Macroeconomic Dynamics, **17**, 2013, 1281–1310. Printed in the United States of America.
doi:10.1017/S1365100512000041

MEANS-TESTED AGE PENSIONS AND HOMEOWNERSHIP: IS THERE A LINK?

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Although several targeted welfare programs across the world have made owner-occupied housing exempt from the means test, relatively little is known about the impact of such exemption on portfolio choice and consumption. We study the Australian age pension scheme and argue that current uncapped exemption may lead to distortionary incentives for high levels of housing wealth to be sheltered from the means test. We set up a life-cycle model with explicit housing choice and borrowing constraints to match some key features of the Australian economy. We find that abolishing the exemption of owner-occupied housing in the assets test increases aggregate output, capital accumulation, and welfare, but decreases housing investment and homeownership. However, removing such distortions does not necessarily imply that all households would be better off. Lowering taxes to maintain fiscal balance would result in wealthy households experiencing a large welfare loss, whereas the majority of the population would benefit.

Keywords: Means-Tested Age Pensions, Homeownership, Life-Cycle Model, Housing Consumption

1. INTRODUCTION

Several targeted welfare programs across the world have designated owner-occupied housing as exempt from the means test, including Supplementary Security Income (SSI) and Medicaid in the United States and the Pension Credit in the United Kingdom. Such exemptions are likely to impact the portfolio choices of households. This is highly pertinent to Australia, as the main program for the elderly, the age pension scheme, is means-tested. That is, at present only people whose income and assets fall below certain thresholds become eligible to receive welfare payments. The owner-occupied home is exempt from the means test, and

We thank participants at the Workshop for Dynamic Macroeconomics 2010 organized by Benoît Julien and Pere Gomis-Porqueras, as well as anonymous referees, for providing very useful suggestions. This work was partially supported by UNSW Special Research Grant 2009–2010. All remaining errors are our responsibility. Address correspondence to: Sang-Wook (Stanley) Cho, School of Economics, University of New South Wales, Sydney, NSW 2052, Australia; e-mail: s.cho@unsw.edu.au.

different asset test schedules apply to homeowners and nonhomeowners. About two million elderly Australians, or 75% of those aged 65 and above, receive the age pension [Harmer (2008)].

If exemption of the family home does lead to overinvestment and overconsumption in housing, then this may be a source of economic inefficiency, and has implications for the portfolio choice of households, as well as for housing markets in the economy. More specifically, the exemption of the owner-occupied home may also lead to a portfolio with a high proportion of housing equity, thereby providing an opportunity for very high levels of wealth to be sheltered from means tests. Residential real estate alone takes more than half of the personal wealth in Australia, and about half of the elderly claim to have spare capacity in their homes, indicating excess housing services consumption. According to Bradbury (2008), high rates of homeownership continue into post–retirement years in Australia, whereas they decline more steeply in most other countries.

The design of the means test has been a topic of discussion in many policy debates around the world [Brewer et al. (2008)]. In Australia, discussions have centered on putting a cap on the exemption of housing from the means test [Henry (2009)]. Although the impact of the owner-occupied exemption on the consumption of housing is appreciated, it is also argued that housing is important for social integration, and that savings invested in owner-occupied housing do not generate cash-flow incomes for retirees.

In this paper, we focus on the implications of life-cycle homeownership and portfolio choice, with specific emphasis on the nature of the means-tested age pension that exempts owner-occupied housing from the pension means test. We develop a general equilibrium model with overlapping generations, with explicit tenure choice and life-cycle attributes, to determine whether removing or changing the current means-testing age pension scheme would have aggregate and life-cycle implications, in addition to considering the distributional impacts of such changes. Although calibrated to match some other key aspects of the data, this framework matches the observed profiles of wealth and homeownership, as well as replicating observed wealth inequality. The fact that such a simple model performs so well along all of these dimensions helps validate the policy implications that are generated.

This paper then evaluates the effects of three different alternative reforms on the current means-testing scheme. All three alternatives share a common feature of removing the uncapped exemption of owner-occupied housing from the asset means test. The first policy removes the current exemption and incorporates housing into the assets test, whereas the second policy is more modest, in the sense that we introduce a limit on the value of the exemption of owner-occupied housing. For the first two policies, a reduction in the pension expenditure of the government implies a lower payroll tax rate on labor earnings. In the third policy, we abolish the current means-testing policy and implement a constant–pension benefit scheme. In this case, the government does not alter the taxes, but adjusts the benefit level to maintain fiscal balance.

