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Abstract

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Keywords

housing, mortgage, offset account, hetereogeneous agents, life-cycle model

JEL Classification

E21, E44, G21, G51, R21

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I study a novel institutional feature of Australian housing markets: the widespread use of mortgage offset accounts. These accounts reduce mortgage interest costs and increase the liquidity of mortgage balances. I build a heterogeneous agent life-cycle model of the Australian housing market to study who benefits from these accounts and by how much. Households in middle age, with high incomes, and with more expensive houses are most likely to use offset accounts and derive larger benefits from their use. I show that a social planner could maintain mortgage profitability, improve household welfare, and more evenly distribute benefits by adjusting the price structure of offset accounts.

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1. Introduction

In this paper, I study a novel institutional feature of Australian housing markets known as the mortgage offset account. Offset accounts are an on-call deposit account directly linked to a mortgage, which effectively reduces a borrower's net debt and thus interest payable on a loan. In the current high interest rate environment, offset accounts are a valuable tool to help homeowners reduce the interest burden of housing finance.

Although offset accounts are not unique to Australia, they are exceptionally popular here. Around 40 percent of all mortgage holders use an offset account (La Cava et al., 2021), and they are associated with 45 percent of mortgage lending by volume (Price et al., 2019). Offset accounts do not appear to exist in the US (O'Sullivan, 2005), and although they are available in both New Zealand and the UK they are much less common.[1] However, despite the popularity of this mortgage product, there is a notable lack of prior work in the macroeconomics literature on the use and benefits of offset accounts for Australian homeowners. The current paper fills that gap.

I build a heterogeneous household model of housing and mortgage finance decisions to study the use of offset accounts and the distribution of benefits associated with these accounts across households. The model is calibrated to closely match several important observations about Australian housing markets. In a series of model experiments I find that households in middle age, with high incomes, and with more expensive houses are most likely to use offset accounts and derive larger benefits from their use. I then show that by simply adjusting the pricing structure of these products a social planner could maintain the profitability of the total mortgage portfolio, while improving average household welfare and more evenly distributing the benefits of offset account use.

The heterogeneous agent modeling framework is a useful setting to study the importance of housing finance arrangements. Housing market experiences differ across household age, income, and wealth. This is because households then make different choices about saving, housing tenure, house size, and extent of mortgage borrowing. In addition, Australian homeowners also have the option to use mortgage offset accounts to lower the interest costs of their loans. To capture these varied factors, I build on the macroeconomics literature incorporating housing and mortgage finance decisions into heterogeneous agent life-cycle models.[2] As in the existing literature, I incorporate standard model features such as working life and retirement, life-cycle income, labour earnings risk, liquid assets subject to borrowing constraints, housing tenure choices, and long-lived mortgage contracts used to finance house purchases.

[1] In the UK mortgages with redraw facilities, which includes offset accounts, were 16 percent of all mortgages by volume in 2009 but has fallen to around 2 percent by 2023 (Financial Conduct Authority, 2023).

[2] See, for example, Gervais (2002), Attanasio et al. (2012), Chambers et al. (2009a), Chambers et al. (2009c), Chambers et al. (2009b), Halket et al. (2014), Sommer et al. (2018), Ma et al. (2021), Karlman et al. (2021), Boar et al. (2022), Balke et al. (2023), and Kinnerud (2022).

The novel features of the model are inspired by institutional details of the Australian housing market. First, and most important, households have access to mortgage offset accounts that both reduce the interest cost and increase the liquidity of existing mortgages. Each period households can pay a fixed cost to access the offset account. If they do so, they reduce their effective mortgage balance used for calculating interest owed by depositing liquid asset balances in the account. While required mortgage payments are unaffected by the use of an offset, the life-time interest cost of the loan is significantly reduced. Second, I assume that a macroprudential policy regime imposes debt-servicing restrictions at mortgage origination, where the serviceability test uses surplus income (i.e. income after typical consumption spending) and an interest rate buffer relative to the current mortgage rate. This feature generates significant variation in mortgage borrowing across households, which leads to wide dispersion in the potential benefits of mortgage offset account use.

I calibrate the model to target several observations about Australian household wealth accumulation, housing market experiences, and mortgage offset account usage. The model replicates average spending on housing, wealth accumulation over the life-cycle, overall homeownership rates and ownership among young households, and the size of mortgage offset account balances. Despite the small number of targeted statistics, I show that the model also closely reproduces the observed life-cycle profiles of: wealth accumulation, the homeownership rate, mortgage loan-to-value (LTV) ratios, offset account balances, and housing equity. Additionally, the model also captures the observed dispersion in homeownership rates and LTV ratios across the distributions of household income and wealth. Taken altogether, the close model fit to the data suggests it is well-suited to studying the importance of mortgage offset account use and benefits.

I first use the model to investigate which households make use of offset accounts and the extent to which they use them. Offset use is most common among middle-aged households, high-income households, households with large or valuable houses, and households with large mortgage balances. I then explore the reasons for these cross-sectional patterns. I compute the net present discounted value (NPDV) of mortgage offset account use for a range of different households. I compare households taking out mortgages at the maximum LTV ratio across different house sizes, and then households taking out mortgages at the maximum servicability ratio across different household incomes. Households with the smallest houses and the lowest incomes take on the smallest mortgages, which in turn generate relatively low life-time interest costs. Since offset accounts require payment of a fixed cost, smaller mortgages can generate negative NPDVs over the life-time of a loan. Thus, it is relatively wealthy households with large mortgage balances that earn the largest net benefits from mortgage offset account use.

Next I compute the welfare benefits that households enjoy from having access to offset accounts. I compute Consumption Equivalent Values (CEV) for households in the baseline model relative to an otherwise identical model where offset accounts are not available. On average, households enjoy benefits of offset accounts equivalent to 0.3 percent of life-time consumption. These benefits are unevenly distributed however. As above, I find that middle-aged households, high-income households, households with large or valuable houses, and households with large mortgage balances enjoy disproportionately large welfare gains from the availability of mortgage offset accounts. For example, households in the top 20 percent of the income distribution enjoy benefits equivalent to 1 percent of life-time consumption.

Finally, I use the model to study whether the pricing of mortgage offset accounts is socially optimal. In practice, many offset accounts are offered by banks at flat rate fee per period of use.[3] My baseline model mimics this pricing structure with a fixed cost of access. However, since the fixed cost results in offset benefits that disproportionately flow to wealthy households, it may be welfare improving to adjust pricing. I consider two alternative pricing policies: one that charges an annual fee proportional to the outstanding mortgage balances, and one that charges an annual fee proportional to the value of current housing. I set these fees so as to generate total revenues earned across the entire mortgage portfolio equal to those earned in the baseline model. I then compute the welfare gains or losses generated by a move to these pricing policies. I find that a price based on house values improves average household welfare by 0.04 percent of life-time consumption. Additionally, young households, middle-income households, and homeowners with the smallest houses disproportionately benefit from this policy change.

My results suggest that commercial banks and financial regulators should further investigate the pricing structure of mortgage offset account products. There may be welfare gains to adjusting price policies that both increase average household welfare, improve access to these products, and more evenly distribute the economic gains from their use.

1.1. Related Literature

Previous macro-housing literature primarily studies the institutional details of the US housing market. This is especially true of the large literature studying fluctuations in housing demand due to the large macroeconomic and financial market shocks the US has experienced in recent years (Greenwald, 2018; Graham, 2019; Kaplan et al., 2020; Garriga et al., 2020; Gamber et al., 2022; Greenwald et al., 2021). Among studies of the US housing market, the most closely related to the current paper are Boar et al. (2022) and Ma et al. (2021). Boar et al. (2022) build a heterogeneous agent model to study household preferences for liquidity in the face of rigid mortgage contracts and

[3]One complication is that some banks alter the interest rates offered on a mortgage when it comes with an offset account. In this paper, I take the flat fee structure as a reasonable first order approximation to offset pricing policies.

illiquid housing. Ma et al. (2021) build a similar model to study the influence of loan-to-value and payment-to-income constraints on mortgage borrowing on home ownership decisions. Neither these nor other papers consider the use or benefits of offset-related mortgage products.

Aside from the novelty of mortgage offset accounts, the Australian housing market is arguably a more interesting topic of research than the US housing market. Housing is known to be especially expensive in Australia, with an average price-to-income ratio of around 5.5 (Reserve Bank of Australia, 2024). As a result, while the total value of the housing stock in the US is around 40 percent of annual GDP, the Australian housing market is valued at around four times annual GDP.[4] One consequence of low and declining housing affordability has been a long-run decline in Australian homeownership rates, especially among young households (Ong et al., 2023). In recent years, rapidly rising interest rates have contributed their own difficulties to housing and mortgage affordability. Hence renewed interest in studying the benefits of mortgage offset account use.

