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Abstract

Reverse mortgage markets remain relatively small internationally, with one frequently cited reason being bequest motives. We study the role of reverse mortgages in intergenerational financial planning as a tool for families to bring forward bequests. We develop a new two-generation lifecycle model with parental altruism to compare the welfare gains of bequests and early bequests (inter vivos gifts) for homeowning parents and adult children seeking to purchase their first home. The two-generation model accounts for house price risk, interest rate risk, investment risk, wage growth, health shocks, long-term care costs, private pensions, and means-tested public pensions. The model results suggest that families across a range of wealth levels can enjoy large welfare gains when the parent uses a reverse mortgage both for retirement income and to gift the adult child a first home deposit. By replacing parent bequest utility with altruism, our model better captures the welfare gains of early bequest for both generations. Compared to literature which shows reverse mortgage demand decreasing as bequest motives increase, we find that as the parent cares more about the child's wellbeing, through altruism, utility gains from reverse mortgages for the family increase.

Keywords: Retirement income, reverse mortgage, inter-generational transfers, altruism, gifting, long-term care costs, bank of mum and dad

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1. Introduction

The practice of the "Bank of Mum and Dad", where parents assist their children in purchasing homes, is becoming increasingly common worldwide due to factors such as rising house prices, higher interest rates and tighter lending restrictions. In the U.S., 12% of home buyers relied on down payment help from friends and family as of April 2024 (Bhattarai and Cocco, 2024). The youngest buyers – ages 25 to 33 – were the most likely to receive help, with nearly 1 in 4 receiving cash gifts or loans. In Canada, the share of first-time home buyers who received help from family members was just under 30% in 2020, with the average gift being C$82,000 (Tal, 2021). In Australia, the "Bank of Mum and Dad" ranks among the top ten mortgage lenders, with parents in New South Wales providing A$92,000 per adult child on average towards a deposit (Wootton, 2023). In the UK, around 16% of adults who move into homeownership receive an average gift of £20,000 from family and friends (Boileau and Sturrock, 2023).

Parents wanting to support their children (or grandchildren) financially face complex decisions that involve balancing this support with their own financial needs over a potentially long retirement period. These decisions include the form of support (e.g., gift or loan), the timing of the support (e.g., inter vivos gift or bequest) and the source of funding (e.g., financial assets or housing wealth). While many parents support their children using financial assets, in several countries, including the USA, the UK and Australia, they can also use home equity release products, such as reverse mortgages, to access the wealth in their home, which is often the parents' largest asset. Reverse mortgages are deferred payment loans that allow older homeowners to age in place and receive an income stream or lump sum payments secured against their homes. This allows parents to provide 'early bequests' and increase the certainty of the timing and size of (early) bequests (Merton, 2007, Dillingh et al., 2017). Two advantages of early bequests are that the parent can observe their child benefiting financially from the gift, while the adult child can use the funds earlier rather than waiting for an uncertain bequest later in life.

This paper presents a new two-generation lifecycle model to study the consumption, housing and bequest decisions of families. We model the decisions faced by many families, where home-owning parents can decide to support their adult children in purchasing their first home. The new two-generation lifecycle model differs from previous lifecycle models used to study consumption and housing decisions (e.g., Nakajima and Telyukova, 2017, Shao et al., 2019, Koo et al., 2022) in two important ways: (i) it captures the decisions of a home-owning parent and their adult child and considers both the parent and child's lifetime expected utility, and (ii) it incorporates altruism by assuming that the parent derives utility from both the child's utility in the same period and the child's expected future utility after the parent's death. Additionally, the model captures factors such as house price risk, interest rate risk, investment risk, wage growth, health shocks and associated long-term care costs, means-tested public pensions, private pensions, as well as relevant taxes, fees, and policies surrounding gifting and retirement planning. While our model is calibrated using Australian socioeconomic, health, and market data and reflects the Australian pension system, our results are informative for other markets, and the two-generation framework can be easily applied to other countries.

We use the model to compare and analyse two key decisions for home-owning parents: whether to access home equity via a reverse mortgage and whether to provide an inter vivos gift or leave a larger bequest. We perform a scenario analysis to quantify the impact of these decisions on the lifetime expected utility of parents and children with different levels of wealth. The model results indicate that families in all wealth quartiles could enjoy welfare gains by using a reverse mortgage to supplement parental retirement income and fund a child's first home deposit. Furthermore, early bequests result in much higher aggregate utility gains for the family compared to the parent only using the reverse mortgage to increase their retirement income[1]. We show that by replacing parent bequest utility with parent altruism, our model can capture the positive impacts of early bequests on both parent and child. We also present a policy experiment where we study the impact of different pension rules for inter vivos gifts. In some countries, inter vivos gifts are taxed[2], whilst in Australia, inter vivos gifts can lead to reduced pension payments.

Our study adds to the growing literature on reverse mortgages by analysing their role in a two-generation model and quantifying the impact of early bequests. Previous studies have explored the demand for reverse mortgages using one-generation lifecycle models for single or couple retirees, with most focusing on the U.S. (e.g., Davidoff, 2009, 2010, Nakajima and Telyukova, 2017, Cocco and Lopes, 2020, Achou, 2021), and only a few on other countries such as Canada (Michaud and Amour, 2023) or Australia (Andreasson and Shevchenko, 2021, Koo et al., 2022). These structural models generally predict a higher demand for reverse mortgages among individuals with weaker bequest motives, lower levels of financial wealth relative to housing wealth, and higher levels of pre-existing debt (Mayer and Moulton, 2022). However, reverse mortgage markets are small internationally, and several studies investigate factors explaining this "reverse mortgage puzzle" – the mismatch between predicted demand and observed low take-up rates. Empirical studies, mostly survey-based, find that low reverse mortgage demand is due to factors such as high costs, aversion to debt, and a lack of understanding of the product (e.g., Davidoff et al., 2017). The empirical findings on bequest motives are mixed: some studies suggest that bequest motives reduce reverse mortgage demand (Davidoff et al., 2017, Hanewald et al., 2020), while others find the opposite (Choinière-Crèvecoeur and Michaud, 2023). Dillingh et al. (2017) found that the most influential factor reducing interest in reverse mortgage products is having grand(children), which diminishes interest in reverse mortgages by 30%. However, providing examples of reverse mortgage use for the benefit of the homeowners' (grand)children significantly raises interest in reverse mortgages among people with a bequest intention, which Dillingh et al. (2017) interpreted as evidence that people are unaware of the potential of reverse mortgages to optimise the timing of wealth transfers.

[1] We found only one exception to this out of 16 cases, when the child is in the highest wealth quartile (quartile 4) and the parent is in the lowest (quartile 1).

[2] In the US, gift limits and estate taxes apply above certain thresholds. However, these taxes only apply to a small proportion of people in the highest wealth quartiles, with a lifetime tax-free threshold of over \$12 million USD in 2022 (see `https://www.irs.gov/businesses/small-businesses-self-employed/estate-tax`).

Our study provides new insights into the factors that influence the demand for reverse mortgages and presents an untapped opportunity for reverse mortgage providers to increase retirees' awareness of the 'gifting function' of a reverse mortgage. Ultimately, this would benefit both reverse mortgage providers and families looking for effective ways to utilise their housing wealth. We compare several scenarios on how to best use a reverse mortgage for the benefit of the family's financial wellbeing. Our two-generation model with altruism suggests that the more a parent cares about the future wellbeing of the child, the higher the demand for reverse mortgages when used as a tool for gifting. Previous studies based on one-generation models found that stronger bequest preferences result in lower reverse mortgage demand, but have not considered the impact of early bequests.

Recent market research by AMP (2024) reports that 7 out of 10 Australians aged 65 and over would be unwilling to compromise their retirement lifestyle to provide financial assistance to children, despite wanting to support them. Our results show that it is possible for parents to provide their adult children with a 20% home deposit with minimal impact on their own consumption. We also use our model to conduct a policy experiment to quantify the impact of removing the gifting limits that apply to Australian Age Pension eligibility[3]. We show that removing current gifting limits only affects families in the middle wealth quartiles, reducing welfare gains for the family by less than 2.3%. Compared to the much larger welfare gains from gifting, the impact of gifting limits is small as it only affects pensioners who are close to the Age Pension asset test thresholds and, at most, only reduces entitlements for the five years immediately after gifting. Our new model framework can be used to study similar policies in other countries.

The remainder of the paper is organised as follows. Section 2 introduces the new two-generation lifecycle model. Section 3 presents the simulation results using this model and discusses their implications. Section 4 provides a sensitivity analysis, followed by concluding remarks in Section 5.

2. Two-Generation Lifecycle Model

In this section, we propose a new two-generation discrete-time life cycle model to study the consumption, housing and bequest decisions of families. The model extends previous literature by representing a retired homeowning parent and their non-homeowning adult child. It considers both the parent's and child's lifetime expected utility and incorporates altruism, where the parent derives utility from the child's current utility as well as the child's expected future utility after the parent's death. The model can be applied to other household types, such as coupled parents or multiple adult children. However, this falls beyond the scope of our study. Our aim is to provide a clear and representative analysis without the added complexity of including the full range of household types.

[3]In Australia, gifts are not taxed, but gifts exceeding certain thresholds ($10,000 per financial year or $30,000 over five years) are considered assets for means-testing and can reduce public pension entitlements.

The model reflects the Australian retirement income system, which comprises a means-tested public pension called the Age Pension and private savings in the so-called superannuation system. Individuals receive the Age Pension if their "means", that is, their assets and income, are below certain thresholds. As a result, Australian retirees can either receive the full Age Pension, a part Age Pension or be "self-funded". The owner-occupied home is exempt from the Age Pension assets test, but gifts above modest limits are included. See Appendix B for a more detailed discussion of the Age pension and means-tested calculations for entitlement. The tax-preferred superannuation system mandates payment of employer contributions (currently 11% of wages) into individual retirement accounts that offer investment choice. Upon retirement, individuals can access their superannuation savings as a lump sum and/or an income stream, including phased withdrawal products known as account-based pensions and/or annuities - subject to age-specific minimum drawdown rates. Most Australians choose to take their superannuation savings as account-based pensions, which are investment accounts with no longevity risk protection. The model captures all of these aspects and reflects aged care costs as well as means-tested government assistance for aged care. We also model commercial reverse mortgages available in Australia.[4]

In summary, the model accounts for house price risk, interest rate risk, investment risk, wage growth, health shocks and associated long-term care costs, means-tested public pensions, as well as relevant taxes, fees, and policies for gifting and retirement planning. Five health states are modelled for each generation and calibrated to match 2018 data from the Survey of Disability, Ageing and Carers (SDAC) from the Australian Bureau of Statistics. Simulations and results are based on realistic forecasts of key economic variables using the SUPA model (Chen et al., 2021), which we apply to model housing and wealth decisions for a single parent and adult child across a range of wealth levels. All variables and parameters are set for the start of the 2022 financial year (FY2022) and are defined in real terms, adjusted for inflation. We estimate initial wealth and income levels estimated from the latest wave of data collected by the nationally representative Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Survey is a household-based longitudinal study of approximately 9,000 households since 2001. Every four years, the survey includes a wealth module, with the latest available in wave 22 for 2022.