The inclusion of housing assets in the current means-testing scheme implies that we remove the wedge that distorts household portfolio decisions over the life cycle. In the aggregate, we find a 3% reduction in the housing capital-to-output ratio and a 0.7% increase in the physical capital-to-output ratio. Aggregate output rises as a result of increased savings, whereas consumption increases because of a lower payroll tax rate on labor earnings. As less wealth is invested in housing, the homeownership ratio will also be lower. However, a reduced interest rate effectively lowers the borrowing costs for potential home buyers and increases homeownership for younger cohorts. Overall, the homeownership ratio decreases modestly by 0.3 percentage points.

Abolishing the distortion caused by the current means-testing scheme generates increased welfare benefits for the aggregate economy. Despite the fall in housing consumption, the gains in average welfare reflect a large increase in nonhousing consumption. When they are divided into wealth quintiles, we find that households in the top quintile suffer, whereas all other households will gain from this policy reform. The majority of households that are not rich enough benefit from the reform because of a lower tax rate and a higher wage rate. The welfare gains for the lower four quintiles range from 0.01 to 1.77%. In contrast, wealthy households, which are typically homeowners with large financial assets, will experience either a cut in the pension benefit or a cut in their asset income from a lower interest rate. Quantitatively, households in the highest wealth quintile will be subject to a welfare loss of 1.17%.

In the policy version in which, perhaps more realistically, we introduce a limit on the value of the exemption of owner-occupied housing, the aggregate and distributional implications are similar to those for the previous reform, but to a lesser extent, partly because some pensioners who were receiving partial benefit now become eligible to receive full benefit. Our results thus indicate that it would be in the interest of most households to oppose the current exemption of housing from means testing.

This paper builds on the housing literature in dynamic macroeconomics. With a few papers allowing for housing in models of portfolio choice, the role of housing wealth has received greater attention because of its unique role: people can borrow against housing; housing is indivisible and relatively illiquid; and housing not only provides a flow of real benefits to the owner as a consumption good, but also acts as an investment good that provides a potential for capital gains or losses. In the recent general equilibrium literature, Yang (2009) explicitly introduces tenure decision, in which people can rent instead of purchasing a house and receive a similar flow of services not subject to capital gains or losses, to estimate the increasing ratio of housing to nonhousing consumption by age in the U.S. data. Similarly, Chambers et al. (2009) uses a life-cycle framework with different curvatures in the utility function for housing and nonhousing consumption to account for the recent changes in the U.S. homeownership ratio. This paper adds to the literature by adding an extra incentive to accumulate housing assets induced by the institutional age pension framework.

This paper also complements the public economics literature, which documents the implications of means testing with respect to household consumption and savings decisions. Since the seminal work of Hubbard et al. (1995) on the impact of assets tests in various welfare programs on savings, many subsequent studies have focused on the negative incentives on savings and labor supply. More recent work by Sefton et al. (2008) concludes that in the United Kingdom, the lightening of the means-test taper rates with the replacement of the Minimum Income Guarantee by the Pension Credit reflects a reasonable compromise across the various distortions caused by the policy. In the current paper, we raise similar questions, but with a theoretical framework, in order to conduct various counterfactual policy experiments.

In the Australian context, some studies have used quantitative approaches similar to that used in this paper. However, no studies have focused on the homeownership and portfolio decisions, which are the focus of our current study.

This paper is organized as follows. Section 2 presents an overview of data on wealth and homeownership. Section 3 presents the model, and Section 4 details the calibration. Section 5 shows the benchmark results. The policy experiments are presented in Section 6, followed by the conclusion in Section 7.

2. A BRIEF OVERVIEW OF WEALTH AND HOMEOWNERSHIP IN AUSTRALIA

We examine in detail the profile of average wealth and wealth composition in Australia using the Household, Income and Labour Dynamics (HILDA) data set, an annual household-level panel study that began in 2001. We begin by presenting a cross-sectional snapshot of average wealth accumulation across all age[1] groups in Australia from the HILDA 2002 wave. We focus on the housing asset, nonhousing equity, and total net worth. The housing asset refers to the value of the primary residence, whereas nonhousing equity is calculated as the value of the financial (or nonhousing) assets minus all liabilities, including the mortgage on the primary residence. Detailed definitions are presented in the Appendix.

