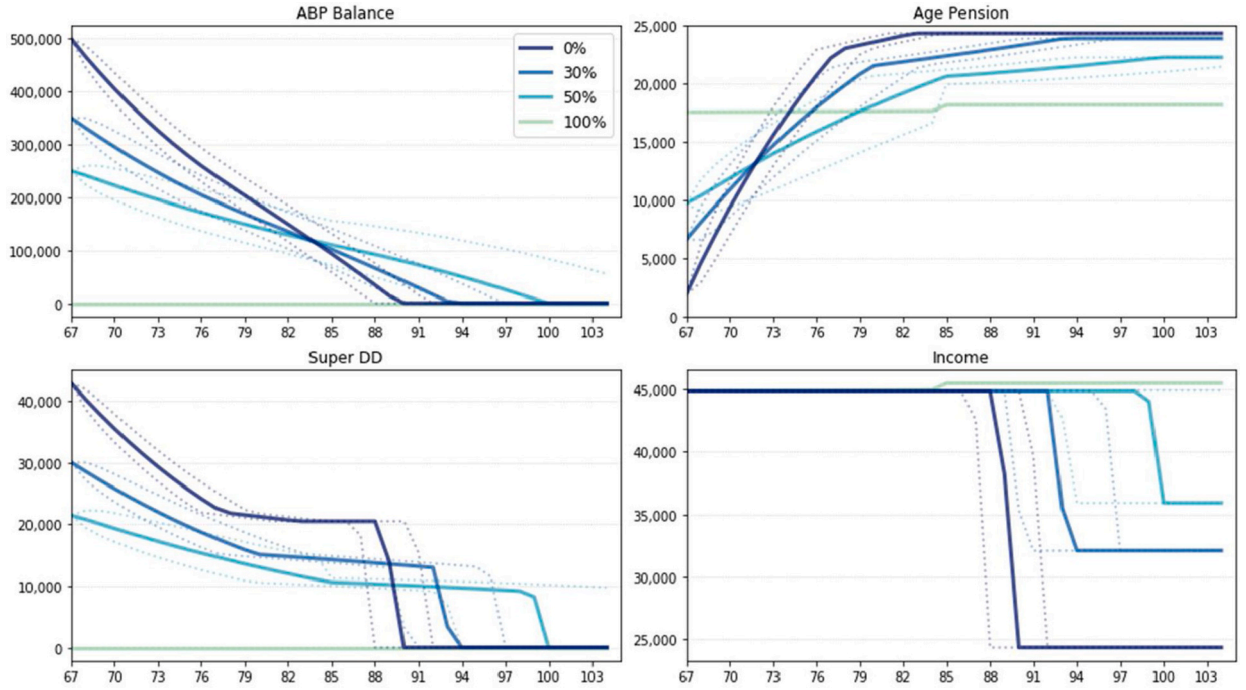

Fig. 3. Retirement outcome with different annuitisation levels and initial balance of A$500,000. Simulated median (solid curves), 20th and 80th percentiles (dotted curves) of ABP balance (top left), Age Pension entitlement (top right), superannuation withdrawal (bottom left) and the total income (bottom right) for 0%, 30%, 50% and 100% annuitisation strategies are displayed from age 67 to 104.