2.1. Utility Framework

We start by developing a utility-based framework suitable for studying decisions about consumption, housing, bequests and the use of reverse mortgages as a tool for early bequests. The model structure is inspired by two-generation models used to study long-term care insurance decisions by older parents with adult children, who can either provide informal long-term care or participate in the labour force (e.g., Klimaviciute et al., 2019, 2020, Ko, 2022, Mommaerts, 2023, Zweifel and Strüwe, 1998).

[4] We model a commercial reverse mortgage rather than the government-provided Home Equity Access Scheme due to the relatively low loan amounts available under the government scheme (which offers only up to 150% of the maximum annual Age Pension per annum). We do not model annuities because the Australian annuity market is small.

However, instead of studying long-term care decisions, our new model focuses on housing wealth, early bequest and reverse mortgage decisions and models utility from consumption and housing. Our model extends the literature by modelling the impact of reverse mortgages for a two-generation family, with the option to gift the child an early bequest. We also clearly quantify the differences in welfare gains between models that consider parent bequest utility, which is commonly used in the retirement modelling literature, versus parental altruism. Mukherjee (2022) has recently shown that pure altruistic preferences play a significant role in retirement transfers, with parents passing on additional income via inter vivos gifts, without receiving any additional care in return. By studying the impact of parental altruism on reverse mortgage decisions, we show that as the parent cares more about their child's wellbeing, the possible benefits from reverse mortgages increase.

The parent gains utility at time t from consumption $C^P(t)$, housing $H^P(t)$, and her child's utility as follows:

$$U^P(t) = I^{P,A}(t) \cdot \big(U(C^P(t), H^P(t)) + \rho \cdot U^C(t)\big) + I^{P,D}(t) \cdot \rho \cdot V^C(T^P), \tag{1}$$

where $I^{P,A}(t)$ is an indicator variable that equals one when the parent is alive and zero otherwise, $I^{P,D}(t)$ is an indicator variable that equals one only in the period when the parent dies and 0 otherwise, and ρ is an altruism parameter that controls the importance of the adult child's happiness to the parent. When the parent is alive ($I^{P,A}(t) = 1$), she gains utility $\rho \cdot U^C(t)$ from the child's utility in the same period. In the period when the parent dies ($I^{P,D}(t) = 1$), the parent gains utility $\rho \cdot V^C(T^P)$ based on the total expected utility of the adult child after the parent's death, which is defined by

$$V^C(T^P) = E_{T^P}\left[\sum_{t=T^P}^{T^C} \beta^{(t-T^P)} U_t^C\right], \tag{2}$$

where E_t represents the conditional expectation based on information up to time t, including realised economic variables from the SUPA model and any health state transitions, and β denotes the subjective discount factor.

The adult child gains utility at time t from both her consumption $C^C(t)$ and housing $H^C(t)$, and from leaving a bequest, $W^C(t)$, to her own child in a third generation which is not modelled:

$$U^C(t) = I^{C,A}(t) \cdot U(C^C(t), H^C(t)) + I^{C,D}(t) \cdot \theta \cdot B(W^C(t)), \tag{3}$$

where $I^{C,A}(t)$ is an indicator variable that equals one when the child is alive and zero otherwise, $I^{C,D}(t)$ is an indicator variable that equals one only in the period when the child dies and zero otherwise, θ is the bequest utility weight, which can be different from the parent's altruism parameter.
The child's bequest utility function, B, exhibits constant relative risk aversion (CRRA) utility with the same relative risk aversion as U and is given by:

$$B(W(t)) = \frac{W(t)^{1-\gamma}}{1-\gamma}. \tag{4}$$

The period utility function for both parent and adult child is given by the Cobb-Douglas utility function for consumption and housing

$$U(C(t), H(t)) = \frac{(C(t)^{\eta}(\delta_i H(0))^{1-\eta})^{1-\gamma}}{1-\gamma}, \tag{5}$$

where $\gamma > 1$ is the relative risk aversion parameter and $\eta \in [0, 1)$ denotes the elasticity of utility with respect to consumption. Utility from housing is based on an 'imputed rent', calculated as a fixed proportion δ_i of the initial home value H_0, following Shao et al. (2019). We assume δ_i to be two possible values (based on Shao et al., 2019), satisfying

$$\delta_i = \begin{cases} \delta_1 = 5\%, & \text{before living in aged care,} \\ \delta_2 = 2.5\%, & \text{if living in aged care,} \end{cases} \tag{6}$$

based on the assumption that retirees still receive housing consumption when living in an aged care facility, but at a proportional rate to account for living conditions that are not as good as ageing in place or living in their own home throughout retirement. As such, housing consumption when in an aged care facility is not related to the actual aged care fees paid by the parent and child, which we define in Section 2.6. If the adult child is a non-homeowner and pays rent, then we estimate the initial home value H_0^C based on her initial rent paid divided by a fixed annual rental yield of 5%.

We assume that consumption is non-negative in each period and that bequest wealth is also non-negative[5]. We also do not allow for borrowing other than reverse mortgage borrowing for the parent and conventional mortgage borrowing for the adult child's home.

The total lifetime expected utility for the parent (V^P) and the adult child (V^C) are given by

$$V^P = E_0\left[\sum_{t=0}^{T^P} \beta^t U^P(t)\right] \text{ and } V^C = E_0\left[\sum_{t=0}^{T^C} \beta^t U^C(t)\right]. \tag{7}$$

The aggregate expected lifetime utility, V, is defined as the weighted sum of the parent and adult child's lifetime expected utility:

$$V = \omega^P V^P + \omega^C V^C, \tag{8}$$

where the Pareto weights ω^P and ω^C are chosen to normalise the parent's and adult child's lifetime expected utility to be of a similar magnitude. The adult child's utility tends to be larger due to having a higher expected number of remaining years alive. These weights also reflect the relative importance of each generation's utility in the aggregate welfare function. They can be adjusted to analyse different decision-making scenarios where the welfare of the parent or the adult child is given more significance. The Pareto weights are subject to the constraint: $\omega^P + \omega^C = 1$.

[5]The Age Pension acts as a safety net, covering expenses such as rent and means-tested LTC costs.

2.2. Model Structure and Timing

We now describe the model structure and timing. The model is defined over a series of one-year time periods, $t \in \{0, 1, 2, \ldots, T\}$, which captures the parent's and child's decision at the start of each year. At time $t = 0$, the parent is 67 years old (which is the minimum age for receiving the means-tested Age Pension in Australia) and retired. The parent owns a home, superannuation savings (mandatory, tax-preferred retirement savings), and financial and other assets (FOA)[6]. The child is 36 years old, does not own a house, is employed full-time and accumulates superannuation savings and FOA.
At the start of each period, the parent and child receive income and consume up to an optimised consumption target depending on their wealth level (see Section 3.1). The parent can access their home equity via a reverse mortgage to supplement their retirement income and/or gift to the child for their first home deposit. Whilst the parent and child are alive, they can be in one of four living health states (based on the disability and aged-care framework discussed in Section 2.6), each associated with out-of-pocket long-term care (LTC) costs (after accounting for means-tested government support). The health state is modelled by Markov processes $G^P(t)$ and $G^C(t)$ for the parent and child, respectively, taking states $\{1, 2, 3, 4, 5\}$ ranging from healthy (state 1) to deceased (state 5), and with associated transition probabilities.

2.2.1. Parent

The parent's state space at time t is defined by

$$X^P(t) = \{G^P(t), H^P(t), S^P(t), FOA^P(t), L^P(t)\},$$

where G^P is the health state, H^P is the house value, S^P is superannuation wealth, FOA^P is the FOA and L^P is the reverse mortgage loan balance. At time $t = 0$, the parent retires in good health, thus $G^P(0) = 1$. Random death of the parent occurs at time T^P, thus $G^P(T^P) = 5$. Assuming a maximum age of 100, the parent's time of death satisfies $1 \leqslant T^P \leqslant 33$.

Let $C^P(t)$ denote the parent's consumption at time t, then

$$C^P(t) = AP^P(t) + \alpha^S(t)S^P(t) - LTC^P(t) + \tilde{C}^P(t), \tag{9}$$

where $AP^P(t)$ is the Age Pension entitlement which is means-tested based on $X^P(t)$. We assume the parent takes her superannuation as an account-based pension with a drawdown rate, $\alpha^S(t)$, that is consistent with the minimum age-based statutory rates. The parent also pays LTC fees, $LTC^P(t)$, based on her realised health state, $G^P(t)$, which is further defined in Section 2.6.The calculation of means-tested LTC fees is described in Appendix C.

We calculate the parent's consumption shortfall, $\tilde{C}^P(t)$. If the parent has enough savings and income

[6]FOA include bank accounts, shares, investment property, business assets and other investments.

to consume $\bar{C}^P$, they deposit the excess income into FOA:

$$\tilde{C}^P = \bar{C}^P - AP^P(t) - \alpha^S(t)S^P(t) + LTC^P(t). \tag{10}$$

If the parent has a consumption shortfall, $\tilde{C}^P > 0$, they withdraw savings from FOA to achieve their target consumption,

$$FOA^P(t+1) = \max\left\{FOA^P(t) - \tilde{C}^P(t), 0\right\} \cdot \big(1 + r_F(t+1)\big), \tag{11}$$

where $r_F(t+1)$ is the investment return for FOA realised at the start of the next year and accounts for taxes on returns based on the parent's taxable income from the Age Pension and investment returns (see Appendix D). If there are insufficient savings in FOA, i.e., $FOA^P(t) < \tilde{C}^P(t)$, then the parent withdraws from their account-based pension account on top of the regulated minimum drawdowns $\alpha^S(t)$. Thus

$$S^P(t+1) = \max\left\{S^P(t) - \alpha^S(t)S^P(t) + \min(FOA^P(t) - \tilde{C}^P(t), 0), 0\right\} \cdot \big(1 + r_S(t+1)\big), \tag{12}$$

where $r_S(t+1)$ is the investment return for the account-based pension realised at the start of the next year. No tax is paid based on the assumption that all superannuation was converted to an account-based pension at the start of retirement.[7]

If the parent ever runs out of liquid assets to consume,

$$(1 - \alpha^S(t))S^P(t) + FOA^P(t) < \tilde{C}^P(t),$$

she can choose to use a reverse mortgage for additional income at any time to finance her own consumption target for the year. However, the parent's reverse mortgage loan balance must always remain below the maximum age-specific loan-to-value ratios (LVR) set by the commercial reverse mortgage provider, in line with legal restrictions[8]. Let $LVR^{max}(t)$ denote the maximum LVR for the parent at time t, then the parent borrows

$$RM^P(t) = \min\left\{\tilde{C}^P(t) - (1 - \alpha^S(t))S^P(t) - FOA^P(t), LVR^{max}(t)H^P(t) - L^P(t)\right\}, \tag{13}$$

where $LVR^{max}(t)H^P(t) - L^P(t)$ denotes the maximum amount the parent can borrow at time t based on their current reverse mortgage loan. If the parent has enough liquid assets, or if her LVR exceeds $LVR^{max}(t)$ then $RM^P(t) = 0$. Finally, if the parent ever exhausts all savings and reaches the maximum LVR, then $\tilde{C}^P(t) = 0$ and the means-tested Age Pension will cover the necessary LTC costs.