Given the importance of the Australian context, a small recent literature studies various features of the Australian housing market using heterogeneous agent models. Cho et al. (2023) builds a general equilibrium life-cycle model with housing tenure, housing investors, and mortgage finance decisions to study the effect of negative gearing tax policies on housing affordability. Cho et al. (2021) build a similar model to study the effects of removing stamp duty on housing affordability. Ong et al. (2023) builds a related heterogeneous agent model to study the effect of the long-run decline in real interest rates on the homeownership rate in Australia. Graham et al. (2024) is complementary to the current paper and incorporates many of the same institutional features of the Australian housing market, but studies the effect of monetary policy shocks on the dynamics of homeownership rates.

Finally, a small number of policy-focused papers study or comment on the prevalence and use of mortgage offset accounts in Australia. The Reserve Bank of Australia (2015) notes that offset account use has grown rapidly in recent decades. For example, mortgages with offsets more than doubled from 3 to 7 percent of total outstanding consumer credit between 2009 and 2015. And both the Reserve Bank of Australia (2015) and La Cava et al. (2021) note that increasing use of offset accounts have been a significant contributor to Australian deposit and liquidity growth. For example, the use of offset account balances accounted for around 12 percent of total deposit growth in 2015. As a result of these trends, Price et al. (2019) argue that the popularity of offset accounts and mortgage

[4]For the US housing market-to-GDP ratio, see the FRED database. The total value of real estate for households is derived from data codes HNOREMV and NOREMV (Board of Governors of the Federal Reserve System (US), 2023a; Board of Governors of the Federal Reserve System (US), 2023b). Gross domestic product is from code GDP (U.S. Bureau of Economic Analysis, 2023). For Australia, the total value of dwellings owned by households is from Australian Bureau of Statistics (2023b) and gross domestic product is from Australian Bureau of Statistics (2023a).

redraw facilities helps to explain the unusually low fraction of households in Australia that are considered to be wealthy-hand-to-mouth (see, for example, Kaplan et al., 2014).

2. Model

In order to study the importance of mortgage offset accounts, I build a heterogeneous household life-cycle model featuring differences in income, liquid assets, housing decisions, and mortgage debt. I incorporate several novel institutional features of the Australian housing market that may be important for understanding housing market outcomes. This includes mortgage offset accounts, and macroprudential policies that require mortgage borrowers to satisfy conditions on their ability to service a mortgage.

2.1. Households

Demographics Time is discrete and one model period is equivalent to one year. I denote age by $j = 1, \cdots, J$. There is no mortality risk, and households die with certainty at age J. Households are in the labour force from period 1 to J_{ret}, and enter retirement from period $J_{ret} + 1$.

Preferences Lifetime utility for households is given by:

$$E_0 \left[\sum_{j=1}^{J} \beta^{j-1} u(c_j,\ s_j) + \beta^J \nu(w_{J+1}) \right]$$

where $u(\cdot)$ is the flow utility function, β is a common discount factor, and $\nu(\cdot)$ is a warm-glow bequest function (see De Nardi, 2004). Utility takes the CRRA functional form, and sits over a Cobb-Douglas aggregate of non-housing consumption c and housing services s. Utility is

$$u\left(c, s\right) = \frac{\left(c^{\alpha} s^{1-\alpha}\right)^{1-\sigma}}{1-\sigma}$$

where α is the consumption share, and σ is the inverse intertemporal elasticity of substitution. The warm-glow bequest function is

$$\nu(w) = \omega \frac{w^{1-\sigma}}{1-\sigma}$$

where ω governs the desirability of end-of-life net wealth w.

Endowments Households are born with no liquid assets, housing, or a mortgage. In working life, household earnings consist of a deterministic life-cycle component and a persistent stochastic process. In order to match average household income over working age, the deterministic component of income is a simple quadratic in age:

$$\Gamma_j = \gamma_1 + \gamma_2 \left(\frac{j}{J}\right) - \gamma_3 \left(\frac{j}{J}\right)^2$$

The persistent component of income z_j follows a log-AR(1) process:

$$\log(z_j) = \rho_z \log(z_{j-1}) + \varepsilon_{z,j}$$

where ρ_z governs the persistence of income shocks, and innovations follow a normal distribution $\varepsilon_{z,j} \sim N(0, \sigma_z^2)$ with mean zero and standard deviation σ_z. Income at birth z_1 is drawn from the stationary distribution for the log-AR(1) process.

In reality, the Australian retirement system is a complicated mixture of private savings, a government provided pension, and a compulsory, subsidised superannuation system.[5] I abstract from these complications and assume that households receive a pension that is a fixed proportion ω of income earned during the final period of working life. This can be thought of as a proxy for cumulated superannuation balances over working life.

Thus, total household earnings at age j are given by

$$y_j(z_j) = \begin{cases} \Gamma_j z_j & \text{if } j \leq J_{ret} \\ \omega \Gamma_{J_{ret}} z_{J_{ret}} & \text{if } j > J_{ret} \end{cases}$$

Housing Households may rent or own a home. Housing services are s are a function of housing tenure choice. Rental services are purchased at constant per-unit cost of P_r each period. The size of rental houses is chosen flexibly so that rented housing services are a continuous choice variable each period.

Households purchasing a house choose from a fixed set of house sizes $h' \in \mathcal{H} = \{\underline{h}, \cdots, \overline{h}\}$. Housing services enjoyed by homeowners are given by current house size. I abstract from household landlords.[6]

Houses are purchased at per-unit cost P_h. Each period homeowners pay maintenance costs that are a fraction δ of the value of the house $P_h h$. Purchasing a home involves paying stamp duty proportional to the value of the home: $f_b P_h h'$. Selling a home involves paying real estate agent costs and legal fees proportional to the value of the home being sold: $f_s P_h h$.

Liquid Assets Households can save via liquid assets a. Liquid assets earn a risk-free net interest rate r. Households face a no-borrowing constraint on liquid assets: $a' \geq 0$.

Mortgages Home buyers use mortgages to finance the purchase of a house. I make several assumptions on mortgages for computational tractability.

[5]See Kudrna et al. (2011) for an example of an overlapping generations model of the Australian pension system.

[6]See Cho et al. (2023) for a model of the Australian housing market featuring landlord-home buyers.

First, mortgages are long-term contracts with a fixed amortization schedule that specifies a required repayment each period. Following Karlman et al. (2021), the required mortgage payment on outstanding mortgage balance m is

$$\pi_j(m, r_m) = m \times \left(\sum_{k=1}^{M_j} \left[\frac{1}{1 + r_m} \right]^k \right)^{-1} = m \times \frac{r_m(1 + r_m)^{M_j}}{(1 + r_m)^{M_j} - 1}$$

where r_m is the interest rate on mortgages, and mortgage maturity is $M_j = \min\{30, J + 1 - j\}$. That is, the required mortgage payment is similar to that of an annuity mortgage with either 30 years remaining or the number of periods until death at $J + 1$.

Second, mortgages are adjustable-rate contracts, consistent with the fact that nearly 80 percent of outstanding mortgages in Australia are on variable rates (Reserve Bank of Australia, 2023a).[7] The mortgage interest rate is $r_m = r + \kappa$, where κ is a fixed spread over the risk-free interest rate r.

Third, I assume households cannot choose the size of mortgage originated for a given house purchase. Instead, households always choose the largest mortgage allowed given their borrowing constraints. Mortgages are limited by a maximum loan-to-value (LTV) ratio as well as a maximum net income surplus (NIS) ratio. The latter is similar to the payment-to-income (PTI) ratio constraint introduced in a model of the USA by Greenwald (2018). Mortgage size m' is given by the minimum size implied by the LTV and NIS constraints:

$$m' = \min\{m'_{LTV}, m'_{NIS}\}$$

A mortgage under the LTV constraint is

$$m'_{LTV} = \theta_m P_h h' \tag{1}$$

where θ_m is the maximum LTV ratio, and $P_h H$ is the value of the home purchased or owned by the household. While similar to a PTI constraint, the NIS constraint reflects two novel institutional features of the Australian mortgage market: assessed mortgage rates and the notion of surplus income. The NIS constraint is given by

$$\pi_j(m'_{NIS}, \widehat{r}_b) = \theta_y(1 - \alpha)y_j(z_j) \tag{2}$$

where $\pi_j(\cdots)$ is the required mortgage payment, $\widehat{r}_m$ is the assessed mortgage interest rate, θ_y is the maximum borrowing capacity as a share of net surplus income, and $(1-\alpha)y_j(z_j)$ is surplus income.

The assessed mortgage interest rate is given by $\widehat{r}_m = r_m + \phi$. As required by the

[7] Even fixed rate mortgages in Australia have relatively short fixed periods of around two years.

Australian Prudential Regulation Authority (APRA), new mortgages must satisfy a NIS constraint evaluated at an interest rate that includes a servicability buffer (Australian Prudential Regulation Authority, 2022a). This buffer is an additional spread ϕ over the current mortgage interest rate r_m. Note that the assessed rate is only used for the purpose of mortgage origination, but households repay mortgages at the actual mortgage rate r_m.