As presented in Figure 1, there is a fall in nonhousing equity starting at age 60. However, housing equity is not subject to the same decline. The decrease in wealth may be different for people with different lifetime incomes. Figure 2 shows the average fraction of households in Australia that are homeowners, or the homeownership ratio across age cohorts. The average homeownership ratio in Australia is around 66%. Similarly to the profile of housing equity in Figure 1, homeownership peaks around the age of 60 and does not decline much during retirement.

3. BENCHMARK MODEL

We consider a general equilibrium life-cycle model that is populated by ex ante heterogeneous agents. We explicitly model the tenure decision, where agents purchasing a home must meet a down-payment requirement and pay transaction costs. We also present a simple analytic case in the Appendix to illustrate the

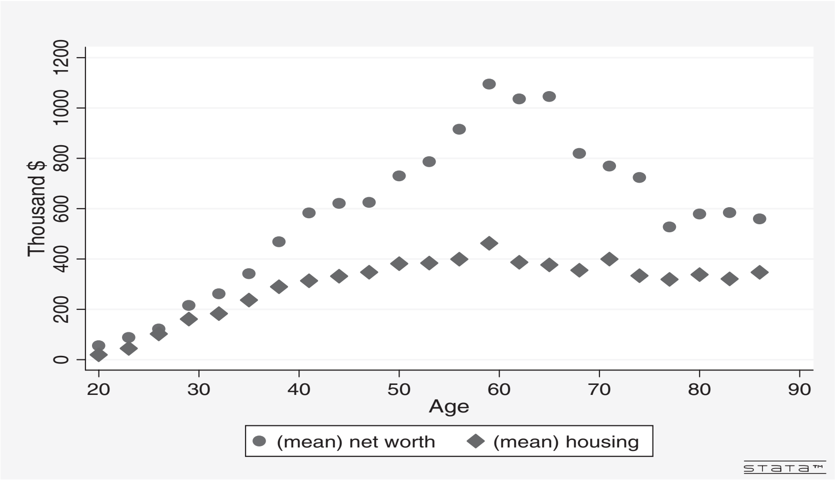

FIGURE 1. Wealth portfolio by age (HILDA, 2002).

impact of exempting owner-occupied homes from the assets test on the housing and nonhousing consumption.

3.1. Demographics

Our model period is three years in length and the economy is populated by a continuum of households of measure 1. Households enter into working life at

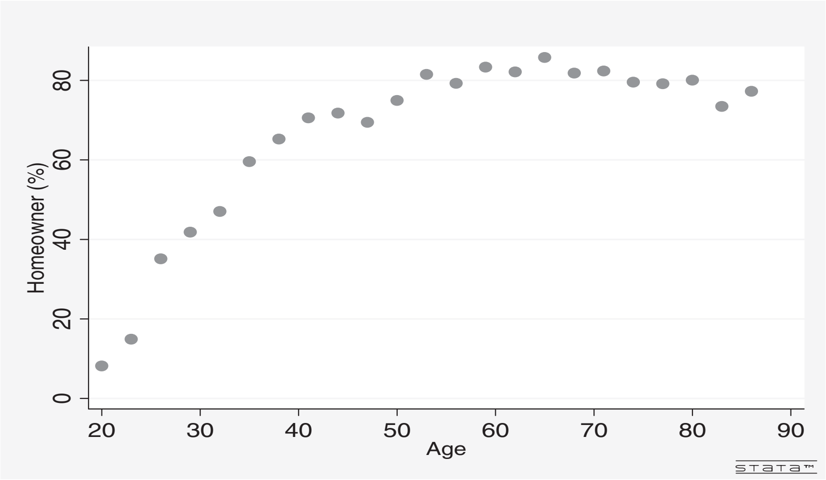

FIGURE 2. Homeownership by age (HILDA, 2002).

age 20 (denoted as $j = 1$ in the model), with zero financial assets. Initially, an exogenous fraction o of the households enter as homeowners (with an exogenous housing endowment), and the remaining $1 - o$ enter as renters. We use an indicator, I, to differentiate homeowners ($I = 1$) from renters ($I = 0$). Households work and receive earnings until the age of mandatory retirement, denoted as j^*. In each period, households face a positive probability of dying. The probability of dying is denoted by ν_j, which is the exogenously given survival probability at age $j + 1$ conditional on being alive at age j. The unconditional survival probability for an agent aged j is thus represented by $\prod_{t=1}^{j} \nu_t$. Households have a maximum life expectancy of 86 years (denoted as $J = 23$). Upon death, the net worth of the household is seized by the government.