For simplicity, the decision to gift the child a lump sum payment using the reverse mortgage is only

[7] Australia has a T (tax on contributions), T (tax on superannuation investment earnings), E (benefits exempt) regime for the taxation of retirement savings

[8] Limited publicly available data suggests that Heartland is the largest active reverse mortgage provider in Australia. We apply the fees and aged dependent LVR as advertised on their website in July 2022, see Appendix E.

considered at time $t = 0$. In this case, the parent borrows an additional lump sum $\widetilde{RM}^P(0)$ as a gift to her child, based on a proportion, α^G, of the child's home[9], satisfying

$$\widetilde{RM}^P(0) = \min\{\alpha^G H^C(0), LVR^{max}(0)H^P(0) - L^P(0)\}, \tag{14}$$

resulting in an initial loan of

$$L^P(0) = RM^P(0) + \widetilde{RM}^P(0).$$

Upon the parent's death or declining health and subsequent move into residential aged care, the house is sold in order to repay possible outstanding reverse mortgage loans and fund means-tested LTC costs such as the accommodation and daily care fees (which vary due to means-testing). We model the Australian downsizer contribution, which allows up to \$300,000 from the sale of the home to be contributed into a superannuation account, with the remaining proceeds deposited into FOA. The sale of the home includes a $r_{HF} = 6\%$ fee to cover costs (Shao et al., 2015, Nakajima and Telyukova, 2017). The loan and housing dynamics satisfies

$$L^P(t+1) = \big(L^P(t) + RM^P(t)\big) \cdot \big(1 + r_{RM}(t+1)\big), \qquad \text{for } 0 \leqslant t \leqslant T^P - 1, \tag{15}$$

$$H^P(t+1) = H^P(t) \cdot (1 + h(t+1)), \qquad \text{for } 0 \leqslant t \leqslant T^P - 1, \tag{16}$$

where $r_{RM}(t)$ and $h(t)$ are the reverse mortgage rate and house price growth rate, respectively. At time $t = T^P$, when the parent dies, the parent bequests net assets $B^P(T^P)$ satisfying

$$B^P(t) = \max\{(1 - r_{HF})H^P(t) - L^P(t), 0\} + S^P(t) + FOA^P(t), \tag{17}$$

where the first term reflects the No Negative Equity Guarantee (NNEG) included in Australian reverse mortgage loans, which ensures that the loan repayment does not exceed the proceeds from the sale of the home.

2.2.2. Child

The child's state space at time t is defined by

$$X^C(t) = \{G^C(t), W^C(t), H^C(t), S^C(t), FOA^C(t), L^C(t)\},$$

where G^C is the health state, W^C is wages, H^C is the value of the house she rents or wishes to buy, S^C is superannuation wealth, FOA^C is the FOA, and L^C is the child's loan from a conventional mortgage (if applicable). At time $t = 0$, we assume the child is employed, does not own a home and pays taxes and rent. She remains healthy until retirement, and her random death occurs at time T^C, thus $G^C(T^C) = 5$, at which time the child gains utility from leaving a bequest to a third generation,

[9] Wave 20 of the HILDA Survey data indicates that most Australians pay 15–25% of their property value as a deposit. In our model, we use 20% for simplicity. In Section 3.6 we consider cases with less than a 20% deposit and costs associated with Lenders Mortgage Insurance (LMI). LMI is insurance that protects the lender when the borrower's deposit is below 20%.

which is not explicitly modelled. We assume a maximum age of 92 for the child[10], and that she retires aged 67, the same retirement age as the parent. This implies the child retires at time $t = 31$ and the child's random time of death satisfies $32 \leqslant T^C \leqslant 56$.

At time $t = 0$, the child purchases a home only if the parent immediately takes out a lump sum reverse mortgage and gifts her child a home deposit. The value of the house the child purchases $H^C(0)$ depends on her own wealth quartile and was estimated using the HILDA dataset, see Table 7. If the child purchases a home, she will stop paying rent $R^C(t)$ and needs to repay her mortgage $M^C(t)$ periodically based on a variable interest rate (see Section 2.3.1), $r_M(t)$. Assuming a typical variable-rate 30-year loan, the mortgage payments satisfy

$$M^C(t) = L^C(t) \frac{r_M(t)(1 + r_M(t))^{(30-t)}}{(1 + r_M(t))^{(30-t)} - 1}, \tag{18}$$

for $0 \leqslant t < 30$. To avoid complexity. we assume that, if the parent does not gift the child a home deposit, the child remains a non-homeowner and pays rent. We further assume that the annual rent is a fixed value r_R^C dependent upon the wealth quartile of the adult child. As the model is discounted by the inflation rate and defined in real terms, rent is assumed to stay constant, thus growing only with inflation, in line with the same assumptions for the means-tested public pension and aged care support.

The child's consumption before retirement, where $t < 31$, satisfies

$$C^C(t) = W^C(t) - R^C(t) - M^C(t), \tag{19}$$

where wages W^C are subject to Australian tax laws, see Appendix D. This implies the child consumes all her wages each year after accounting for taxes, rent or mortgage payments. She will also receive the compulsory employer superannuation contributions to her superannuation account, which we assume to be 11% of gross wages, in line with current laws in Australia. Thus, for $0 \leqslant t \leqslant 30$ we have

$$\begin{aligned}
W^C(t+1) &= W^C(t) \cdot \big(1 + w(t+1)\big), && (20)\\
H^C(t+1) &= H^C(t) \cdot \big(1 + h(t+1)\big), && (21)\\
S^C(t+1) &= \big(S^C(t) + 0.11 \cdot W^C(t)\big) \cdot \big(1 + 0.85 \cdot r_S(t+1)\big), && (22)\\
FOA^C(t+1) &= \big(FOA^C(t) + I^{P,D}(t) \max\{B^P(t) - L^C(t) + M^C(t), 0\}\big) \cdot \big(1 + r_F(t+1)\big), && (23)\\
L^C(t+1) &= \big(L^C(t) - M^C(t) - I^{P,D}(t) \min\{L^C(t) - M^C(t), B^P(t)\}\big) \cdot \big(1 + r_M(t)\big), && (24)
\end{aligned}$$

where $w(t)$ is the wage growth at time t, and $I^{P,D}(t)$ is an indicator variable that takes the value 1 in the period when the parent dies and 0 otherwise. If the child has an existing mortgage, the parent's bequest is used to pay off the child's mortgage loan; otherwise, the bequeathed assets are deposited into the child's FOA. Prior to retirement, the annual returns from superannuation, r_S, are taxed at

[10] This corresponds to the age used by the Australian Securities and Investments Commission (ASIC) for retirement income forecasts.

15%, while the returns from FOA, r_F, are taxed according to the child's progressive tax rate based on their total taxable income, see Appendix D.

At time $t = 31$, the child is a healthy 67-year-old who retires from work, is now eligible for means-tested Age Pension entitlements, and converts her superannuation assets into an account-based pension. We apply the same assumptions for the child in retirement as for the parent, with a consumption target $\bar{C}^C$ set based on the child's own starting wealth quartile. The only difference is that the child may pay rent $R^C(t)$ if a home deposit was not gifted at $t = 0$. The child's consumption during retirement, where $t \geqslant 31$ satisfies

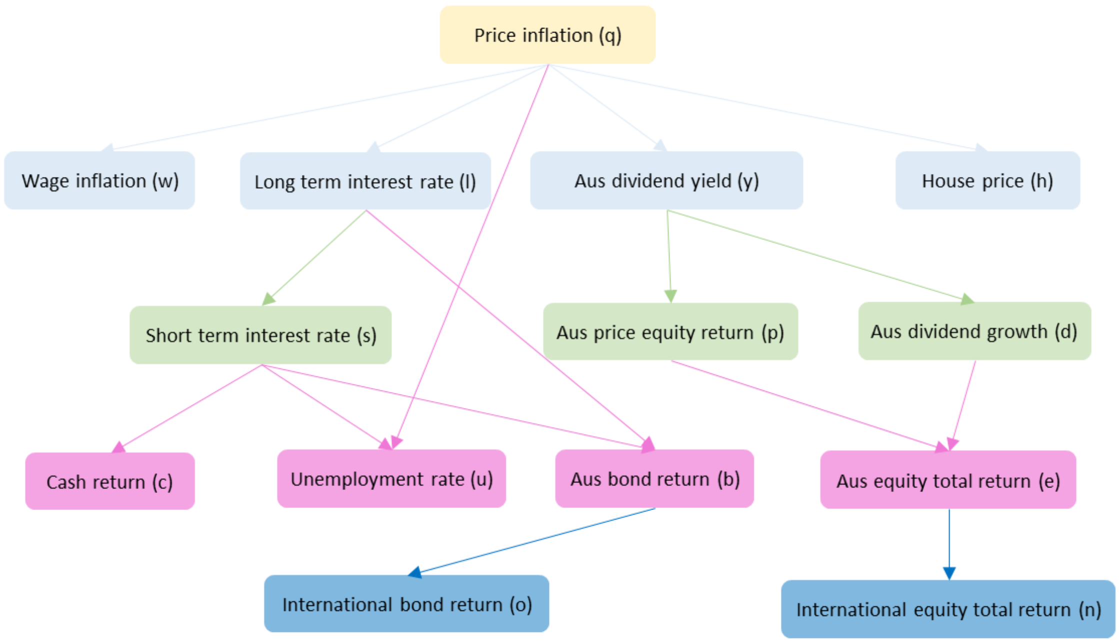
$$C^C(t) = AP^C(t) + \alpha^S(t-31)S^C(t) - R^C(t) - LTC^C(t) + \tilde{C}^C(t), \tag{25}$$

where $AP^C(t)$ is the Age Pension entitlement which is means-tested based on $X^C(t)$, $\alpha^S(t-31)$ is the minimum withdrawal requirements from an account-based pension, $R^C(t)$ is the child's rent if applicable, $LTC^C(t)$ are LTC costs associated with the child's health state $G^C(t)$, and $\tilde{C}^C(t)$ is the child's consumption shortfall, which is the calculated the same way as the parent's consumption shortfall, except with a separate consumption target $\bar{C}^C$ and an additional rent expense. As for the parent, withdrawals are again prioritised from FOA and then the account-based pension account, however (and for simplicity), the child cannot access reverse mortgage products. At time $t = T^{(C,D)}$, the child dies, and the simulation ends.

2.3. Economic Scenario Generator

We use an economic scenario generator to simulate the key economic variables required for retirement modelling. The scenario generator, developed by Chen et al. (2021), is known as the Simulation of Uncertainty for Pension Analysis (SUPA) model. It is a multi-factor stochastic investment model that describes the dynamics of economic and financial factors, such as price inflation, wage growth, interest rates and asset returns by stochastic time series, and examines their interdependent relationships via a cascade structure as described in Figure 1. The structure is based on an extension of the Wilkie model (Wilkie, 1984, 1995), where price inflation $q(t)$ is modelled independently and its performance cascades through the other economic variables, such as wage growth $w(t)$; long-term interest rates $l(t)$, short-term interest rates $s(t)$, cash returns $c(t)$, domestic (Australian) equity price returns $p(t)$, domestic dividend growth $d(t)$, domestic equity total returns $e(t)$, international equity total returns $n(t)$, domestic bond returns $b(t)$ and international bond returns $o(t)$. All the residuals are assumed to be normally distributed. We chose this model because it is one of the latest and most realistic models calibrated for the Australian retirement system and has the ability to capture the impact of rising interest rates and the follow-on effect on mortgages. Chen et al. (2021) applied historical market data from 1992 to 2018 to calibrate the SUPA model using data from the Reserve Bank of Australia (RBA) and the Australian Bureau of Statistics. We simulated the SUPA model 5,000 times to obtain the necessary variables for our simulation analysis. We simulated 13 out of 14 variables, omitting the unemployment rate in the final layer of the cascading structure due to it not being relevant in this study.