The net income surplus itself reflects income left over after typical household spending (Australian Prudential Regulation Authority, 2022b). To calculate surplus income, mortgage originators typically require households to provide bank statements documenting their recent spending patterns excluding rental costs. I approximate this calculation under the conservative assumptions that households spend all of their income each period and that the expenditure share allocated to non-durable consumption is α.[8] Net surplus income is then computed as: $(1-\alpha)y_j(z_j)$.

Mortgages Offset Accounts Homeowners with a mortgage may use a mortgage offset account. An offset account enables a borrower to hold liquid assets against an outstanding mortgage balance to reduce mortgage interest costs. Since $r_m > r$, mortgage holders with an offset account earn a higher effective rate of interest on their liquid assets. Additionally, unlike the mortgage balance itself, assets held in the offset account remain liquid and can be drawn upon at any time with no additional cost.

Use of an offset account does not change the required mortgage payment $\pi_j(m, r_m)$ in a given period, but instead affects how mortgage interest is accumulated. For households repaying a mortgage without an offset account, mortgage balances evolve according to:

$$m' = (1 + r_m)m - \pi_j(m, r_m)$$

For households repaying a mortgage while using an offset account, mortgage balances evolve according to:

$$m' = m + r_m \times \max\{m - a, 0\} - \pi_j(m, r_m)$$

Any liquid assets a held in the offset account reduce the interest accumulated on the mortgage balance m. Since the mortgage payment $\pi_j(m, r_m)$ is held fixed, mortgage balances are repaid more quickly under an offset account.

Finally, access to an offset account requires payment of a fixed cost f_o in each period that funds are held in the account. Conditional on using the account, all liquid assets up to the size of the mortgage balance are held in the account. Any liquid assets held in excess of the mortgage balance $\max\{a - m, 0\}$ earn the liquid asset interest rate r.

[8] This assumption means that I avoid the need to keep track of past spending as a state variable. It also implies that households cannot act strategically by reducing consumption and increasing their net income surplus in order to increase borrowing capacity.

2.2. Household Decision Problems

A household enters age j with state variables $\mathbf{s} = \{a, h, m, z\}$ where a are liquid assets, h denotes housing tenure, m is the outstanding mortgage balance, z is the persistent component of income.

Each period households make discrete choices over: renting (R), buying a new house (B), making mortgage payments without an offset account (N), and making mortgage payments with an offset account (O). The value function over the discrete choice problem is characterized by:

$$V_j(\mathbf{s}) = \max\left\{V_j^R(\mathbf{s}), V_j^B(\mathbf{s}), V_j^N(\mathbf{s}), V_j^O(\mathbf{s})\right\} \tag{3}$$

Renter Problem Renters choose the size of rental property s, non-durable consumption c, and liquid assets a'. The value function for renters is:

$$\begin{aligned} V_j^R(\mathbf{s}) = \max_{s,c,a'} & \, u(c,s) + \beta\mathbb{E}[V_j(\mathbf{s}')] \\ \text{s.t.} \quad & c + P_r s + a' + (1+r_m)m = y_j(z) + (1+r)a + (1-f_s)P_h h \\ & a' \geq 0 \\ & h' = 0, m' = 0 \end{aligned} \tag{4}$$

where β is the discount factor, expectations $\mathbb{E}$ are taken over the value function in Equation (3) with respect to the evolution of next period idiosyncratic income z'. Notice that a current renter may be selling a previously owned property h and repaying an outstanding mortgage m.

Home Buyer Problem Buyers purchase a new home h', and choose a new mortgage balance m', consumption c, and liquid assets a'. The value function for a home buyer is:

$$\begin{aligned} V_j^B(\mathbf{s}) = \max_{c,a',h',m'} & \, u(c,h') + \beta\mathbb{E}[V_j(\mathbf{s}')] \\ \text{s.t.} \quad & c + a' + (1+f_b+\delta)P_h h' + (1+r_m)m = \\ & \qquad y_j(z) + m' + (1+r)a + (1-f_s)P_h h \\ & a' \geq 0 \\ & h' \in \mathcal{H} \\ & m' = \min\{m'_{LTV}, m'_{NIS}\} \end{aligned} \tag{5}$$

where house size h' is chosen from the available set of houses $\mathcal{H}$, and the new mortgage choice m' is restricted to the minimum of the amount allowed under the maximum LTV and NIS constraints in Equations (1) and (2). The household sells any existing housing h subject to the sales cost f_s and repays any outstanding mortgage debt m at the beginning of the period. The household buys a new home subject to the purchase fee f_b and pays housing maintenance costs during the period.

Mortgage Payment Without Offset Account Problem A homeowner making mortgage repayments without an offset account chooses consumption c and liquid assets a'. The value function is

$$
\begin{aligned}
V_j^N(\mathbf{s}) = \max_{c,a'} &\, u(c,h) + \beta \mathbb{E}[V_j(\mathbf{s}')] \\
\text{s.t.} \quad & c + a' + \delta P_h h + \pi_j(m, r_m) = y_j(z) + (1+r)a \\
& a' \geq 0 \\
& h' = h \\
& m' = (1+r_m)m - \pi_j(m, r_m)
\end{aligned} \tag{6}
$$

where the household keeps the same house h that they entered the period with, pays maintenance costs on the house, and makes the required mortgage payment $\pi_j(m, r_m)$.

Mortgage Payment With Offset Account Problem A homeowner making mortgage repayments while using an offset account chooses consumption c and liquid assets a'. The value function is

$$
\begin{aligned}
V_j^O(\mathbf{s}) = \max_{c,a'} &\, u(c,h) + \beta \mathbb{E}[V_j(\mathbf{s}')] \\
\text{s.t.} \quad & c + a' + \delta P_h h + \pi_j(m, r_m) + f_o = \\
& \qquad y_j(z) + a + r \max\{a - m, 0\} \\
& a' \geq 0 \\
& h' = h \\
& m + r_m \times \max\{m - a, 0\} - \pi_j(m, r_m)
\end{aligned} \tag{7}
$$

where the household keeps the same house h that they entered the period with, pays maintenance costs on the house, pays the fixed offset account access cost f_o, earns interest on any liquid assets held in excess of the mortgage balance, and the mortgage accumulates according to the interest accumulated on net-of-offset mortgage balances less the required repayment.

3. Calibration

I calibrate a subset of model parameters to be consistent with the existing macro-housing literature, Australian data, and institutional features of the Australian housing market. I then calibrate a small subset of parameters via a Simulated Method of Moments (SMM) algorithm to match key statistics on housing service costs, life-cycle wealth accumulation, homeownership, and mortgage offset usage.

Table 1 reports our model parameters. Panel (a) reports parameters that are chosen consistent with information external to the model. The model period is one year, households enter the model at age 20, retire after age 65, and die at age 85, so the total number of model periods is 65. I fix the discount factor β at 0.95, and risk aversion σ is set to 2.

The persistence ρ_z and standard deviation σ_z of income shocks are borrowed from Cho et al. (2023). They estimate an idiosyncratic income process using panel data from the Household, Income and Labour Dynamics in Australia (HILDA) survey from 2001 to 2015. In Table 1 I report the estimated values from their log-AR(1) process.

I construct the deterministic life-cycle profile of income Γ_j by estimating a quadratic function for average incomes across age groups during working-life in the Australian Survey of Income and Housing (SIH) (Australian Bureau of Statistics, 2020a).[9] Our life-cycle profile is given by $\Gamma_j = \Gamma_1 + \Gamma_2(j/J) - \Gamma_3(j/J)^2$, and I estimate the parameters $\Gamma_1, \Gamma_2, \Gamma_3$ so that average income by age group matches the observed averages by age groups 15–24, 25–34, 35–44, 45–54, 55–64 in the SIH data. The retirement replacement rate ω is set to 50 percent, consistent with data for Australia reported in Publishing (2020).

The interest rate on liquid assets r is the real 10-year Australian treasury yield over the years 2000 to 2019 (Organization for Economic Co-operation and Development, 2023b; Organization for Economic Co-operation and Development, 2023a). The mortgage interest rate spread $\kappa = r_m - r$ is calculated from the average offered floating rate mortgage contract over the years 2000 to 2019 (Reserve Bank of Australia, 2023b).

The maximum LTV and NIS ratios are set to $\theta_m = 0.8$ and $\theta_y = 0.7$. The Australian Prudential Regulation Authority (APRA) has not imposed required maximum LTV ratios on Australian lenders, however, it reserves the right to do so and requires lenders to hold the ability to limit the extent of lending with LTV ratios of greater than or equal to 80 or 90 percent (see Attachment C of Australian Prudential Regulation Authority, 2022a). The Reserve Bank of Australia (2018) reports that the maximum allowable NIS ratio is 90 percent, but shows that more than 65 percent of new mortgages have an NIS ratio of 70 percent or less. APRA does set mortgage lending regulations over required mortgage servicability buffers (Australian Prudential Regulation Authority, 2022a). These servicability buffers have varied between 2 and 3 percent over the last decade.[10] I use an annual servicability buffer ϕ of 2.5 percent.