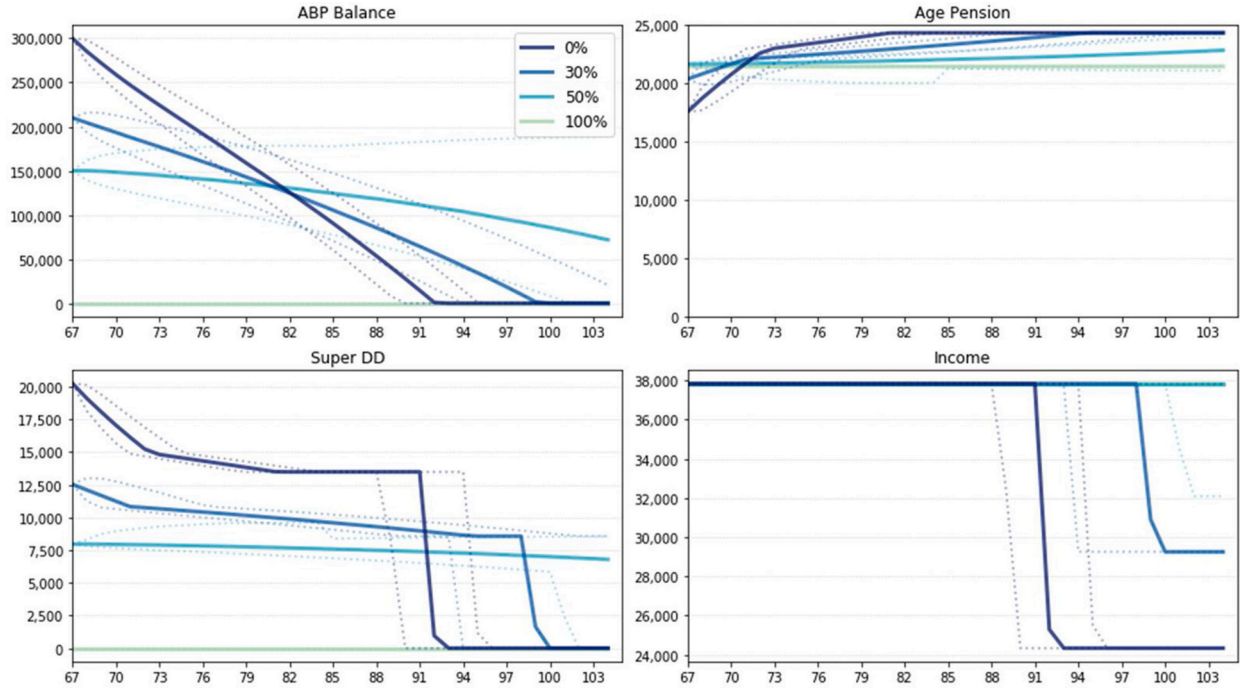

Fig. 4. Retirement outcome with different annuitisation levels and initial balance of A$300,000. Simulated median (solid curves), 20th and 80th percentiles (dotted curves) of ABP balance (top left), Age Pension entitlement (top right), superannuation withdrawal (bottom left) and the total income (bottom right) for 0%, 30%, 50% and 100% annuitisation strategies are displayed from age 67 to 104.