Figure 1: Cascading Structure of the SUPA Model (Chen et al., 2021).



Summary statistics for the economic variables used are given in Table 1, each simulated over 100 years.

2.3.1. Mortgage Rates

The mortgage rate for the adult child and reverse mortgage rate for the parent are based on the cash rate modelled by the SUPA model plus a fixed lender's margin. Let $c(t)$ be the cash rate at time t, then the mortgage rate is given by

$$r_M(t) = c(t) + \pi_M, \tag{26}$$

where π_M is the fixed lender's margin. We calculate this margin based on 20 years of historical interest rate data from the RBA from July 2002 to June 2022. We consider the difference between average owner occupied mortgage rates from all banks and the daily return of 3-month bank bonds, resulting in an estimated lender's margin of $\pi_M = 2.08\%$. Let $r_{RM}(t)$ be the reverse mortgage rate, then

$$r_{RM}(t) = c(t) + \pi_{RM}, \tag{27}$$

where π_{RM} is the reverse mortgage margin. We calculate the reverse mortgage margin by comparing the same daily return of 3-month bank bonds to the reverse mortgage rates of two major active providers in Australia, Heartland and Household Capital. By averaging the latest data on reverse mortgage rates from 2018 to 2022, and discounting using the historical estimated lender's margin of $\pi_M = 2.08\%$, we find an estimated reverse mortgage margin of $\pi_{RM} = 5.04\%$. This margin includes the value of the No Negative Equity Guarantee (NNEG), which is mandatory for commercial reverse

Table 1: SUPA Rates: Statistics based on 5,000 simulations, each over 100 years.

Variable	Mean	SD	Max	Min
SUPA Model Variables				
Price Inflation $q(t)$	2.5%	1.3%	8.6%	-3.6%
Cash Rate $c(t)$	2.5%	2.8%	16.0%	-9.9%
Aus Bond Return $b(t)$	2.5%	9.1%	45.5%	-38.1%
Intl. Bond Return $o(t)$	-0.3%	13.5%	61.9%	-59.8%
Aus Equity Total Return $e(t)$	9.4%	11.2%	61.2%	-43.9%
Intl. Equity Total Return $n(t)$	7.5%	14.4%	71.9%	-58.9%
House Price Growth $h(t)$	4.8%	6.4%	34.1%	-28.0%
Wage Inflation $w(t)$	3.8%	1.3%	9.7%	-1.8%
Mortgage Rates				
Mortgage Rate $r_M(t)$	4.6%	2.8%	18.1%	-7.8%
Reverse Mortgage Rate $r_{RM}(t)$	7.5%	2.8%	21.0%	-4.8%

mortgages in Australia and ensures that the individual's loan repayment does not exceed the proceeds from the sale of the home.

2.4. Superannuation, FOA and Taxes

We make two assumptions regarding the parent's and adult child's income from superannuation in retirement. First, we assume that both generations convert their superannuation into an account-based pension at the start of retirement. In Australia, 84% of retirement-phase superannuation accounts are account-based pensions or allocated pensions[11]. Second, the withdrawal rate from the account-based pension is assumed to follow the age-specific statutory minimum rates given in Table 2.

Table 2: Minimum Withdrawal Percentages for Account-Based Pensions in Australia

Age Group	Under 65	65–74	75–79	80–84	85–89	90–94	95 or older
Min Percentage (2024)	4%	5%	6%	7%	9%	11%	14%

Note: Minimum withdrawal rates were temporarily reduced by half during COVID-19. Our model uses the full 2024 rates ranging from 4% to 14%, based on age.

We use 2022 superannuation data from the Australian Prudential Regulation Authority (APRA) to set the asset allocation for the parent's and the child's superannuation savings (see APRA quarterly superannuation performance statistics in June 2022, Table 6a). We model the returns of key asset classes such as cash and Australian and international bonds and shares using the SUPA model described in Section 2.3. Other asset classes, such as listed and unlisted property, infrastructure, hedge funds, and unlisted equity, are not included in the SUPA model. We have removed these asset classes and rescaled the remaining asset classes. The resulting superannuation asset allocation is given in Table 3, which we apply to the retirement-phase superannuation accounts of both the parent and

[11] APRA Annual Superannuation Bulletin June 2022, Table 8.

adult child. Thus, we can calculate the return from superannuation during retirement at time t as

$$r_S(t) = 5.9\,c(t) + 16.2\,b(t) + 8.8\,o(t) + 27.9\,e(t) + 41.2\,n(t), \tag{28}$$

which is close to a 70/30 split between growth (risky) and defensive asset classes. Before retirement, the adult child pays tax on 15%[12] of positive superannuation returns, resulting in a return of

$$0.85 \max(0, r_S(t)) + \min(0, r_S(t)).$$

Table 3: Superannuation Asset Allocation

Asset class	APRA 2022 (%)	Rescaled (%)
Cash	4	5.9
Australian bond	11	16.2
International bond	6	8.8
Australian listed shares	19	27.9
International shares	28	41.2
Listed property	2	0
Unlisted property	7	0
Infrastructure	10	0
Hedge funds	0	0
Unlisted equity	6	0
Other	8	0

Note: 'APRA 2022 (%)' reports the asset allocations of MySuper[13] funds in the June quarter of 2022 (see Table 6a in APRA quarterly superannuation performance statistics). The column 'Rescaled (%)' is the asset allocation used in the model.

Retirees often own financial and other assets (FOA) in addition to mandatory retirement savings (superannuation) and housing. We estimate both the parent's and child's FOA from wave 22 of the HILDA Survey. Due to the differences in average savings and longevity between males and females, we assume both the parent and adult child are a single female. For simplicity, we divide FOA into two categories, cash assets and growth assets. The cash assets include bank accounts and cash and bond investments. The remaining FOA are assumed to be growth assets. We assume the interest rate on cash assets is the Australian bond return, and the interest rate on the growth assets is the Australian total equity return, both included in the SUPA model. Table 4 reports the FOA asset allocations for both the parent and the child, estimated using HILDA wave 22. For example, a parent in wealth quartile 1 will receive, at time t, the pretax rate return from FOA is equal to

$$\tilde{r}_F(t) = 94.90\,b(t) + 5.10\,e(t). \tag{29}$$

[12]This is based on superannuation contributions below the annual concessional contributions cap, currently set at $27,500 (FY2023/24). We do not consider the tax benefits from imputation credits in Australia which could further reduce tax.

[13]MySuper is a simple, low-cost superannuation product with a balanced investment strategy introduced by the Australian government as a default option for employees who do not choose a specific super fund.

Table 4: Parent and adult child FOA asset allocation

	Parent		Adult child	
Quartile	Cash assets (%)	Growth assets (%)	Cash assets (%)	Growth assets (%)
1	94.9	5.1	100.0	0
2	84.2	15.8	100.0	0
3	72.2	27.8	96.6	3.4
4	42.3	57.7	78.9	21.1

Note: The estimated weights for cash and growth assets for the 'Parent' are based on a subsample of 65- to 69-year-old females, and for the 'Adult child' are based on a subsample of 34- to 38-year-old females in wave 22 of HILDA.

All positive returns from FOA, before and after retirement, are taxed based on the parent's and adult child's respective progressive income tax rates, see Appendix D. Let $Tax(t)$ denote the individual's current tax rate. Then, at time t, the return from FOA is given by

$$r_F(t) = (1 - Tax(t)) \cdot \max(0, \tilde{r}) + \min(0, \tilde{r}). \tag{30}$$

2.5. Model Parameterisation

This subsection summarises the utility parameters and household data used to simulate outcomes for the parent and adult child. Table 5 reports the preference parameter values used in this study and their sources. Estimates of the altruism parameter ρ vary significantly across different studies and contexts based on differences in cultural norms, economic conditions and family dynamics. We refer the reader to Laferrère and Wolff (2006) for a comprehensive review and empirical evidence on the altruism parameter. Our choice of $\rho = 0.08$ represents a mild level of parental altruism, consistent with Mommaerts (2023), who studied a similar model in the context of informal care and demand for long-term care insurance. We provide a detailed sensitivity analysis of ρ in Section 3.5 for our two-generational model, along with a full sensitivity table of our results to other preference and model parameters in Section 3.6 to demonstrate robustness.

Table 5: Preference parameters

Parameter	Description	Value	Source
γ	Risk aversion	2	Hanewald et al. (2016)
η	Consumption elasticity parameter	0.792	Nakajima and Telyukova (2017) and Shao et al. (2019)
β	Subjective discount factor	0.98	Hanewald et al. (2016)
θ	Bequest motive weight	0.5	Hanewald et al. (2016)
ρ	Altruism parameter	0.08	Mommaerts (2023)
ω^P	Parent's Pareto weight	0.6	Mommaerts (2023)
ω^C	Child's Pareto weight	0.4	Mommaerts (2023)

We use data from the nationally representative HILDA Survey to set key model assumptions and estimate starting values for households with different income, housing wealth and non-housing wealth levels. To determine the starting wealth and income variables, we use the data from wave 22 of the

HILDA Survey, filtered by age and gender, and divided the resulting sample into quartiles based on net wealth. Unless otherwise stated, both the parent and adult child are assumed to be in corresponding wealth quartiles (of the separate wealth distributions for the parent and adult child).

We assume the parent is a single female homeowner aged 67. To ensure a sufficient sample size, we use as the estimation sample all single female homeowners aged between 65 and 69 (with a median age of 67) in wave 22 of HILDA. The parent's wealth portfolio includes accumulated superannuation, home equity, and FOA. We estimate the value of FOA as the difference between the parent's total net wealth minus superannuation and home equity. Table 6 presents the estimated wealth components used as starting values for the female parent.

Table 6: Summary of assets by wealth quartile for the female parent.

Quartile	Superannuation	Housing wealth	FOA	Total wealth
1	\$0	\$370,000	\$38,500	\$438,500
2	\$106,439	\$700,000	\$74,399	\$880,778
3	\$260,502	\$900,000	\$260,644	\$1,446,146
4	\$410,000	\$1,200,000	\$915,000	\$2,525,400

Note: The estimates are based on the sample of 65-69-year-old female homeowners in wave 22 of HILDA.

We assume that at the start of the simulation, the adult child is a single female non-homeowner aged 36. We estimate her income, assets and annual rent using as the estimation sample all single female non-homeowners aged between 34 and 38 (with a median age of 36) in wave 22 of HILDA. We estimate annual gross income to include income from employment and other sources, such as government allowances and income support payments. In some scenarios considered in the paper, the parent uses a reverse mortgage to gift a home loan deposit, and the child purchases a home. We estimate this home value based on the sample of single female homeowners aged between 34 and 38 in wave 22 of HILDA. Table 7 reports the corresponding values that are used as starting values in the simulation. Every year, the parent and child receive housing utility when they are alive, which is based on their estimated housing consumption calculated from their annual rent or a fixed proportion of their home value (5% before moving into residential aged care and 2.5% after, see Section 2.1).

Table 7: Summary of assets and income by wealth quartile for the female adult child.