I set the house sales cost f_s, purchase cost f_b, and depreciation costs δ to the same

[9] The SIH is conducted every two years and surveys around 14,000 households. For income, wealth, and housing statstics I use averages of SIH data from 2014 to 2020, since these waves of the survey provide publicly accessible cross-section data by age.

[10] See, for example, historical directives on buffers to be applied to mortgage lending: https://www.apra.gov.au/news-and-publications/apra-finalises-amendments-to-guidance-on-residential-mortgage-lending and https://www.apra.gov.au/sites/default/files/2021-10/Letter%20to%20ADIs_Strengthening%20residential%20mortgage%20lending%20assessment.pdf.

Table 1: Model Parameters

Parameter	Symbol	Value	Source
Panel (a): Externally Calibrated Parameters			
Model period		1 quarter	Author
Minimum age		20	Author
Retirement age		65	Author
Death age		85	Author
Discount factor (annualized)	β	0.95	Author
Risk aversion coefficient	σ	2	Author
AR(1) income, persistence	ρ_z	0.9400	Cho et al. (2023)
AR(1) income, std. dev. shocks	σ_z	0.1700	Cho et al. (2023)
Income: age profile, intercept	Γ_1	-0.3643	SIH, 2014–2020
Income: age profile, coefficient	Γ_2	6.9562	SIH, 2014–2020
Income: age profile, curvature	Γ_3	6.4619	SIH, 2014–2020
Interest rate on bonds	r	0.0190	OECD (2023a,b)
Mortgage interest rate spread	κ	0.0217	RBA (2023)
Maximum LTV ratio	θ_m	0.8000	Author
Mortgage servicability buffer	ϕ	0.0250	APRA (2022)
Maximum servicability ratio	θ_y	0.7000	Author
House purchase cost	f_b	0.0400	Cho et al. (2023)
House sales cost	f_s	0.0200	Cho et al. (2023)
Housing maintenance cost	δ	0.0200	Cho et al. (2023)
Panel (b): Internally Calibrated Parameters			
Nondurable consumption share	α	0.8066	SMM
Utility weight on retirement wealth	ω	84.8177	SMM
House price	P_h	6.5041	SMM
Minimum house size	$\underline{h}$	0.7620	SMM
House grid spacing	Δ_h	2.0483	SMM
Fixed cost of offset account	f_o	0.0319	SMM

Notes: Interest rate, mortgage rate spread, servicability buffer, maintenance cost, AR(1) income parameters, and discount factor reported at annual rates and frequencies.

values in Cho et al. (2023). Sales costs are set to 2 percent, consistent with average real estate agent fees.[11] Purchase costs are set to 4 percent, consistent with average stamp duty costs. The depreciation rate or maintenance cost of housing δ is set to 2 percent at an annual rate.

Since homeownership rates are determined by house prices P_h and house sizes in the set $\mathcal{H}$, I normalize the per-unit rental cost of housing P_r to 1.

Panel (b) of Table 1 reports model parameters chosen via the SMM algorithm. I choose six parameters $\{\alpha, \omega, P_h, H, \underline{h}, \Delta_h, f_o\}$ to match the observed statistics reported in Table 2. Several of our targeted moments are taken from the Australian Survey of

[11] Fox et al. (2014) estimate Australian housing sales costs at around 3 percent.

Income and Housing (SIH). The SIH is conducted every two years and surveys around 14,000 households. For income, wealth, and housing statstics I use SIH data from 2014 to 2020, since these waves of the survey provide publicly accessible cross-section data by age (Australian Bureau of Statistics, 2020a). For rental costs statistics I use SIH data on housing and occupancy costs from 2000 to 2019 (Australian Bureau of Statistics, 2020b).

I set the non-durable consumption share α in the utility function to match average rental costs relative to income among all renters. Holding fixed the discount factor β, the bequest utility parameter ω governs the level of wealth accumulated in old age. I choose ω to target the ratio of average net worth for households aged 75–85 to average income for the same group. I choose the house price P_h to match the Australian homeownership rate.

Next I set the parameters describing the set of houses available for purchase, $\mathcal{H}$. For computational tractability, I assume there are 5 house sizes. The minimum house size is determined by $\underline{h}$. The spacing between houses is determined by the parameter Δ_h, which governs the log-distance between neighboring house sizes. I choose the minimum house size $\underline{h}$ to match the homeownership rate amoung young households, aged 25 and under. In the absence of more granular data, I set the housing grid scaling parameter Δ_h so that 5 percent of households choose to live in the largest house size. Finally, I choose the fixed cost f_o to target the fraction of Australian mortgage holders using offset accounts (La Cava et al., 2021).

The calibration implies that: households allocate 19 percent of total expenditure to housing costs; the average house value is around 3.6 times average annual household income; and the implied cost of using an offset account is around \$1677 per year.[12]

3.1. Model Fit

Table 2 reports the model fit to statistics targeted in the SMM calibration process, as well as a selection of untargeted statistics. In panel (a) I show that the model fits the targeted statistics very well. The rental costs-to-income ratio is around 0.2, as in the data. Households accumulate significant networth as they approach retirement, holding around 13 times as much wealth as income between ages 75 and 85. The overall homeownership rate is 70 percent, which is slightly higher than the 66 percent observed in the data. The homeownership rate for households aged 25 and under is around 10 percent, similar to the 12 percent rate observed in Australia over the last decade. Around five percent of homeowners live in the largest house size in the model. And the fraction of mortgage holders using offset accounts is 40 percent as in the data.

Panel (b) of Table 2 reports untargeted statistics that are not part of the calibration

[12] The model offset account cost f_o is equivalent to 2.87% of annual average income, while mean per-capita disposable income in the 2020 SIH is \$58,448 per year.

Table 2: Model Fit to Targeted and Untargeted Statistics

Moment	Data	Model	Source
Panel (a): Targeted Moments			
Mean rent-to-income ratio, renters	0.1919	0.1907	SIH, 2000–2019
Mean networth/Mean income, age 75—85	13.5499	13.5551	SIH, 2014–2020
Homeownership rate	0.6680	0.7033	SIH, 2014–2020
Homeownership rate, age ≤ 25	0.1197	0.0991	SIH, 2014–2020
Fraction owners with largest house size	0.0500	0.0491	Author
Fraction mortgage holders with offsets	0.4000	0.3948	La Cava et al. (2021)
Panel (b): Untargeted Moments			
Mean house value/Mean income	5.0395	3.6345	SIH, 2014–2020
Mean mortgage/Mean income	1.0624	0.9272	SIH, 2014–2020
Mean costs-to-income ratio, mortgagors	0.1727	0.2494	SIH, 2000–2019
Total offset accounts/Total liquid assets	0.1634	0.1648	SIH, 2014–2020
Housing turnover rate	0.0520	0.0284	Leal et al. (2017)

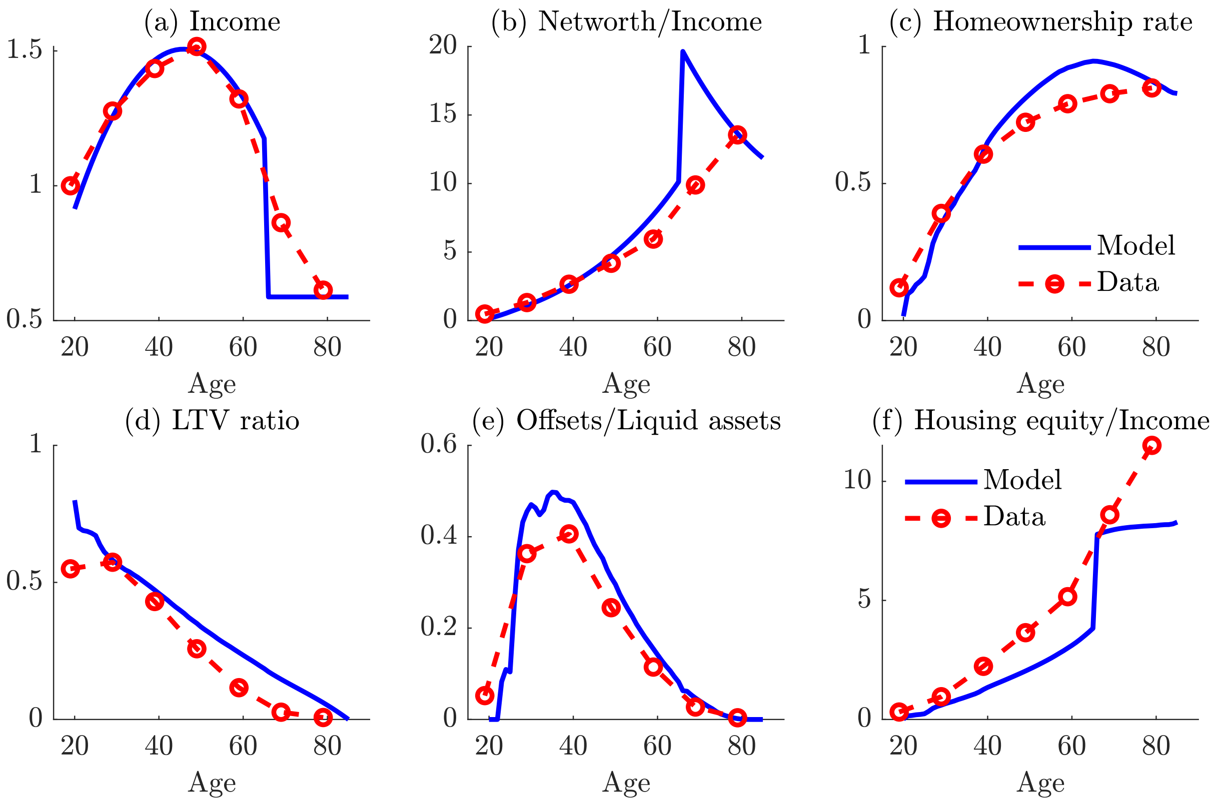
Notes: Mean income computed at annualized rate. Cost of housing for mortgagors includes: mortgage payments, depreciation costs, offset account costs.