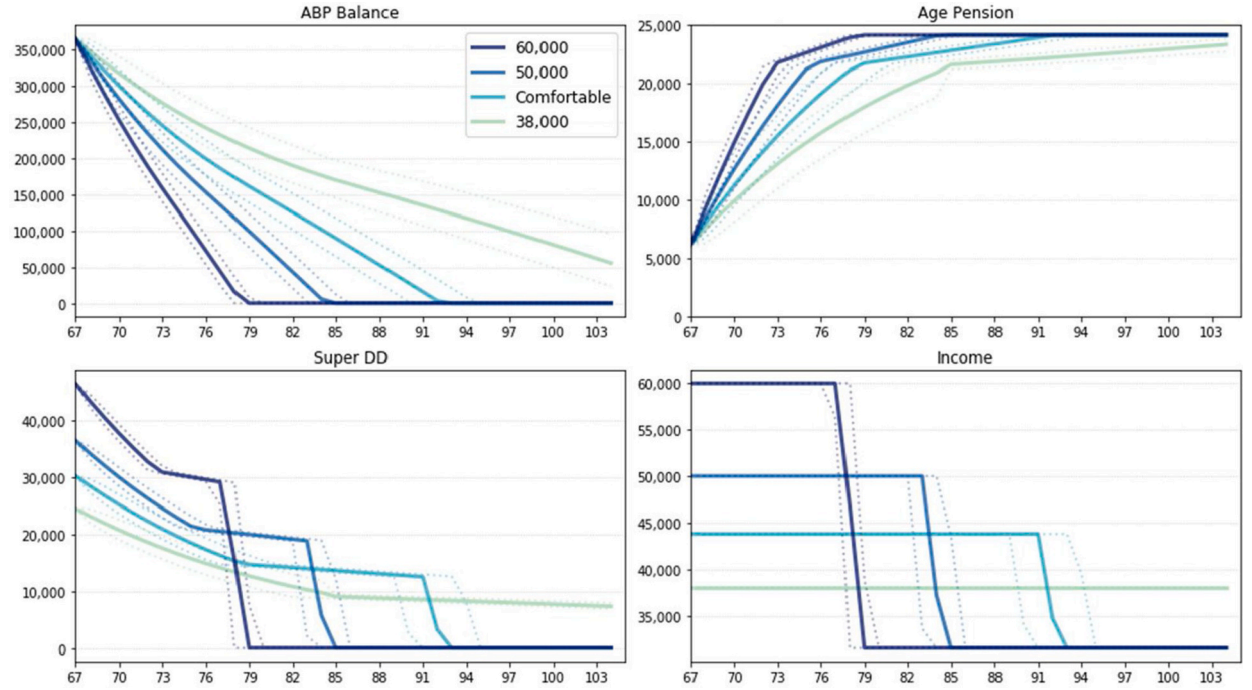

Fig. 5. Retirement outcome with LPA with 'safe net': A$30,000 for different consumption targets. Simulated median (solid curves), 20th and 80th percentiles (dotted curves) of ABP balance (top left), Age Pension entitlement (top right), superannuation withdrawal (bottom left) and the total income (bottom right) for 0%, 30%, 50% and 100% annuitisation strategies are displayed from age 67 to 104 for four annual consumption targets: A$38,000, Comfortable target(A$43,787), A$50,000 (Luxury target) and A$60,000.

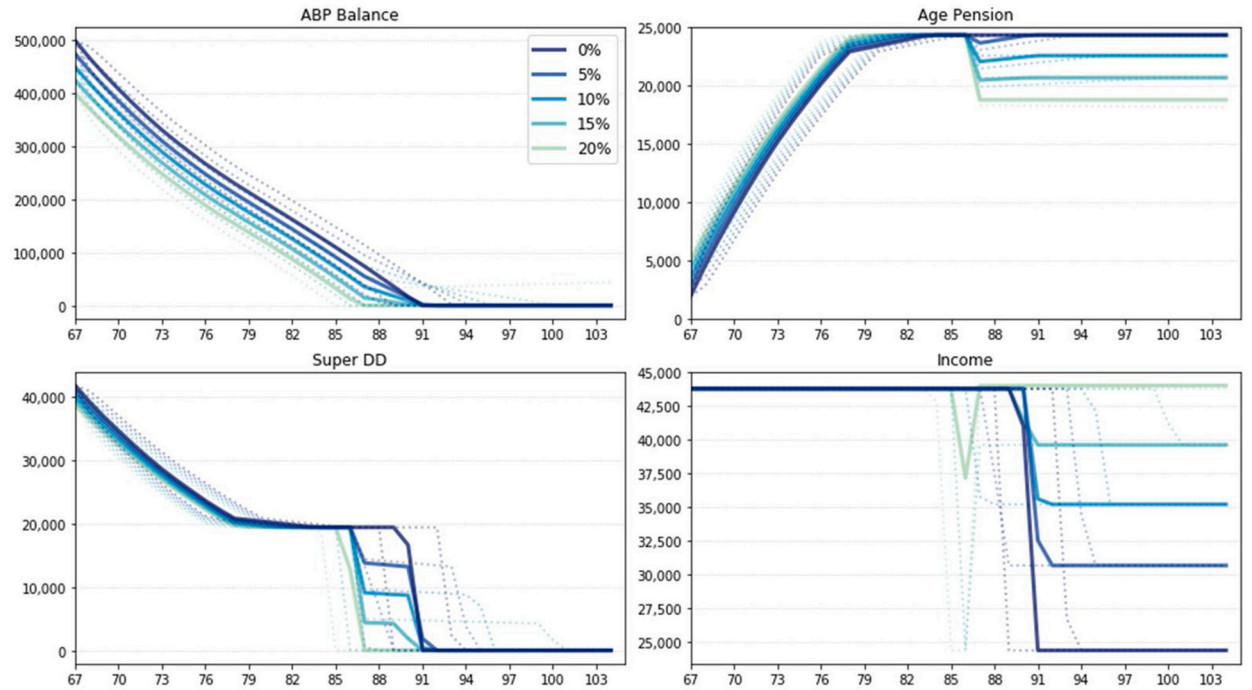

Fig. 6. Retirement outcome with different levels of 20-year DLA for Comfortable consumption target. Simulated median (solid curves), 20th and 80th percentiles (dotted curves) of ABP balance (top left), Age Pension entitlement (top right), superannuation withdrawal (bottom left) and the total income (bottom right) for 0%, 5%, 10%, 15% and 20% DLA are displayed from age 67 to 104.