	Non-homeowner					Homeowner
Quartile	Income from employment	Income from government	Superannuation	FOA	Annual rent	Home value
1	\$2,400	\$33,967	\$120	\$3,080	\$12,516	\$437,500
2	\$28,907	\$26,546	\$14,422	\$13,317	\$17,988	\$500,000
3	\$73,527	\$0	\$50,855	\$32,958	\$18,726	\$620,000
4	\$106,500	\$0	\$109,000	\$80,000	\$19,812	\$945,000

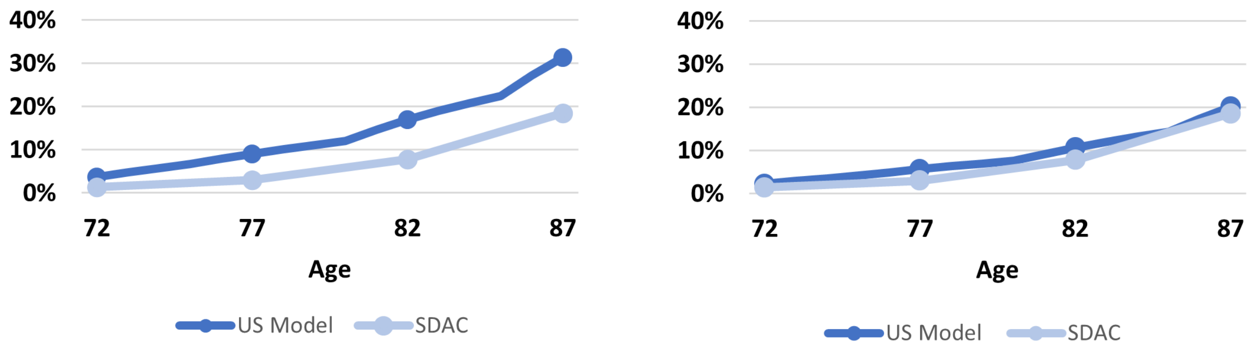
Note: The estimates (\$) are based on the sample of 34-38-year-old female non-homeowners and homeowners in wave 22 of HILDA.

2.6. Disability and Aged-care Framework

We use the five-health-state Markov model developed by Shao et al. (2019) to simulate the health and lifespan of the parent and the adult child. Based on the simulated health states, we calculate the associated means-tested aged care costs. The five states are healthy (state 1), mildly disabled at home needing care at cost LTC_2 (state 2), severely disabled at home needing care at cost LTC_3 (state 3), in residential aged care needing care at cost LTC_4 (state 4), and deceased (state 5). The health states are defined by the number of activities of daily living (ADLs) individuals cannot perform and whether they reside at home or in residential aged care. The six ADLs are eating, dressing, bathing, toileting, continence and mobility. States 1, 2, and 3 are defined by experiencing 0, 1, and 2-6 ADL difficulties, respectively. We assume both the parent and child retire healthy, but can transition to different health states and are liable to pay the associated LTC costs. Further, we assume that the move to residential aged care (transition to health state 4) requires the parent or child to sell their home if they own one to finance costs associated with means-tested residential fees.

Shao et al. (2019) developed their framework using calibrated, graduated transition rates based on Health and Retirement Survey (HRS) data from the United States for 1998-2010. We first assess whether it is reasonable to directly use the US transition rates in the Australian setting. We use data from the 2018 Survey of Disability, Ageing and Carers (SDAC) from the Australian Bureau of Statistics to compare the proportion of those alive who reside in residential care, observing a tendency towards significant over-prediction through the use of the US model, particularly among female retirees in their 80s (see Figure 2a). The result is unsurprising, as average retiree health outcomes in the US are poorer than in Australia. According to the SDAC data, 0.06 million out of 1.831 million Australians over 65 reside in residential care, for an overall proportion of 3.25%. However, the United States Census Bureau 2018 reports that the proportion in the US is 4.5%. Therefore, we estimate that the proportion of the older population that lives in residential care is overpredicted by 38% if we apply the US model directly. We decrease the transition rate into state 4 (state 1 to state 4, state 2 to state 4, state 3 to state 4) by 38% and distribute the population proportionally into states 1, 2, and 3. The comparison after these adjustments is shown in Figure 2b, indicating a more reasonable approximation. Moreover, the life expectancy at birth predicted by the adjusted model is 86.12, which is also a reasonable estimate, as the current life expectancy in Australia is 83.19. We assume a maximum age of 100 years for the parent.

The Australian government offers a Home Care Package (HCP) to help older persons access affordable care services. These services include support for activities of daily living (ADLs) such as hygiene, food preparation, and transportation. There are different levels of HCPs available based on individual needs, and the government subsidises most of the costs. However, older persons must pay basic fees. The HCP level is determined by the number of ADLs an individual can perform and their physical and mental health. In this study, we assume that in state 2, the retiree receives a level 2 (low care) HCP, and in state 3, a level 4 (high care) HCP. Appendix C calculates the associated $LTC(t)$



(a) Before adjustment

(b) After adjustment

Figure 2: The proportion of those alive who reside in residential aged care in the US before (a) and after (b) adjustments compared to SDAC data in Australia.

for both parent and child based on their health state[14]. The daily basic fees for level 2 and level 4 HCPs are \$10.66 and \$11.26, respectively. Care fees are based on income, with a maximum cost of \$32.30 per day. In addition to HCPs, the government also provides subsidies for retirees to live in residential aged care, with a basic fee of \$54.69[15], a means-tested care fee, and a means-tested accommodation fee. The means-tested care fee is capped at \$264.81 per day, with annual and lifetime caps of \$30,574.33 and \$73,378.49, respectively. The accommodation fee is also means-tested, with an average cost of \$60 per day, but can reach \$140 per day for self-funded retirees in high-quality facilities.

2.7. Scenarios and Policy Experiment

We use the parameterised model to analyse the impact on families of alternative strategies for using a reverse mortgage for personal income and as a tool for early bequest. To do so, we create a range of scenarios and experiments and compare each scenario with the baseline scenario in which the parent does not take out a reverse mortgage. In this baseline, the only income sources for the parent are the Age Pension, superannuation assets, and FOA. Moreover, in the baseline, the adult child will never own a home and instead pay rent for the rest of her life. For other scenarios, we assume the parent can use the reverse mortgage for personal income, after exhausting liquid savings, and/or borrow a lump sum against her home equity to gift the adult child a home deposit at time $t = 0$, allowing the adult child to buy a home. For simplicity, we assume that the child only buys a home when the parent gifts her a deposit.

- **Baseline Scenario**: No reverse mortgage or gifting. The parent does not use a reverse mortgage product and does not gift to the child. The adult child remains a non-homeowner, paying rent

[14]All calculations are based on the schedule of fees and charges for residential and home care from 1 July 2022, published by the Australian Department of Health. We assume indexing is based on inflation, as our model is given in real terms. However, typically an annual review is held over the indexation process, which involves adjusting the fees based on several economic indicators, primarily the Consumer Price Index (CPI) and the Wage Price Index (WPI).

[15]We include the basic fee as part of consumption, rather than treating it only as an expense, as this fee cover the costs of daily living, like meals, cleaning, laundry, heating and cooling.

every year.

- **Scenario 1**: Reverse mortgage but no gifting. An extension of the Baseline Scenario where the parent uses a reverse mortgage to increase their income and consume up to the consumption target. The adult child does not receive a gift and remains a non-homeowner, paying rent every year.
- **Scenario 2**: Reverse mortgage only for gifting. An extension of the Baseline Scenario where the parent only uses a reverse mortgage at time $t = 0$ to provide a lump sum gift to the adult child for their 20% first home deposit[16]. The parent does use the reverse mortgage for additional income.
- **Scenario 3**: Reverse mortgage and gifting. A combination of Scenarios 2 and 3, where the parent uses a reverse mortgage for additional income to ensure she reaches her consumption target. Additionally, she uses the reverse mortgage at time $t = 0$ to provide a lump sum gift to her adult child, covering her 20% first home deposit.

Here, we describe the Baseline Scenario in more detail, where the parent does not use a reverse mortgage. The parent funds her retirement income from the Age Pension, superannuation, and FOA. Upon death, $1 \leqslant T^{(P,D)} \leqslant 33$, with a maximum age of 100, she bequeaths her remaining assets. The adult child is a non-homeowner and pays rent each year. She earns income from employment and retires at age 67. When the parent dies, the adult child inherits the remaining superannuation assets, FOA and, most importantly, the parent's home equity. In all scenarios, we assume that the parent's home is sold when she moves to residential care or passes away. This ensures that children in different scenarios always inherit liquid assets, rather than some inheriting a home and others liquid wealth. In the Baseline Scenario, bequeathed assets are deposited into the child's FOA account to provide investment income. The child dies with certainty at the maximum age of 92, with a random time of death $31 \leqslant T^{(C,D)} \leqslant 56$, at which time she leaves her own remaining wealth as a bequest.

The baseline is used as a benchmark for comparing the results of other scenarios. We compute the Consumption Equivalent Variation (CEV) of each scenario relative to the Baseline Scenario because expected utility values are difficult to interpret and compare. The parent's CEV is defined as the fixed percentage increase in the parent's annual consumption in the Baseline Scenario required to achieve the same utility gain as in the scenario under consideration. This increase is applied across all 5,000 simulations. Similarly, the adult child's CEV is calculated by increasing the child's annual consumption by a fixed percentage such that the utility gain matches those of the scenarios. The aggregate CEV is defined as a fixed percentage increase in both the parent's and adult child's annual consumption each year they are alive. This increase is necessary to achieve the change in the total

[16]At the start of retirement, we assume the parent has a maximum LVR of 27% based on ratios advertised by Heartland, Australia's largest reverse mortgage provider, see Table E.15 in Appendix E. If the child's 20% home deposit exceeds this, then the child enters a mortgage with a home deposit of less than 20% and must pay Lenders Mortgage Insurance (LMI). This only occurs when the child is in quartile 3 or 4, and the parent is in quartile 1, resulting in an initial home deposit equaling 16% and 10%, respectively.

expected utility of the scenario under consideration.

We also consider a policy experiment that removes the gifting limits under the Australian Age Pension assets test. The current gifting limits are \$10,000 per financial year or a maximum of \$30,000 over five financial years. Gifts exceeding these limits are considered assets for means-testing purposes and can reduce Age Pension entitlement. In Scenarios 2 and 3 mentioned above, if the parent gifts the child a 20% first home deposit at time $t = 0$, the portion of the gift exceeding \$10,000 is included in the parents' total assessable assets for the first five years of retirement. We conduct the policy experiment as follows.

- **Policy Experiment**: No gifting limits. An extension of Scenario 3, where gifting limits and subsequent impact on the parent's Age Pension entitlement are removed. Thus, when the parent gifts the adult child a 20% first home deposit, this gift is not assessed under the Age Pension assets test.