process. I find that the average house value relative to average income is a little lower than in the data (3.5 vs 5.0), while average mortgage size relative to income is similar to the data (0.93 vs 1.06). One reason for the discrepancy in home values is that there are no housing capital gains in the model, so the value of a given owner-occupied property does not grow relative to income over time. Average housing costs for mortgage holders – mortgage payments, depreciation, and offset account costs – are a little higher than in the data (23 vs 17 percent of income). Finally, the housing turnover rate (2.8 percent) is a little over half of the rate in the data (5.2 percent).

Figure 1 compares the life-cycle profiles of various statistics in the model and the data. I illustrate life-cycle patterns of income, wealth, and housing variables, where solid blue lines are model statistics and dashed red lines with circle markers show data averages by 10-year age group in the SIH (Australian Bureau of Statistics, 2020a). Panel (a) shows that average household income follows a hump-shaped life-cycle profile. Panel (b) shows that households accumulate significant networth relative to income as they age. Panel (c) illustrates the rising profile of homeownership by age. Panel (d) reports a measure of the aggregate mortgage LTV, that is, the average value of loans relative to the average value of housing. Panel (e) shows the size of mortgage offset account balances relative to total liquid assets. Panel (f) shows average housing equity-to-average income.

Overall, Figure 1 shows that households begin life as renters and slowly move into homeownership over their working lives. Around half of all households become homeowners by age 35 and homeownership rates continue to grow through until retirement. The

Figure 1: Model fit to data across the life-cycle

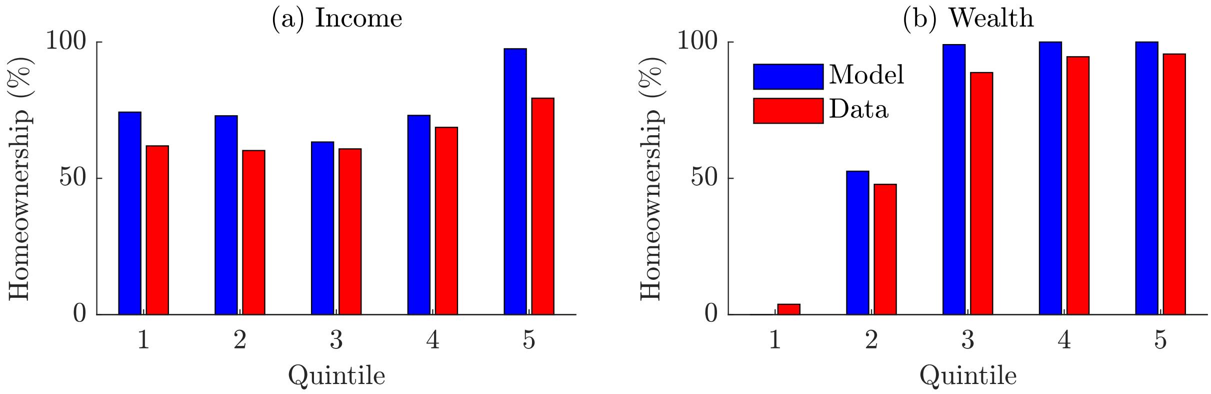


Note: Panel (a) is normalized to average income at age 15–24. Statistics in the data are computed as time-averages over 2014–2020.
Source: Author's calculations using Survey of Income and Housing (Australian Bureau of Statistics, 2020a).

biggest barrier to homeownership for young households is the down-payment required to purchase a house. Young households begin life with no assets, and must accumulate liquid assets prior to house purchase. First time home-buyers then borrow up to the largest feasible mortgage implied by their LTV and NIS constraints. Thus, the aggregate LTV sits at around 80 percent for the youngest households. After borrowing to enter the housing market, the fixed mortgage amortization schedule implies a near-linear decline in mortgage balances over the life-cycle. However, households can and do reduce their mortgage interest costs by accumulating liquid assets in mortgage offset accounts. Offset account usage peaks around age 40. By this time, many households are homeowners and have had time to accumulate enough assets that the mortgage interest cost savings outweigh the offset account fixed cost. Later in life, mortgage balances have been paid down and the interest savings produced by an offset account are not worth the fixed cost of use.

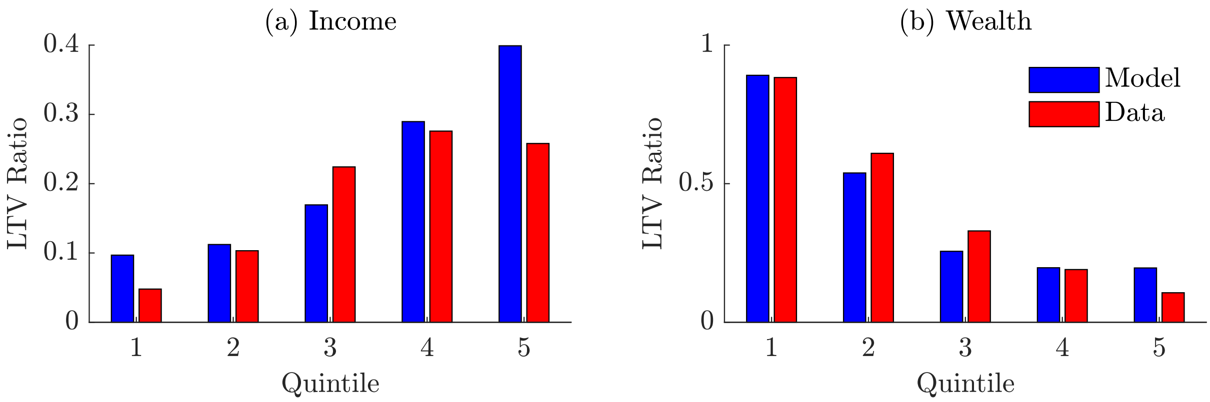
Finally, Figures 2 and 3 compare homeownership rates and LTV ratios, respectively, across the household income and wealth distributions in the model and data (Australian Bureau of Statistics, 2020a). As in the data, the model generates a rising profile of

Figure 2: Homeownership Rates by Income and Wealth



Source: Author's calculations using Survey of Income and Housing (Australian Bureau of Statistics, 2020a).

Figure 3: Mortgage LTV Ratios by Income and Wealth



Source: Author's calculations using Survey of Income and Housing (Australian Bureau of Statistics, 2020a).

homeownership in income above the middle quintile, and rising homeownership over the entire wealth distribution. Additionally, the model fairly accurately captures the average mortgage LTV ratio across the income and wealth distributions.

4. Analysis of Mortgage Offset Account Usage and Benefits

While as many as 40 percent of all Australian mortgage holders are reported to make use of mortgage offset accounts (La Cava et al., 2021), it is much harder to find data on the distribution of mortgage offset account use and benefits. In this section, I first investigate the frequency and utilization rate of mortgage offset accounts. I then consider the distribution of offset account benefits across the population. Finally, I consider how household behaviour would change if offset accounts were eliminated or if they were made

Table 3: Mortgage Offset Frequency, Utilization, and Welfare Benefits

Panel (a): Age	20–33	33–46	46–59	59–72	72–85
Fraction Offset	0.35	0.64	0.71	0.34	0.02
Offset/Mort	0.75	0.90	0.97	0.99	1.00
Panel (b): Income	20^{th}	40^{th}	60^{th}	80^{th}	100^{th}
Fraction Offset	0.04	0.11	0.28	0.52	0.74
Offset/Mort	0.99	0.98	0.96	0.94	0.94
Panel (c): House Size	h_1	h_2	h_3	h_4	h_5
Fraction Offset	0.34	0.40	NaN	0.60	0.67
Offset/Mort	0.93	0.91	0.00	0.99	0.99
Panel (d): Mortgage Size	20^{th}	40^{th}	60^{th}	80^{th}	100^{th}
Fraction Offset	0.00	0.00	0.03	0.63	0.63
Offset/Mort	0.00	1.00	1.00	0.99	0.90

Notes: Incomes and mortgages grouped by model population quantiles. House sizes taken from the discretized model housing grid.

freely available to all mortgage holders.