3.2. Technology

There is a representative firm producing an aggregate output good Y under the standard Cobb–Douglas production function,

$$Y = K^{\alpha} L^{1-\alpha}, \tag{1}$$

where K and L are the aggregate physical capital stock and labor input, respectively. Aggregate output can either be consumed or invested in physical or housing capital. Let I^k and I^h denote the aggregate investment in physical capital and housing capital, respectively. The aggregate resource constraint is

$$Y = C + I^k + I^h + \Pi + G, \tag{2}$$

where C denotes aggregate consumption of nonhousing goods, Π denotes housing transaction costs, and G denotes government purchase. In addition, business capital and housing capital depreciate at rates δ^k and δ^h, respectively.

3.3. Preferences

Households derive utility from the consumption of nonhousing goods, c, and from the flow of services from housing stock, $f(h)$, as well as from bequests, q, left upon death. Deriving utility from leaving bequests (or the "warm glow" bequest motive) is a simple way to incorporate bequests into the model without introducing the complexities of intergenerational strategies. The service flow from housing, $f(h)$, is proportional to the housing stock h.

The instantaneous utility function reflects the empirical evidence on the nonlinearity of the housing-to-nonhousing consumption ratio, as suggested by Jeske (2005) and employed in Chambers et al. (2009), given as

$$U(c, f(h)) = \omega \frac{c^{1-\sigma_1}}{1-\sigma_1} + (1-\omega) \frac{f(h)^{1-\sigma_2}}{1-\sigma_2}, \tag{3}$$

where the parameter ω measures the importance of nonhousing consumption relative to housing expenditures, whereas σ_1 and σ_2 are the curvature parameters with respect to nonhousing and housing consumption.

As for the utility derived from leaving bequests, q, we incorporate a nonhomothetic bequest motive and follow the specification by De Nardi (2004), denoted as

$$\varphi(q) = \varphi_1 \left[1 + \frac{q}{\varphi_2}\right]^{1-\sigma_q}. \tag{4}$$

The term φ_1 reflects the degree of bequest motive, whereas φ_2 measures the extent to which bequests are luxury goods. The curvature parameter σ_q governs the relative risk aversion for the bequest in the utility function.

3.4. Income Dynamics

Prior to the retirement age, denoted as j^*, households are endowed with one unit of time, which is supplied inelastically. Households also face the same exogenous age-efficiency profile, ϵ_j, during the working years. This profile is estimated from the data and reflects the fact that productive ability changes over the life cycle. Each unit of effective labor is paid the wage rate w. Working households are also subject to stochastic shocks to their productivity level (denoted as υ_j) that are positively correlated over time. These shocks are represented by a finite-state Markov process with a transition function Q_υ, which is identical for all households. Hence, the total productivity of a worker of age j is given by the product of the stochastic productivity of a worker in that period and the age-efficiency index of the worker: $y_j\epsilon_j$. Working households also pay social security payroll taxes on their labor earnings. Upon retirement, households receive a pension benefit, b, that depends on their assets, homeownership status, and age, and is defined by

$$b(j, a, I) = \max\{0, \min\{\bar{b}, \bar{b} - b_1[a_j - (I\bar{a}_o + (1-I)\bar{a}_r)]\}\}, \tag{5}$$

where $\bar{b}$ is the maximum pension benefit. With assets higher than the cutoff levels $\bar{a}_o$ and $\bar{a}_r$ for homeowners (denoted with indicator I) and renters, respectively, the pension receipt is reduced by the taper ratio b_1.

Let y denote the sum of after-tax income expressed as a function of age (j), financial net worth (a), and productivity shock (υ):

$$y(j, a, I, \upsilon) = \begin{cases} (1-\tau)w\epsilon\upsilon & \text{if} \quad j < j^* \\ b(j, a, I) & \text{if} \quad j \geq j^*. \end{cases} \tag{6}$$

3.5. Housing and Tenure Choice

In the economy, households may either own or rent a house. If the household decides to rent, a rental payment of p is paid to the rental agency per unit of housing service. The household may also decide to become a homeowner and purchase a house of size h.