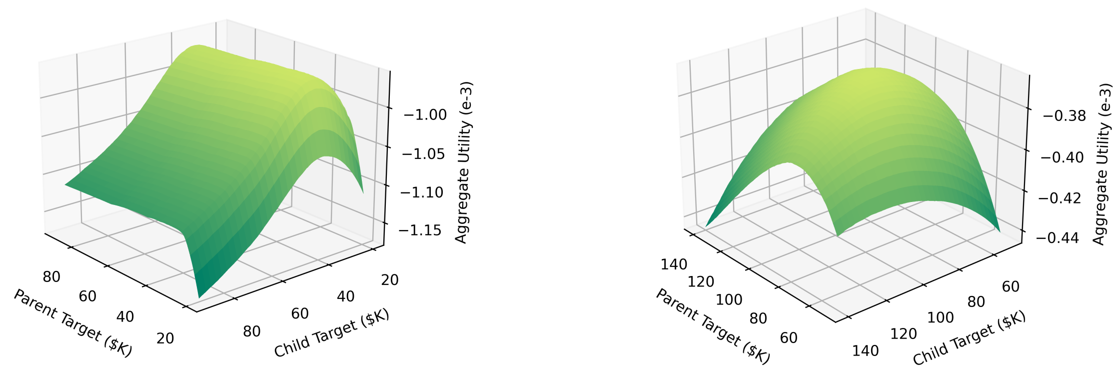
3. Simulation Results

This section presents the simulation results for the parent, the adult child and the family as a whole based on our new two-generation lifecycle model with altruism. All results are based on 5,000 simulated outcomes for each generation, using the economic scenario generator, health state model, and utility framework outlined in Section 2. We consider parents and adult children in different wealth quartiles, ranging from quartile 1 (Q1) to quartile 4 (Q4). For the main results, we assume a moderate level of parental altruism ($\rho = 0.08$). We start by finding the optimal consumption target for each scenario and each generation across different wealth quartiles. Then, we present, as the main results, the effects of the scenarios and policy experiment defined in Section 2.7 on the parent, adult child and the family as a whole. We then compare the main results to a two-generation model with a standard parental bequest function instead of our altruistic utility function in Section 3.4. Finally, Sections 3.5 and 3.6 study the robustness of our model by performing a sensitivity analysis on parental altruism ρ, the proportion of the child's home gifted by the parent, and a wide range of other preference and economic variables.

3.1. Optimal Consumption Targets

For each scenario defined in Section 2.7, we calculate the optimal consumption targets for the parent and adult child in the different wealth quartiles. Consumption targets set too low will result in underspending, over-bequesting, and can bias the utility gains in different scenarios. For example, a child with a lower-than-optimal consumption target will benefit less from gifting, as she does not require additional wealth or assistance from the parent. Similarly, high consumption targets that are unattainable can lead to welfare losses. Thus, by considering the actual wealth and income levels of each wealth quartile, we perform a grid search to determine the parent and adult child's optimal consumption target that maximises the utility of each scenario. To illustrate this approach, Figure 3 shows the aggregate utility of the Baseline Scenarios over a grid of consumption targets for parents and children when both are in wealth quartile Q1 (a) or Q4 (b).

Figure 3: Baseline Scenario aggregate utility for different parent and child consumption targets.



(a) Baseline (Q1, Q1)

(b) Baseline (Q4, Q4)

Note: The figure shows the aggregate expected lifetime utility for the family in the Baseline Scenario when the parent and child are both in wealth quartile Q1 (a) and both in Q4 (b) for a range of consumption targets.

Table 8: Optimal consumption targets ($) for parent and adult child, by scenario and wealth quartiles

	Wealth quartiles (Parent, Child)					
	(Q1, Q4)	(Q1, Q1)	(Q2, Q2)	(Q3, Q3)	(Q4, Q4)	(Q4, Q1)
Baseline Scenario	P: $37,000 C: $57,000	P: $33,000 C: $37,000	P: $41,000 C: $44,000	P: $56,000 C: $56,000	P: $88,000 C: $89,000	P: $86,000 C: $62,000
Scenario 1	P: $39,000 C: $50,000	P: $37,000 C: $30,000	P: $50,000 C: $38,000	P: $71,000 C: $46,000	P: $100,000 C: $75,000	P: $91,000 C: $59,000
Scenario 2	P: $37,000 C: $89,000	P: $33,000 C: $52,000	P: $41,000 C: $71,000	P: $56,000 C: $88,000	P: $91,000 C: $133,000	P: $91,000 C: $100,000
Scenario 3	P: $37,000 C: $86,000	P: $35,000 C: $50,000	P: $50,000 C: $66,000	P: $67,000 C: $82,000	P: $100,000 C: $122,000	P: $103,000 C: $88,000

Note: The different wealth quartiles for parents and children are given in Tables 6 and 7, respectively. Q1 denotes the lowest wealth quartile.

Table 8 reports the optimised annual consumption targets for parents and adult children in the different wealth quartiles given in Tables 6 and 7. The consumption targets are higher for parents and adult children in higher wealth quartiles. In Scenario 1, the parent's optimal consumption targets are higher than in the Baseline Scenario because she can use a reverse mortgage to supplement her income when she exhausts her liquid savings. However, this reduces the child's expected inheritance and her optimal consumption targets. Interestingly, when the parent only uses a reverse mortgage to gift her adult child a 20% home deposit at the start of retirement (Scenario 2), the child's optimal consumption target increases significantly, which highlights the negative impact that renting can have on the adult child's consumption in retirement. The parent's optimal consumption targets in Scenario 2 are mostly similar to the Baseline Scenario, except for wealthy parents in Q4, who can afford to increase their consumption. Finally, the optimal consumption targets for Scenario 3 show the benefit that both the parent and adult child can have when the parent uses a reverse mortgage for both personal income and intergenerational wealth transfer. We note that the consumption targets only apply to the parent and adult child whilst in retirement, as described in Section 2.2. Before retirement, the child will consume her entire wage after accounting for taxes, compulsory superannuation contributions and rent or mortgage payments. If either generation runs out of savings, then the parent or child may fail to consume their target and instead can only consume the net income they have received that year, resulting in lower period utility.

3.2. Main Results

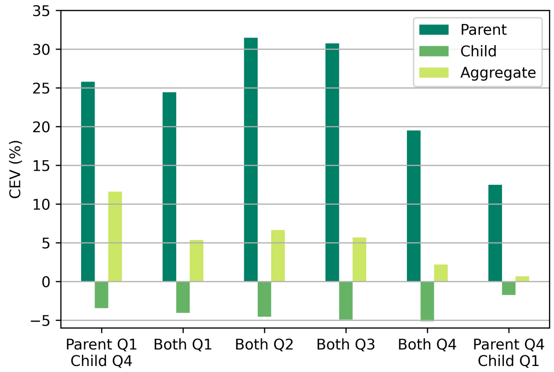
In this section, we present the main results of the paper, comparing the utility gains and losses for scenarios with different reverse mortgage and gifting strategies compared to the Baseline Scenario, where the parent neither uses a reverse mortgage nor gifts the child. Figures 4a–4c show the results of the three scenarios defined in Section 2.7, while Figure 4d summarises the utility gains of each scenario based on the total aggregate utility of the family. We plot the utility gains for six socioeconomic pairs: parent and adult child in corresponding wealth quartiles and two 'extreme' cases where the parent and adult child are in opposite wealth quartiles.

Scenario 1 involves the parent using a reverse mortgage to increase consumption without gifting to the child. The results in Figures 4a show large utility gains (measured by CEV values) for parents across all wealth quartiles. This finding aligns with previous studies, which have found that home equity release products, such as reverse mortgages, are welfare-enhancing by increasing the parent's consumption at the expense of bequests (e.g., Hanewald et al., 2016, Andreasson and Shevchenko, 2021, Koo et al., 2022). However, unlike previous studies, our model also quantifies the welfare effects of the parent's reverse mortgage decision on the adult child. Figure 4a shows that adult children in all wealth quartiles experience a welfare loss (i.e., a negative CEV) due to receiving a lower bequest. Nevertheless, the aggregate family welfare gain is still positive across all wealth quartiles.

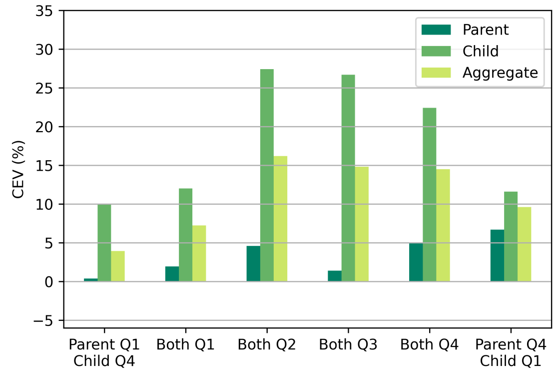
Figure 4b shows the welfare effects for **Scenario 2**, where the parent only uses a reverse mortgage at the start of retirement to gift the child a 20% home deposit. The positive impact of the "Bank of Mum and Dad" on the adult child is evident from the child's utility gains. The child benefits from being a homeowner in multiple ways, including (i) after she pays off her 30-year mortgage by age 66, she lives rent-free and mortgage-free in retirement, (ii) the value of the property she buys grows over time at an average rate of 4.8% per annum (see 1), which allows her to leave a larger bequest to the third generation, and (iii) her housing wealth is exempt from the Age Pension assets test.

The effect of Scenario 2 on the parent's utility in Figure 4b is equally interesting. Because the model assumes parental altruism, the parent enjoys positive utility gains compared to the baseline model, even when withdrawing a large lump sum from home equity early in retirement and consequently leaving a significantly smaller bequest upon death. Standard bequest utility functions would fail to capture the parent's utility gain from early bequests, as they are only a function of terminal bequests. By modelling parental altruism, our model captures the parent's happiness from helping the adult child early in retirement and considers the positive impact on the child's current and future wellbeing.

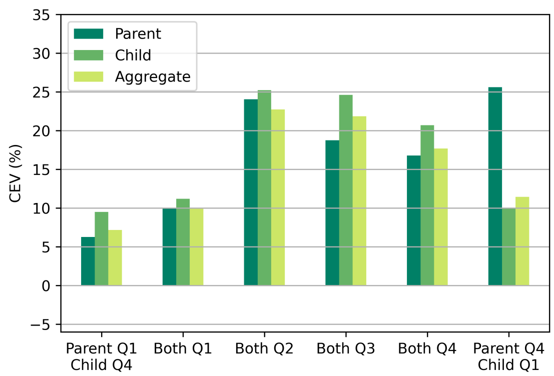
Figure 4: Main results: Two-generation model with moderate altruism ($\rho = 0.08$).



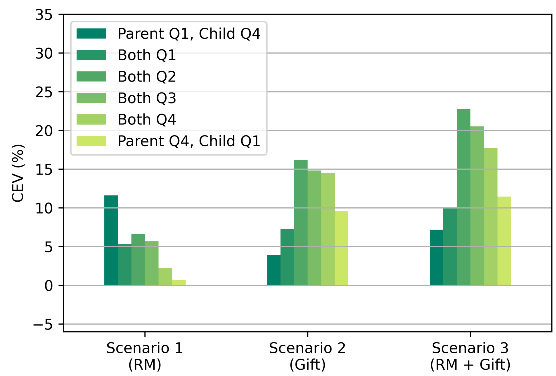
(a) Scenario 1 (reverse mortgage only for income).



(b) Scenario 2 (reverse mortgage only for gifting).



(c) Scenario 3 (reverse mortgage for income and gifting).



(d) Aggregate CEV across scenarios.