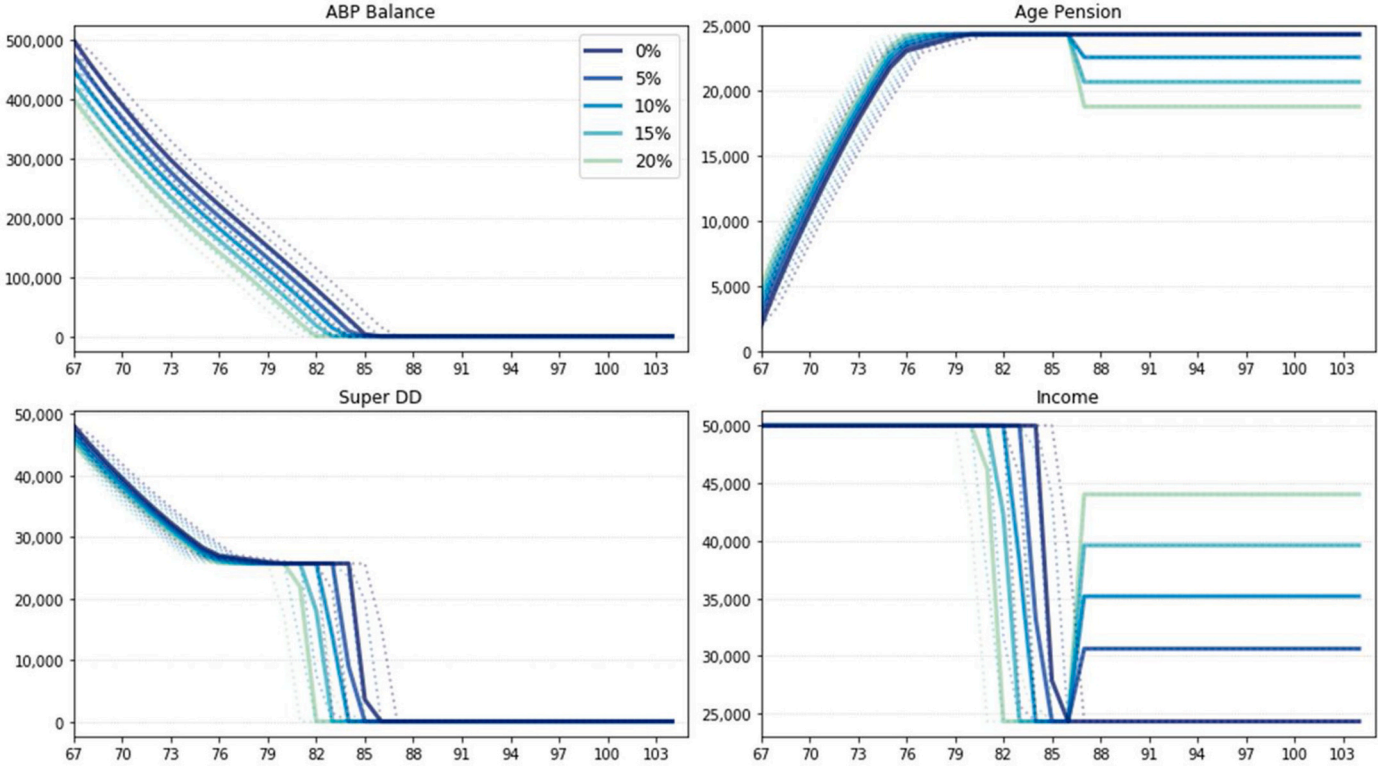

Fig. 7. Retirement outcome with different levels of 20-year DLA for Luxury consumption target. Simulated median (solid curves), 20th and 80th percentiles (dotted curves) of ABP balance (top left), Age Pension entitlement (top right), superannuation withdrawal (bottom left) and the total income (bottom right) for 0%, 5%, 10%, 15% and 20% DLA are displayed from age 67 to 104.