4.1. Mortgage Offset Account Usage

I first use the model to study the use of mortgage offset accounts across the population. In Table 3, I first report the fraction of all mortgage holders within each household subgroup that use an offset account. Second, I report the average size of offset balance relative to total mortgage balance, conditional on using an offset account.

Panel (a) shows that mortgage offset use is low for young households, peaks in middle age, and then declines over during retirement. 71 percent of mortgage holders aged 46–59 make use of a mortgage offset account. Conditional on use, the size of liquid asset balances held in a mortgage offset account is also rising with age. Offset users in the 20–33 age group offset around 75 percent of their mortgage balance. Households aged 46–59 and above offset nearly the entirety of their mortgage balance. These results are consistent with the model life-cycle profiles illustrated in Section 3.1. Young households have large mortgage balances but low networth, indicating that they are unlikely to have large enough liquid asset balances for the mortgage interest cost savings to outweigh the fixed cost of offset use. In contrast, older households have had time to accumulate large enough savings balances that there are substantial benefits to offset use.

Panel (b) shows that mortgage offset use is rising sharply with household income. Only 4 percent of mortgage holders in the lowest income quintile use an offset account, while over 70 percent of households in the highest income quintile make use of one. Conditional on offset use, low income households have somewhat larger offset balances than high income households, likely reflecting selection within income groups.

Panel (c) shows that mortgage offset use rises with house size or house value. Only 34 percent of mortgage holders in the smallest house size use offset accounts, while 67 percent of households in the largest house size use offset accounts. Conditional on offset use, larger house sizes are generally associated with larger offset balances.

Panel (d) shows that offset use is also rising with mortgage size. Mortgages in the bottom 40 percent of the size distribution are never offset, but 63 percent of mortgages in the top 40 percent of the size distribution are offset. Conditional on use, most of the mortgage balance is offset, with some decline in utilization rates in the highest mortgage size groups.

Overall, mortgage offset accounts are most likely to be used by middle-aged households, those with very high incomes, those with more valuable houses, and those with large mortgage balances.

4.2. Mortgage Offset Account Benefits

Now I consider the benefits of mortgage offset account use. I do this in two ways. First, I compute the net present discounted value of mortgage offset account use for different household groups. Second, I compute the implicit welfare benefit of offset accounts by comparing household outcomes in the baseline model to a counterfactual world where offset accounts are unavailable.

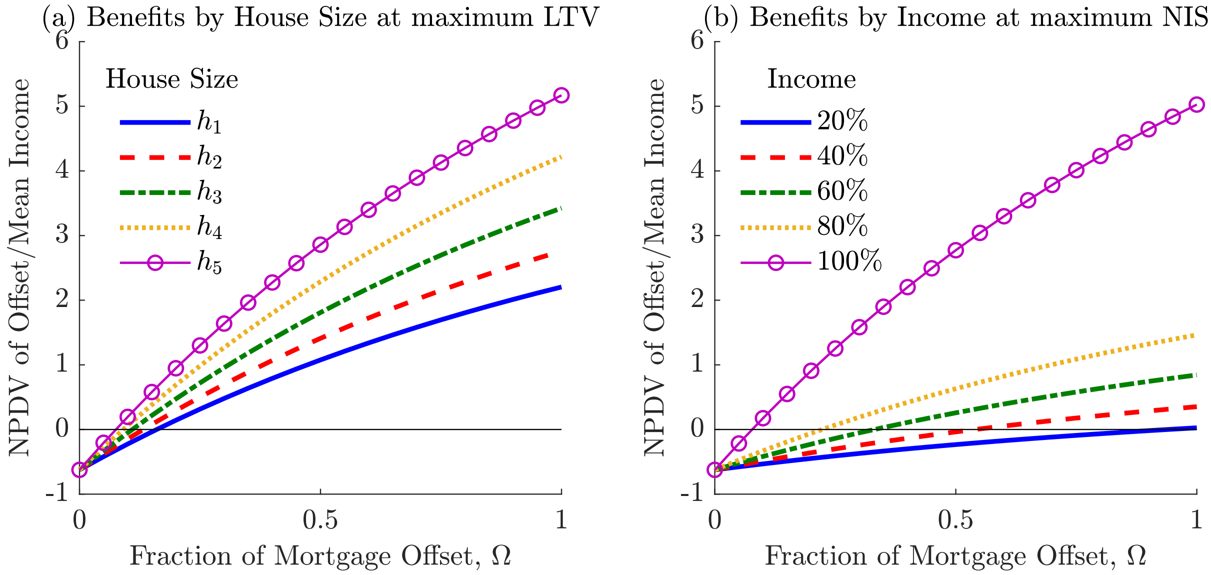
The net present discounted value of mortgage offset account use is computed as the sum of mortgage interest savings in each period the mortgage is held less the fixed cost of using the mortgage account. The stream of benefits and costs is discounted using the liquid asset interest rate r. For simplicity, I assume that households use the offset account over the entire mortgage maturity, regardless of whether using the account in a given period is worthwhile.

Recall that the evolution of mortgage balances without an offset account m_N and with an offset account m_O are given by

$$\begin{aligned} m_{N,t+1} &= (1 + r_m)m_{N,t} - \pi(m_{N,t}, r_m) \\ m_{O,t+1} &= (1 + r_m(1 - \Omega))m_{O,t} - \pi(m_{O,t}, r_m) \end{aligned}$$

where t denotes the current period of the mortgage, for simplicity I assume that the mortgage payment $\pi(\cdot, \cdot)$ is always made assuming a 30 year remaining maturity, and the fraction of a mortgage being offset is fixed at Ω. In any given period, the interest being paid on a mortgage is $r_m m_{N,t}$ or $r_m(1 - \Omega)m_{O,t}$ depending on whether the mortgage is being offset.

Figure 4: NPDV Offset Accounts



The net present discounted value (NPDV) can then be computed as:

$$NPDV(m_0, \Omega) = \sum_{t=1}^{M} \frac{(r_m m_{N,t} - r_m(1-\Omega)m_{O,t} - f_o \mathbf{1}_{m_{O,t}>0})}{(1+r)^{t-1}} \tag{8}$$

where the numerator captures the within period interest savings from using an offset in comparison with a mortgage that is never offset, less the fixed cost of holding the offset in any period when the mortgage balance is above zero. The NPDV is computed using a fixed initial mortgage balance m_0 and choice of offset size Ω.

Each panel in Figure 4 computes Equation (8) for different choices of offset size Ω. Panel (a) shows NPDVs for initial mortgages m_0 that would be generated by loans taken out at the maximum LTV ratio for each of the possible house sizes in the model. Panel (b) shows NPDVs for initial mortgages m_0 that would be generated by loans taken out at the maximum NIS ratio for households in each quintile of the household income distribution. NPDVs below zero indicate that the life-time net benefit of offset account usage is negative, while NPDVs above zero indicate life-benefits that exceed offset account costs.

Panel (a) shows that mortgages originated for every house size have positive life-time value as long as at least 15 percent of the mortgage is offset. Smaller houses (e.g. size h_1) require smaller mortgages, but this also implies lower mortgage interest costs over the life of the loan. Lager houses (e.g. h_5) require larger mortgages and thus generate larger interest costs. Since mortgage offset accounts only require a fixed cost to be paid, larger interest costs defrayed by the offset account generate larger net benefits. If the entire mortgage is offset by liquid balances, homeowners with the largest houses earn net present discounted benefits of nearly 5 times the average annual household income.

Panel (b) shows more variation NPDVs as a function of mortgages originated under

Table 4: Welfare Benefits Associated with Mortgage Offset Accounts

Panel (a): All Households					
CEV of Offset (%)	-0.28				
Panel (b): Age	20–33	33–46	46–59	59–72	72–85
CEV of Offset (%)	-0.47	-0.73	-0.52	-0.11	-0.00
Panel (c): Income	20^{th}	40^{th}	60^{th}	80^{th}	100^{th}
CEV of Offset (%)	-0.02	-0.07	-0.20	-0.49	-0.94
Panel (d): House Size	h_1	h_2	h_3	h_4	h_5
CEV of Offset (%)	-0.37	-0.45	-0.23	-0.51	-0.70
Panel (e): Mortgage Size	20^{th}	40^{th}	60^{th}	80^{th}	100^{th}
CEV of Offset (%)	-0.27	-0.21	-0.01	-0.28	-1.07

Notes: Incomes and mortgages grouped by model population quantiles. House sizes taken from the discretized model housing grid. CEV defined relative to alternative economy with no offset accounts. Negative values of CEV indicate that the benchmark economy with availability of offset accounts is preferred.

the maximum NIS at different points in the household income distribution. For example, households in the top 20 percent of the income distribution earn positive NPDV if just 5 percent of their mortgage is offset. But households in the bottom 20 percent of the income distribution need to offset the entirety of their loan before the NPDV of an offset account is positive. The NIS constraint on mortgage borrowing generates large variation in allowable loan sizes according to household income. Since low income households can borrow very little, their mortgages generate small interest costs over the life of the loan, and this is generally not enough to be worthwhile offsetting given the fixed offset cost. High income households can borrow a lot, and the large interest costs associated with their loans make it worthwhile to pay the fixed cost. Similar to the result from panel (a), high income households earn net present discounted benefits from offsetting their mortgages of more than 5 times average annual household income.