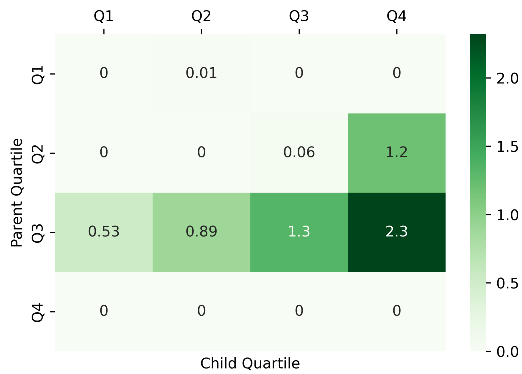
Note: Parent, child and aggregate CEV values based on utility gains compared to the Baseline Scenario. Scenarios are defined in Section 2.7. Model parameters are given in Table 5.

Compared to Scenario 1, the aggregate utility gains in Scenario 2 are larger for almost all combinations of wealth quartiles, in particular for those in middle wealth quartiles (Q2 and Q3). However, for parents who are much less wealthy than their children (e.g., parent Q1 and child Q4), Scenario 1 has a higher aggregate CEV than Scenario 2.

The largest aggregate utility gains are found for **Scenario 3**, where the parent uses a reverse mortgage for additional income and to gift a home deposit to the child (see Figure 4c). In this scenario, parents and children across all wealth quartiles enjoy large utility gains, which is especially true for parents in wealth quartiles Q2, Q3 and Q4, where the parent has enough home equity to generate reverse mortgage income and is not restricted by their reverse mortgage loan-to-value ratio after gifting. The aggregate CEV is over 20% when the parent and child are both in Q2 or both in Q3, with positive utility gains greater than 7% of CEV across all combinations of quartiles.

The **aggregate utility results** are summarised in Figure 4d, which compares the non-gifting Sce-

Figure 5: Policy experiment.



Note: The difference in aggregate utility gain of the policy experiment (Scenario 3 with no gifting limits) compared to the utility gain of Scenario 3 (with gifting limits).

nario 1 to gifting Scenarios 2 and 3. Overall, we find that unless the parent is significantly less wealthy than the child (parent Q1 and child Q4), gifting results in much larger aggregate welfare gains, with Scenario 3 becoming the most optimal.

3.3. Policy Experiment

Next, we perform a policy experiment to demonstrate how our two-generation model with parental altruism can be used to quantify the impact of public pension policy changes. In Australia (and in our main results), if a parent uses a reverse mortgage to borrow a large lump sum at the start of retirement and gifts it to their child, she can lose a significant amount of her Age Pension entitlement for the first five years of retirement. This reduction occurs because the liquefied home equity is now considered an asset once it exceeds the gifting limits of $10,000 in one financial year and $30,000 over five financial years. We extend Scenario 3, where the parent gifts their adult child a first home deposit equal to 20% of the child's home value, by removing all gifting limits.

Figure 5 shows the aggregate utility gain of the policy experiment compared to Scenario 3. Removing the gifting limits only affects parents in the middle wealth quartiles (Q2 and Q3), with CEV values increasing as the child's gift becomes larger. The largest utility gain, at 2.3% of CEV, occurs for a parent in Q3 paired with an adult child in Q4. The parent is likely to be a full or part Age Pensioner close to the asset test free threshold, and so a large 20% gift of the Q4 child's home valued at $945,000 results in a significant decrease in the parent's Age Pension entitlement for the first 5 years of retirement. However, this utility gain from removing gifting limits is small compared to the overall welfare gains of Scenario 1, 2 and 3, with CEV values of 7.30%, 10.21% and 14.34%, respectively, for the same illustrative parent and child.

3.4. Bequest vs Altruism

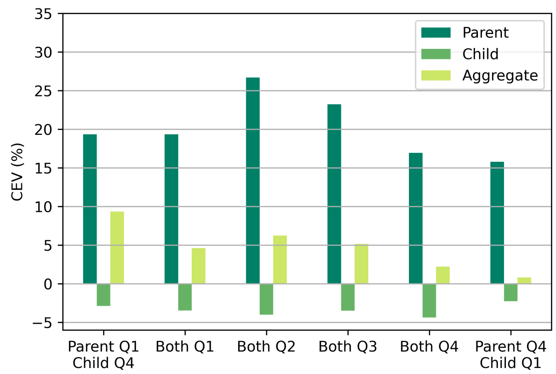
We now compare our main results with a version of the two-generation model without parental altruism. This 'bequest model version' assumes that the altruism parameter is zero ($\rho = 0$) and reintroduces the standard bequest utility function for the parent based on the net amount of assets bequeathed. We describe this model version in more detail in Appendix A. Figure 6 reports the corresponding results, which can be directly compared with the main results in Figure 4. Overall, the utility gains from the 'bequest model version' are generally lower than the main results across all wealth quartiles and scenarios, especially for parents in Scenarios 2 and 3 who now experience utility losses from early bequests. Most families still have positive aggregate utility gains (see Figure 4d) from using reverse mortgages in Scenarios 1-3, but these are smaller than for the main results in Figure 6d. Less wealthy parents (Q1) who gift a deposit to high wealth adult children (Q4) in Scenarios 2 and 3 suffer welfare losses compared to the Baseline Scenario without reverse mortgage use. In these cases, the parent gifts a substantial amount, due to higher home values for Q4 children (see Table 7). This gift reduces the parent's ability to meet their consumption target and reduces the amount they can leave as a bequest.

Overall, these results suggest that models using the standard parent bequest utility function without altruism can underestimate welfare gains from the use of reverse mortgages for the family. As discussed, standard bequest utility functions do not provide the parent with a utility gain when the parent gifts the adult child at time $t = 0$ with a first home deposit. This is despite the large positive impact that owning a home can have for the adult child. Our two-generation model with parental altruism can capture the impact of early bequest, resulting in positive utility gains for Scenarios 2 and 3, as reported in Figure 4. Instead of focusing on the net amount of assets bequeathed when the parent passes away, in our model, the parent cares more about how wealth transfers at any time can improve the future wellbeing of the adult child.

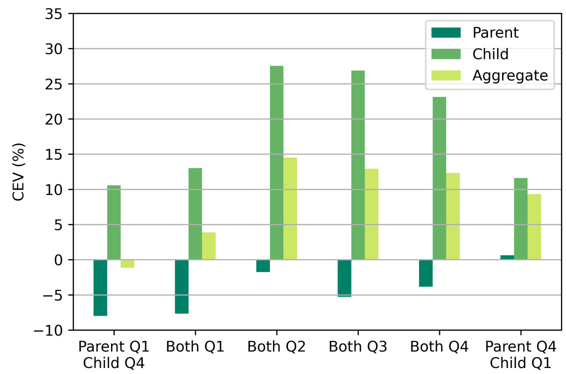
3.5. Level of Altruism

Figure 7 compares the aggregate utility changes across all three scenarios for four different values of the altruism parameter ρ. As discussed in the previous subsection and in Appendix A, $\rho = 0$ implies no parental altruism and use of the standard parent bequest utility function. As ρ increases, the utility gains of Scenario 1 decrease, as the parent cares more about the child's future wellbeing, while the utility gains of the gifting scenarios increase across all wealth quartiles. Figure 8 shows changes in CEV for (a) Scenario 1 (where the parent uses a reverse mortgage only for income) and (b) Scenario 3 (reverse mortgage for income and gifting) as ρ increases, emphasising how the parameter ρ controls how much the parent cares about the future wellbeing of the child, favouring gifting scenarios over non-gifting.

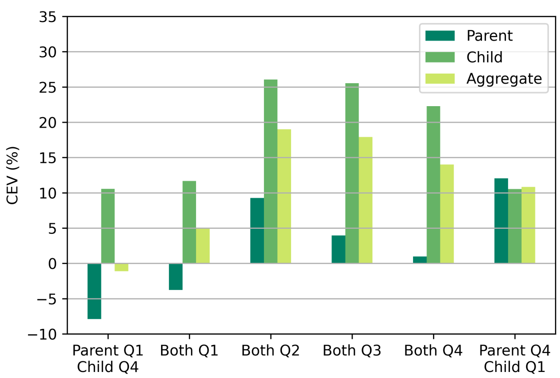
Figure 6: Results for two-generation model without altruism ($\rho = 0$).



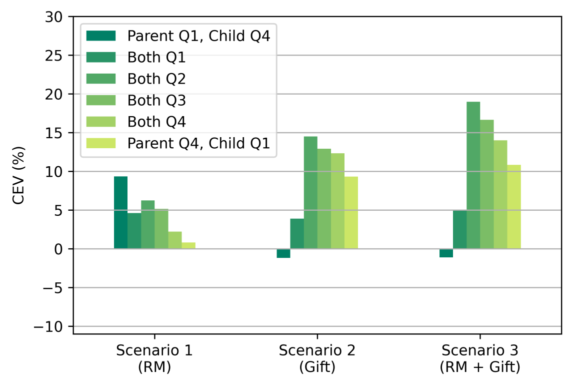
(a) Scenario 1.



(b) Scenario 2.



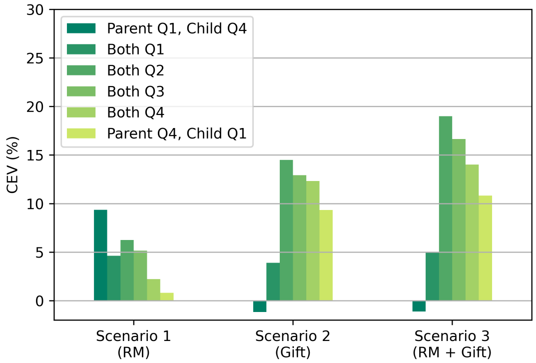
(c) Scenario 3.



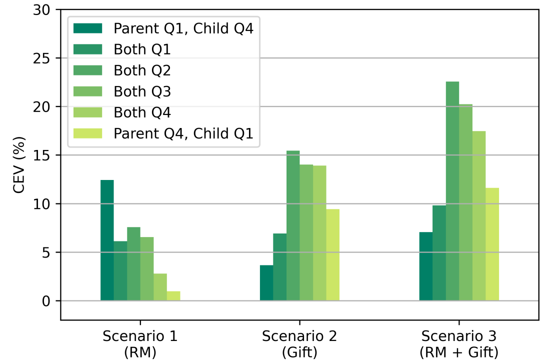
(d) Scenario aggregate CEV.

Note: Same as Figure 4, but $\rho = 0$.

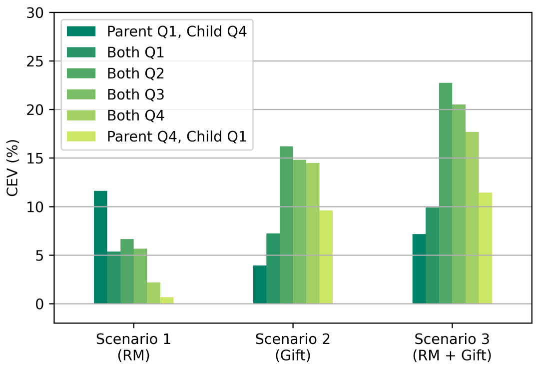
Figure 7: Results for two-generation model with different values of parental altruism, ρ.