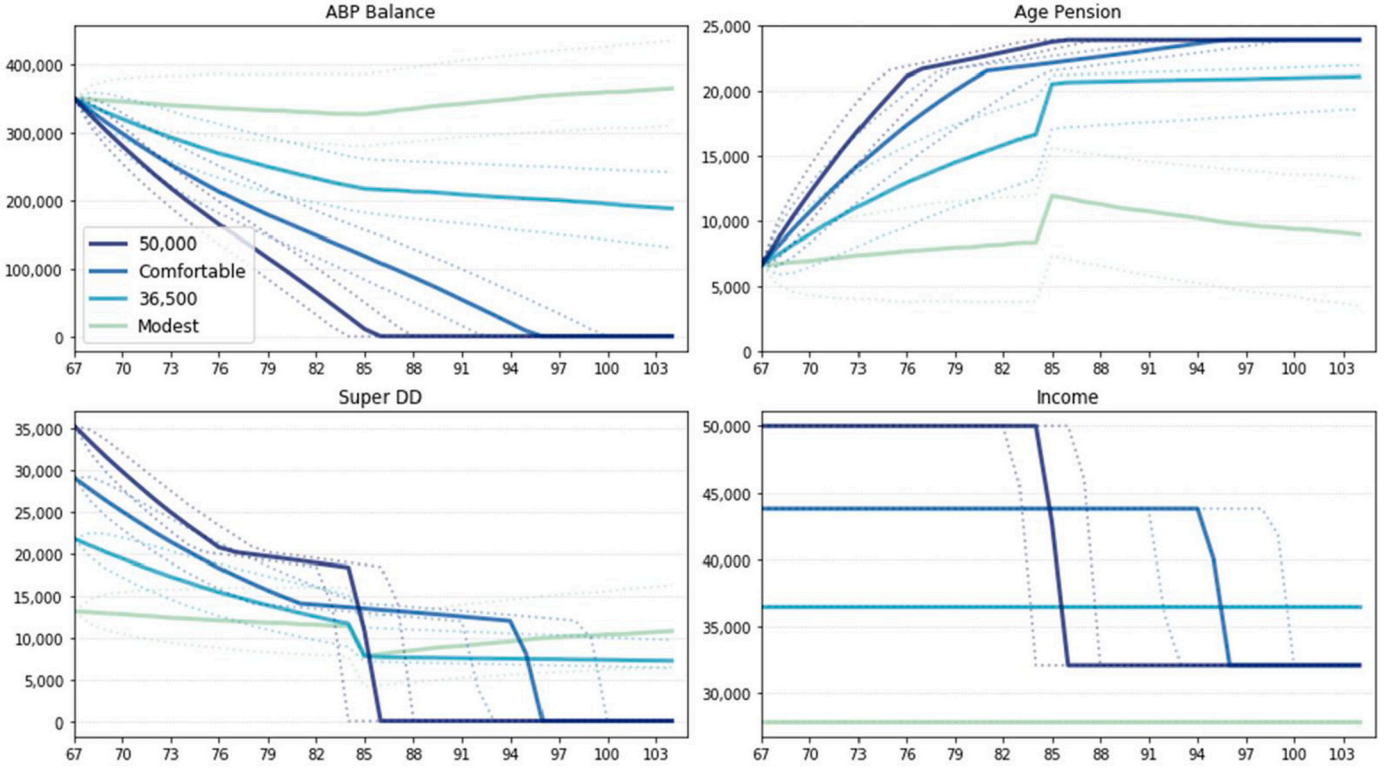

Fig. 8. Retirement outcome for different annual consumption targets with 30% annuitisation. Simulated median (solid curves), 20th and 80th percentiles (dotted curves) of ABP balance (top left), Age Pension entitlement (top right), superannuation withdrawal (bottom left) and the total income (bottom right) for four consumption targets: ASFA Modest, A$36,500, Comfortable and A $50,000 with A$500,000 initial balance from age 67 to 104.

Table 1
MDUF Scores ($\rho = 5$) with 0%, 30%, 50% LA, and 10%, 20% DLA for two bequest motive φ: 0 and 0.5.