Next I compute the implicit welfare benefits of the availability of mortgage offset accounts. I compute these welfare benefits by comparing household outcomes in the baseline model to policy change that eliminates mortgage offset accounts. Recall that $V_j(\mathbf{s})$ is the value function of an age j household with idiosyncratic state vector $\mathbf{s}$. Let $\widehat{V}_j(\mathbf{s})$ be the value function of a household with the same age and state vector but when mortgage offset accounts are not available. Suppose we offered this household additional consumption worth λ in every period to stay in the baseline model. The value λ is known as the Consumption Equivalent Value (CEV) of the policy change to eliminate mortgage offsets. Because the flow utility functions are homothetic, we can write the CEV as:

$$\lambda_j(\mathbf{s}) = \left(\frac{\widehat{V}_j(\mathbf{s})}{V_j(\mathbf{s})} \right)^{\frac{1}{1-\sigma}} - 1$$

where σ is the risk aversion parameter. The interpretation of $\lambda_j(\mathbf{s})$ is the percentage increase in life-time consumption associated the policy change. Positive values of $\lambda_j(\mathbf{s})$ indicate that the world without offset accounts is preferred, while negative values of $\lambda_j(\mathbf{s})$ indicate that the baseline model with offset accounts is preferred.

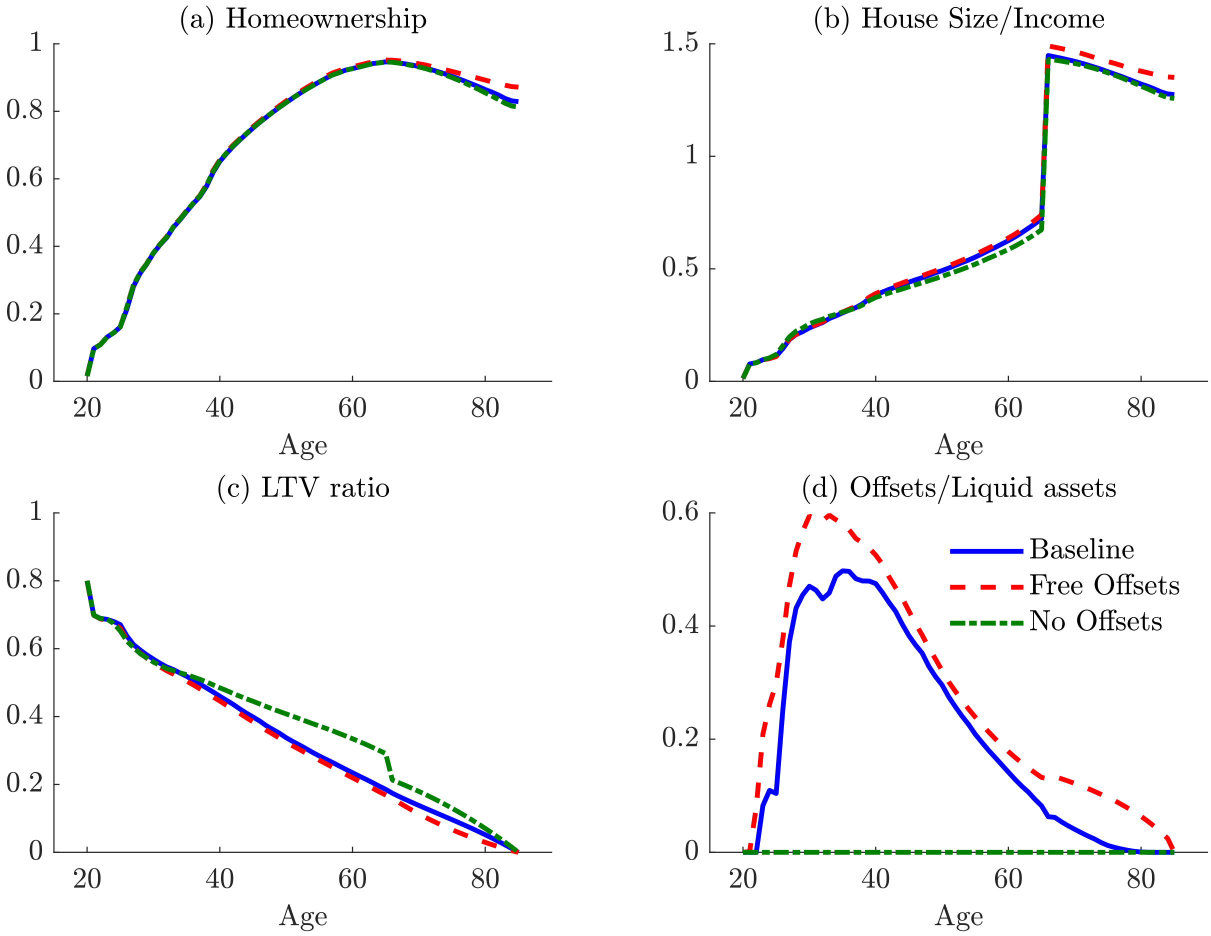
Panel (a) of Table 4 reports the average CEV of the policy change across all households at birth. Panels (b)–(e) report average CEVs by sub-groups of households according to age, income, house size, and mortgage size. All reported CEVs are negative, indicating that households uniformly prefer the world with mortgage offset accounts. However, the size of these benefits varies significantly. Panel (a) shows that offset accounts are worth around 0.3 percent of life-time consumption across all households. Panel (b) shows that young and middle aged households enjoy large benefits from the availability of offset accounts. Panel (c) shows that offset accounts are much more valuable to high income households than they are to low income households. Households in the bottom 20 percent only enjoy a 0.02 percent life-time consumption benefit of offset accounts, whereas households in the top 20 percent enjoy a 1 percent life-time consumption benefit. Panel (d) shows that benefits range from 0.4 percent of consumption for the smallest house owners to 0.7 percent of consumption for the largest house owners. And panel (e) shows a non-monotonic relationship between CEV and mortgage size. Small mortgage sizes are associated with moderate benefits of offset accounts, likely because these mortgage holders are close to purchasing a new house, involving an increase in mortgage size and larger benefits from offsetting again. Middle-sized mortgages have very small benefits, while large mortgages are associated with benefits worth more than 1 percent of life-time consumption.

Overall, the welfare benefits reported in Table 4 are consistent with the mortgage offset usage statistics reported in Table 3. Those households that benefit most from mortgage offset accounts are those most likely to make use of those accounts. The young will take on large mortgages soon, and the middle aged hold both large mortgages and liquid assets balances. And high income households are more likely to buy large houses and take out large mortgages, increasing the interest costs that can be avoided by offsetting.

4.3. Influence of Offset Accounts on Housing Market Outcomes

Finally, I consider how the availability of mortgage offset accounts affects housing market outcomes broadly considered. I compare the baseline model to two alternative economies: one in which offset accounts are unavailable, and another in which offsets are

Figure 5: Housing Outcomes With and Without Offset Accounts



completely free to use.

Figure 5 compares the life-cycle profiles of homeownership, house size, mortgage LTV ratio, and offset account balances. When offset accounts are free (red dashed lines) the homeownership rate and house sizes are both somewhat higher after retirement. Free offset accounts reduce the life-time cost of mortgages and so encourage both homeownership and upsizing behaviour. In addition, loan-to-value ratios are lower late in life, and the size of offset balances is much larger over the entire life-cycle.

When offset accounts are no longer available (green dash-dotted lines), the homeownership rate and house size are slightly lower than in the baseline model. Removing offset accounts does not have a particularly large effect because only 40 percent of mortgage holders are offset account users in the baseline model. Without offset accounts, mortgage LTV ratios are also larger, especially later in life. This is because additional interest accumulation keeps total mortgage balances larger for longer.

Overall, the availability of mortgage offset accounts does not appear to have a large effect on other housing market outcomes. Rather, its impact is predominantly felt through the uneven distribution of interest cost savings across different sub-grounds of households in the population.

5. Alternative Offset Pricing Policies

Finally, I consider whether offset accounts are priced socially optimally. In practice, many offset accounts are priced at a flat rate regardless of borrower characteristics or mortgage size.[13] But as the results of Section 5 make clear, fixed cost pricing means that the benefits of offset accounts primarily accrue to those most likely to make use offset accounts: high income and wealthy households with large mortgages. This suggests that fixed cost pricing may not be socially optimal.