We assume a minimum housing size, $\underline{H}$, for owner-occupied housing, to capture the lumpiness and indivisibility of housing investment. This constraint was previously introduced by Cocco (2005) and Gervais (2002), among others. The constraint on minimum owner-occupied housing size is as follows:

$$h_j \geq \underline{H} \quad \forall j. \tag{7}$$

Homeowners may decide whether to keep their current houses or to sell and move. Homeowners also pay a maintenance cost equal to the level of depreciation, δ^h, in the period during which the house is owner-occupied. In addition, buying or selling a house incurs a transaction cost, which is a fraction ϕ^s of its selling value and ϕ^b of its purchase value:

$$\phi(h_j, h_{j+1}) = \begin{cases} \phi^s h_j + \phi^b h_{j+1} & \text{if} \quad h_{j+1} \neq h_j \\ 0 & \text{if} \quad h_{j+1} = h_j. \end{cases} \tag{8}$$

Owning a house provides several benefits. Homeowners may use their houses as collateral and borrow up to a fraction κ of the housing value in the next period. The collateral constraint for a household of age j is

$$a_{j+1} \geq -\kappa h_{j+1} \quad \forall j, \tag{9}$$

where a_{j+1} is the financial net worth. On the other hand, renters are not allowed to borrow, because they do not own a collateral asset. In addition, homeowners derive higher utility from housing services than renters. Following Ortalo-Magné and Rady (2006), we assume that a renter derives only a fraction $\lambda < 1$ of the utility that a homeowner derives with the same housing stock. Thus, we conclude that $f(h) = Ih + (1-I)\lambda h$. Finally, housing assets may also be added to bequests, from which agents derive utility.

3.6. Rental Agency

The rental market in the economy is operated by a rental agency. Following Gervais (2002), this rental agency is a two period–lived institution that takes deposits, D_t, in the first period and buys rental properties, S_t, as well as issuing loans B_t to households. Unlike business capital, which must satisfy a one-period time-to-build constraint, residential capital may be rented immediately on purchase. In the second period, the agency receives payments for rental units, pS_{t+1}, and interest from loans extended to households, rB_{t+1}, and pays the depreciation costs of the rental properties ($\delta^h S_{t+1}$) and the interest on the deposits (rD_{t+1}). At the end of the second period, the existing institution sells the undepreciated part of the residential stock to a new institution. The problem of the rental agency is formulated as follows:

$$\begin{array}{ll}\max\limits_{S_{t+1},B_{t+1},D_{t+1}} & pS_{t+1} + rB_{t+1} - \delta^h S_{t+1} - rD_{t+1} \\ \text{subject to} & S_{t+1} + B_{t+1} \quad \leq \quad D_{t+1}.\end{array} \tag{10}$$

For this maximization problem to be a well-defined one, the following no-arbitrage condition needs to be satisfied in a stationary equilibrium with constant prices:

$$p = \delta^h + r. \tag{11}$$

This implies that renting out a property and receiving the rental payment net of the maintenance costs yields the same profit as receiving interest income. In other words, in a stationary equilibrium with constant prices, the rental rate on housing is uniquely determined, given the interest rate and depreciation rate.

3.7. Government and Taxation

An infinitely lived government taxes labor earnings at a proportional rate τ on working households, and uses the tax revenues to provide a pension benefit b to each retiree. In addition, the government collects the bequests of the decedents. A portion of the revenues is used to provide housing endowment to initial homeowner cohorts (denoted as G in equation (2)), whereas the remainder is used for public purchases that are not explicitly included into our model design. For simplicity, we abstract information from other sources of government taxation, expenditures, and debt.

3.8. Household Recursive Problems

This subsection describes the recursive problem faced by the households in different states. The state space is a vector $\mathbf{x} = \{j, a, h, I, \upsilon\}$, where j is the age of the household, h is the stock of housing, a is financial net worth (financial assets less all liabilities), I is a housing tenure status indicator, and υ is the productivity shock. Households choose their housing tenure for the next period by comparing the value of owning a house with that of renting. The value function $V(\mathbf{x})$ is given as $V(\mathbf{x}) = \max\{V^o(\mathbf{x}), V^r(\mathbf{x})\}$, where V^o and V^r denote the value of owning and renting, respectively.