Drawdown	0% LA		30% LA		50% LA		10% DLA		20% DLA	
φ	0	0.5	0	0.5	0	0.5	0	0.5	0	0.5
min *DD*	30,773	31,203	34,937	35,421	37,585	38,102	32,188	32,636	33,577	34,044
min + *1%*	34,975	35,439	38,073	38,560	40,073	40,570	36,033	36,505	37,062	37,542
4% Rule	25,850	4099	28,647	5419	29,256	6725	27,017	4439	27,964	4872
RoT	36,853	**36,853**	41,470	**41,961**	42,024	***42,538***	40,249	**40,725**	40,943	**41,425**
Modest	27,368	27,753	27,369	27,755	27,391	27,777	27,368	27,753	27,368	27,753
Comfortable	**39,587**	2618	**42,448**	3380	***42,733***	5026	**41,162**	2785	**42,040**	3025

a dip in income to the Age Pension by 87, with higher annuitisations dipping earlier, but at age 87 all positive annuitisation strategies see income rise above the Age Pension, with the higher annuitisation strategies resulting in higher incomes (see Fig. 7).

Consumption strategies can also impact entitlements to the Age Pension and income. Based on a balance of A$500,000 and 30% annuitisation, four consumption strategies: *Modest; Middling; Comfortable*; and *Luxury* (A$50,000) lifestyles are compared in Fig. 8, where *middling* is an annual income of A$36,500. The middling lifestyle has a high probability of being sustained until 100 years of age, but *Comfortable* and *Luxury* incomes eventually fall to somewhere between *middling* and *moderate* incomes, thus middling is better at covering the longevity risk in the longer term.

3. Discussions and conclusion

Comparisons of the different strategies highlight that no individual strategy is better than all others across the range of accumulated wealth levels (see Figs. 1 and 2), indicating suggesting those approaching retirement either receive financial advice regarding a personalised optimal option, accounting for individual preferences, or guidance based on a small range of factors. Different strategies align better with the different financial goals that people can have in retirement, which necessitates personalised drawdown strategies.

The most obvious goal in retirement is having money to spend. The alignment of different strategies are shown in the bottom rows of Figs 1 and 2. The pattern of aggregate cashflow available to spend varies across the strategies. The *minimum* drawdown strategies tend to provide a hump-shaped pattern where spending can peak in the middle to later stages of retirement. This contrasts to the observed pattern that spending falls in real terms over retirement (Blanchett, 2014; Daley et al., 2018). The cashflows from the *RoT* approach more closely align with this observed behaviour. The analysis also indicates that fixed benchmarks are not useful across the board. If they are too low, such as observed with the *Modest* target, the income will be sustained, but at a lower level than necessary. Higher levels can result in a cliff when the consumption target is no longer sustainable, and the retiree must rely on whatever pension and guaranteed income source remains. For each consumption target there will be an initial wealth level where the cliff occurs at an appropriate time (say life expectancy plus 5 years) but it is not that useful to be a broad benchmark.

Another goal is to manage the longevity risk. While Yaari (1965) proposed a complete annuitisation solution as the optimal way to manage longevity risks, the analysis here highlights the benefit of a partial annuitisation strategy through the layering approach, which can be implemented in order to ensure that the expenditure that is considered essential is maintained for life. This is evident in strategies where total spending declines, indicating that spending is maximised in the earlier stages of retirement.

Comparing the various drawdown strategies, with different levels of annuitisation by the MDUF score (Callil et al., 2018) (see Appendix 4.1 of the OSM), it is shown that the *Comfortable* consumption results in the highest utility when there is no intent for bequest but *RoT* gives the highest utility when the bequest motive φ is strong (see Table 1).

Partial approaches to annuitisation such as layering and DLAs introduce greater flexibility into retirement income planning while still diminishing longevity risk. Careful planning is required with these new approaches as desired lifestyle choices can negatively impact retirement income. Retirement income choices need to factor in the complex interplay between lifestyle choices, desired income level, and annuitisation levels.

Authors statement

1 Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; and
2 Drafting the work or revising it critically for important intellectual content; and
3 Final approval of the version to be published; and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
4 In addition to being accountable for the parts of the work he or she has done, an author should be able to identify which co-authors are responsible for specific other parts of the work. In addition, authors should have confidence in the integrity of the contributions of their co-authors.

According to this recommendation, the authors of the paper titled:

Personalised drawdown strategies and partial annuitisation to mitigate longevity risk are the undersigned, and there are no other valid authors. The order in which the authors' names appear in the submitted paper is acceptable to all authors. All authors agree that they have met the criteria listed above and have approved the final version of the paper. All authors agree that they are responsible for

the content of the paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.frl.2020.101644.

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