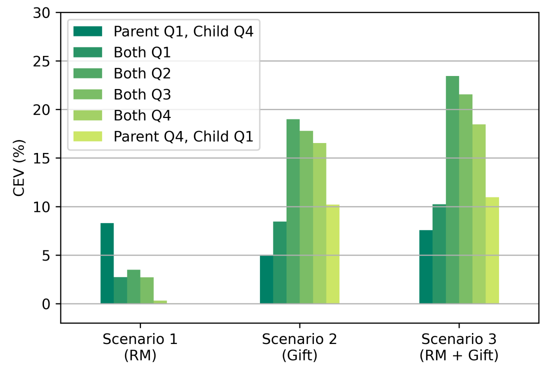
(a) Parental bequest (no altruism $\rho = 0$)



(b) Parental altruism ($\rho = 0.001$)



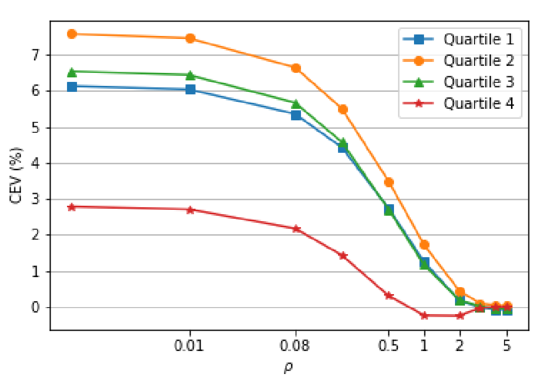
(c) Parental altruism ($\rho = 0.08$), main results



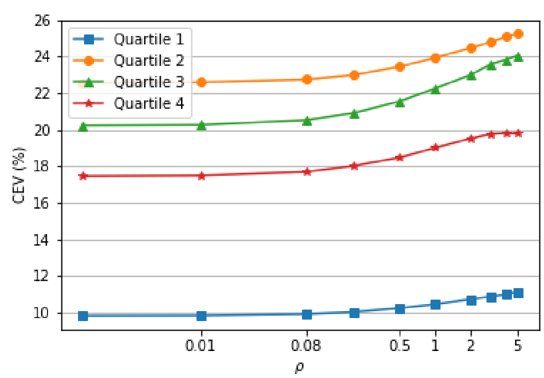
(d) Parental altruism ($\rho = 0.5$)

Note: Same as Figure 4, but with $\rho = 0, 0.001, 0.08$ and 0.5.

Figure 8: Sensitivity analysis for parental altruism, ρ.



(a) Parental altruism ρ sensitivity for Scenario 1.

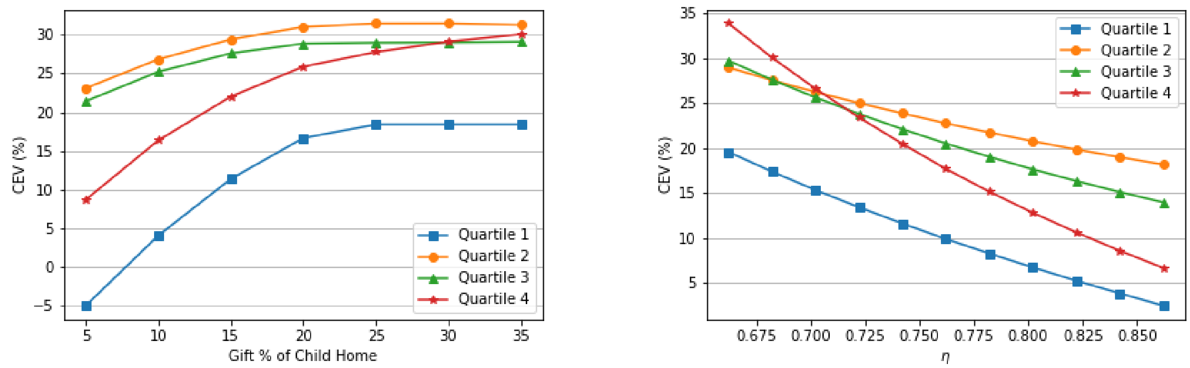


(b) Parental altruism ρ sensitivity for Scenario 3.

3.6. Further Sensitivity Analyses

In this section, we analyse the effects of variations in other preference and economic parameters and assumptions on the main results presented in Section 3.2. We assess the robustness and stability of

Figure 9: Sensitivity analyses.



(a) Parent gift % sensitivity for Scenario 3

(b) Consumption preference η for Scenario 3

our model under different assumptions and show how each variable affects welfare gains and losses in the different scenarios. Each analysis assumes a moderate level of parent altruism $\rho = 0.08$.

Figure 9 shows that the utility gains are fairly similar to the main results for gifts greater than 20% of the child's home value. However, gifts smaller than 20% result in increased costs to the child, with the cost of Lenders Mortgage Insurance explaining the lower utility gains and, in some cases, CEV losses. This result further highlights the welfare opportunity for early bequests, where larger gifts early in retirement can significantly increase the overall welfare of the family compared to terminal bequests. Figure 9 also shows the sensitivity with respect to non-housing consumption preference η.

In Table 9, we test the sensitivity of the main results to ten other model parameters. We focus on the utility gains in Scenario 3 compared to the Baseline Scenario. Recall that Scenario 3 involves the parent using a reverse mortgage to both gift their adult child a home deposit at the start of their retirement and use it to increase personal income. Given a moderate level of parental altruism $\rho = 0.08$, higher utility gains for Scenario 3 are seen for: (A) lower relative risk aversion, (B) higher preference for housing (via a lower η), (C) a lower discount factor (via a higher β), (D) higher bequest preference, θ, (E) a lower reverse mortgage margin, (F) a higher reverse mortgage LVR, (G) higher annual child rent, (H) higher house price growth, $h(t)$, (I) higher wage growth, $w(t)$, and (J) lower equity returns from investments, $e(t)$ and $n(t)$.

4. Conclusion

This paper develops a new two-generation discrete-time life cycle model with parental altruism, modelling a retired homeowning parent and their non-homeowning adult child. We analysed how a reverse mortgage loan can serve as a tool for intergenerational wealth transfers, specifically to facilitate early bequests and gifts. Simulations were based on a calibrated economic scenario generator, a five-health-state Markov model that was re-calibrated for Australian retirees with associated aged care fees, and wealth and income data from the nationally representative HILDA Survey.

Table 9: Sensitivity analysis: Utility gains (CEV %) for Scenario 3 compared to baseline model.

	A. Relative risk aversion (γ)					B. Non-housing consumption preference (η)				
	1.8	1.9	2	2.1	2.2	0.722	0.742	0.762	0.782	0.802
Q1	11.06	10.51	9.91	9.29	8.36	13.44	11.63	9.91	8.30	6.75
Q2	22.48	22.66	22.76	23.08	23.21	25.01	23.87	22.76	21.74	20.77
Q3	19.90	20.19	20.52	20.77	21.02	23.81	22.11	20.52	19.04	17.65
Q4	17.49	17.58	17.70	17.66	17.84	23.42	20.48	17.70	15.17	12.83
	C. Discount factor (β)					D. Bequest preference (θ)				
	0.9	0.95	0.98	0.99	1.0	0.1	0.3	0.5	0.7	0.9
Q1	-2.28	3.53	9.91	12.92	16.28	7.69	9.14	9.91	10.58	10.95
Q2	13.69	17.97	22.76	24.98	27.70	20.32	21.88	22.76	23.56	24.00
Q3	6.65	14.14	20.52	23.08	26.11	17.93	19.51	20.52	21.15	21.71
Q4	0.26	9.86	17.70	20.86	24.40	15.46	16.75	17.70	18.34	18.91
	E. Reverse mortgage margin (π_{RM})					F. Changes to loan-to-value ratio (LVR)				
	1.0%	2.0%	2.93%	4.0%	5.0%	-10%	-5%	0%	+5%	+10%
Q1	12.22	11.02	9.91	8.72	7.65	2.94	8.00	9.91	10.67	11.32
Q2	25.62	24.16	22.76	21.15	19.62	20.47	21.66	22.76	23.73	24.59
Q3	23.06	21.84	20.52	18.89	17.35	18.66	19.62	20.52	21.28	21.88
Q4	19.94	18.89	17.70	16.17	14.68	16.65	17.21	17.70	18.14	18.49
	G. Changes to annual child rent					H. Changes to house price growth rate ($h(t)$)				
	-10%	-5%	+0%	+5%	+10%	-2%	-1%	0%	+1%	+2%
Q1	9.06	9.42	9.91	10.57	11.18	7.91	8.82	9.91	11.32	12.78
Q2	21.55	22.09	22.74	23.59	24.62	19.11	20.77	22.76	24.97	27.42
Q3	20.14	20.19	20.52	20.98	21.53	16.70	18.48	20.52	22.33	23.75
Q4	17.96	17.83	17.69	17.98	18.58	15.43	16.49	17.70	18.90	19.85
	I. Changes to wage growth ($w(t)$)					J. Changes to domestic and international total equity return ($e(t)$ and $n(t)$)				
	-2%	-1%	0%	+1%	+2%	-2%	-1%	0%	+1%	+2%
Q1	5.35	8.54	9.91	10.69	11.03	10.78	10.36	9.91	9.52	9.12
Q2	26.01	24.22	22.76	21.81	21.12	24.54	23.64	22.76	21.87	20.97
Q3	21.90	21.13	20.52	19.97	19.35	22.73	21.69	20.52	19.35	18.06
Q4	14.35	16.59	17.70	18.38	18.69	20.27	18.95	17.70	16.57	15.30

Our results show that for a moderate level of parental altruism, both the parent and adult child enjoy significant utility gains when the parent uses a reverse mortgage loan to both gift their child a 20% home deposit towards their first home and withdraw home equity for personal consumption. Compared to the Baseline Scenario, where the parent does not access their home equity, and the child only receives an end-of-life bequest, we find utility gains equivalent to over a 20% increase in consumption for both the parent and the adult child. Families in the middle wealth quartiles (Q2 and Q3) benefit the most from such a strategy; however, all combinations of parent and adult children in different wealth quartiles can receive at least a 7% boost to baseline consumption. Additionally, we show that the impact of early gifting on the parent's standard of living is small, maintaining their optimal consumption target in both gifting and non-gifting scenarios. In many countries, gifts can result in additional taxes or a loss of means-tested public pension entitlement. However, our policy experiment suggests that only parents close to gifting limit thresholds face pension losses, and the resulting welfare losses are less than 16.2% of the welfare gains possible when the parent gifts their adult child a home deposit at the expense of the terminal bequest.

Previous studies using lifecycle models to study consumption and housing wealth decisions in retirement have focused on one generation, the parent, and have assumed that the parent gains bequest utility from the bequeathed amount only at the time of their death. Our new model captures the impact of intergenerational wealth transfers more comprehensively by assuming that the altruistic parent enjoys utility from the child's current and expected future utility from consumption and housing. As a result, our model generates larger utility gains for the parent and the family overall. Our sensitivity analyses show that the utility gains are stable across a range of different model parameters, including preference parameters and economic variables.

In summary, our two-generation model with parental altruism better captures the positive financial benefits of early intergenerational wealth transfers. The ability for reverse mortgages to increase the liquidity of the "Bank of Mum and Dad" benefits not only the parent's standard of living but also their adult child's housing and financial security. This paper advances the modelling of complex retirement income decisions, risk management, and retirement income products. Such important decisions can have significant long-term impacts, affect family members across multiple generations, and have applications to families all around the world with the global shift towards personal responsibility for retirement planning.

5. Acknowledgements

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however, are those of the authors and should not be attributed to the Australian Government, DSS, or any of DSS' contractors or partners. DOI:10.26193/R4IN30.

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