I study two alternative offset account pricing policies to explore whether these might be welfare maximizing. First, a policy where offset accounts are priced proportional to the size of outstanding mortgage balance: $f_{oM}m$. Second, a policy where offset accounts are priced proportional to the value of the current house owned by the mortgage holder: $f_{oH}P_h h$. The first policy implies large upfront costs that decline as mortgage balances are repaid. This policy implies that mortgagors will make use of mortgage offset accounts for a longer proportion of their mortgage duration. The second policy implies fixed costs over the life of a given mortgage loan, however these costs vary with house size.

I set the pricing parameters f_{oM} and f_{oH} to keep total mortgage revenue constant relative to the baseline model. Mortgage revenues are given by:

$$\Pi(f_o, f_{oM}, f_{oH}) = \sum_{j=1}^{J} \int \mathbf{1}_N r_m b d\lambda_j(a, h, b, z)$$
$$+ \sum_{j=1}^{J} \int \mathbf{1}_O \left(r_m \max(b-a, 0) + f_o + f_{oM} b + f_{oH} P_h h\right) d\lambda_j(a, h, b, z)$$

where the first term is total mortgage revenue collected from non-offset account users, and the second term is total mortgage revenue collected from offset account users. The latter group pay reduced interest costs of their mortgage but also pay fees depending on the price policy given by parameters f_o, f_{oM}, and f_{oH}.

After equalizing mortgage revenue across policies, I compute welfare via consumption equivalent value (CEV) and report the results in Table 5. Recall that positive values of CEV indicate that an alternative pricing policy is preferred to the baseline fixed cost policy, while negative CEV values indicate that the baseline model is preferred to an alternative price policy.

Panel (a) shows that, on average, an offset pricing policy based on mortgage size is welfare-reducing. Positive CEVs in panels (b)–(d) suggest that older households, lower income households, and homeowners with the smallest house size would actually benefit from this policy. These households tend to have smaller mortgages which would be

[13] One complication is that some banks alter the interest rates offered on a mortgage when it comes with an offset account. I take the flat fee structure as a reasonable first order approximation to offset pricing policies.

Table 5: Welfare Analysis of Alternative Offset Pricing Policies (CEV, %)

Panel (a): All Households					
Mortgage cost f_{oM}	-0.10				
House value cost f_{oH}	0.01				
Panel (b): Age	20–33	33–46	46–59	59–72	72–85
Mortgage cost f_{oM}	-0.16	-0.17	0.01	0.12	0.03
House value cost f_{oH}	0.01	0.01	0.01	-0.01	-0.00
Panel (c): Income	20^{th}	40^{th}	60^{th}	80^{th}	100^{th}
Mortgage cost f_{oM}	0.06	0.05	0.03	-0.01	-0.28
House value cost f_{oH}	0.00	0.01	0.03	0.05	-0.10
Panel (d): House Size	h_1	h_2	h_3	h_4	h_5
Mortgage cost f_{oM}	0.03	-0.09	-0.04	-0.16	-0.32
House value cost f_{oH}	0.04	-0.05	-0.05	-0.17	-0.27
Panel (e): Mortgage Size	20^{th}	40^{th}	60^{th}	80^{th}	100^{th}
Mortgage cost f_{oM}	-0.08	-0.06	0.14	0.18	-0.36
House value cost f_{oH}	0.03	0.02	-0.00	0.03	-0.05

Notes: Incomes and mortgages grouped by model population quantiles. House sizes taken from the discretized model housing grid. CEV defined relative to alternative economies with different offset account cost structures. Negative values of CEV indicate that the benchmark economy with the fixed cost is preferred.

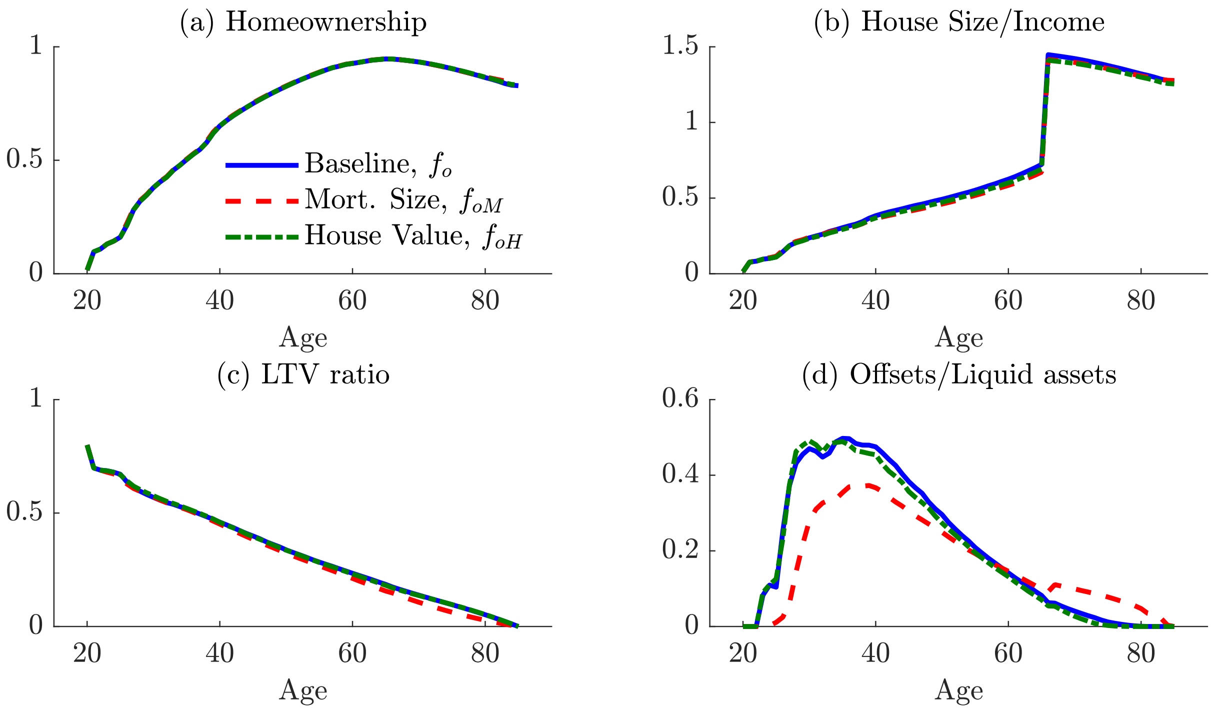
charged less for using an offset account under this policy. Since these groups were less likely to use an offset account in the baseline economy, the reduction in pricing represents a net gain for them.

Panel (a) also shows that, on average, an offset pricing policy based on house value is welfare-improving: households benefit by 0.04 percent of life-time consumption. Panels (b)–(e) show that those who disproportionately benefit from this policy are younger households, middle income households, homeowners with smaller houses, and homeowners with smaller mortgage balances.

Overall, offset pricing based on house value is capable of raising significant revenue, and this revenue is disproporionately raised from wealthier households with larger houses. Reducing the price for other households improves access, which reduces the life-time cost of mortgages for those housheolds. While wealthier households facing higher fees are worse off under the policy change, it does not appear to significantly distort their decisions. Figure 6 shows that the policy has very little effect on homeownership, house size, or mortgage size.

These results suggest that mortgage providers and financial market regulators should further investigate alternative pricing policies to improve access to offset accounts, reduce the life-time costs of mortgages for a larger number of households, and possibly increase

Figure 6: Life-Cycle Profiles by Alternative Offset Pricing Policy



social welfare.

6. Conclusion

In this paper I study the novel institutional feature of Australian housing markets known as the mortgage offset account. I focus on the use of these accounts and the benefits derived by different households by age, income, house value, and mortgage balances. To address these questions, I develop a heterogeneous agent life-cycle model calibrated to reflect key characteristics of the Australian housing market. In a series of model experiments, I find that households in middle age, with high incomes, and with more expensive houses are most likely to use mortgage offset accounts. Moreover, they also derive the largest benefits from offset account use, largely because these households maintain higher mortgage balances, accumulate larger interest costs over the life of their loans, and have a greater capacity to accumulate liquid assets for use in offsetting.

I show that offset accounts significantly reduce the lifetime interest costs of mortgages, particularly for wealthy households with large mortgage balances. For the wealthiest households, the net present discounted value of the interest cost savings can be as large as 6 times average annual income and valued at around 1 percent of life-time consumption.

These reuslts illustrate the potentially large economic advantages of these financial products. But they also highlight the highly unequal distribution of these benefits. This disparity suggests the possibility of policy intervention to improve accessibility and equity of these benefits. As an initial study into this possibility, I consider alternative mortgage offset pricing policies that set fees based on mortgage size or house value. I find that a policy maker could maintain the current profitability of the mortgage sector while improving average household welfare and redistributing the benefits of mortgage offset account use more evenly.

While this is the first structural macroeconomic study of mortgage offset accounts, there are several possibilities for further research. First, we might consider a more detailed investigation of the pricing policies of these mortgage products. Second, we might consider whether the use of offset accounts helps stabilize housing market outcomes over the course of the business cycle or a monetary policy tightening cycle. By addressing these and other questions, future research can contribute to a much more nuanced understanding of housing and mortgage markets and the extent to which they are or are not working for the benefit of all Australians.

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