If agents choose to own ($I' = 1$), then the value function $V^o(\mathbf{x})$ is given by

$$V^o(j, a, h, I, \upsilon) = \max_{c,a',h'} \big[U(c, f(h')) + \nu\beta\mathbf{E}V(j+1, a', h', 1, \upsilon') \\ +(1-\nu)\varphi(a'+h')\big]$$

s.t.

$$c + a' + h' + \phi(Ih, h') \leq y(j, a, I, \upsilon) + (1 + r)a + I(1 - \delta^h)h \quad \textbf{(12)}$$

$$h' \geq \underline{H} \quad \textbf{(13)}$$

$$a' \geq -\kappa h' \quad \textbf{(14)}$$

$$c \geq 0. \quad \textbf{(15)}$$

If agents choose to rent ($I' = 0$), then the value function $V^r(\mathbf{x})$ is as follows:

$$V^r(j, a, h, I, \upsilon) = \max_{c, a', h'} \big[U(c, f(h')) + \nu\beta \mathbf{E} V(j + 1, a', 0, 0, \upsilon') + (1 - \nu)\varphi(a')\big]$$

s.t.

$$c + a' + ph' + \phi(Ih, 0) \leq y(j, a, I, \upsilon) + (1 + r)a + I(1 - \delta^h)h \quad \textbf{(16)}$$

$$c, a', h' \geq 0.$$

3.9. Definition of Stationary Equilibrium

A stationary equilibrium is represented by a set of government policy arrangements $\{\tau, b(\mathbf{x})\}$; prices $\{p, r, w\}$; value functions $V(\mathbf{x})$, $V^r(\mathbf{x})$, $V^o(\mathbf{x})$; allocations $c(\mathbf{x})$, $a'(\mathbf{x})$, $h'(\mathbf{x})$; a time-invariant distribution of agents over the state variables $\mathbf{x} = \{j, h, a, I, \upsilon\}$, $m^*(\mathbf{x})$; and aggregate quantities $\{Y, C, H, K, L, S, D\}$, such that, given the prices and the government policies,

(i) The functions $c(\mathbf{x}), a'(\mathbf{x}), h'(\mathbf{x})$ solve the maximization problem of the households presented in Section (3.8).

(ii) Factor prices are equal to their marginal products:

$$r = F_K(K, L) - \delta^k,$$
$$w = F_L(K, L).$$

(iii) The government budget is balanced:

$$\int_{j<j^*} \tau w L \, m^*(dx) = \int_{j \geq j^*} b(j, a, I) \, m^*(dx). \quad \textbf{(17)}$$

(iv) m^* denotes the invariant distribution for the economy.

(v) All markets clear:

$$C = \int c \;\; m^*(dx),$$

$$H = \int_{I=1} h \;\; m^*(dx),$$

$$S = \int_{I=0} h \;\; m^*(dx),$$

$$L = \int \epsilon \upsilon \;\; m^*(dx),$$

$$K = \int a \;\; m^*(dx) - S.$$

4. CALIBRATION

The set of parameters is divided into those that can be estimated independent of the model or are based on the estimates provided by other literature and data, and those that are chosen so that the predictions generated by the model match a given set of targets. All parameters were adjusted to the three-year time span that each period in the model represents. Table 1 lists the parameters provided by other literature and data for the first group of calibrated parameters.

TABLE 1. Parameter definitions and values

	Preference	
σ_1	Risk-aversion coefficient (nonhousing)	3
σ_2	Risk-aversion coefficient (housing)	1.5
σ_q	Risk-aversion coefficient (bequest)	1.5
ϕ_1	Bequest parameter	−17
ϕ_2	Bequest parameter	11.6
λ	Utility premium	0.9
	Technology	
α	Capital income share	0.264
δ^h	Housing depreciation rate	5.7%
δ^k	Business capital depreciation rate	9.1%
ϕ^s	Selling transaction cost	4%
ϕ^b	Buying transaction cost	2%
κ	Loan-to-value ratio	75%
	Stochastic Process	
υ	Income shock	See text
ρ	Persistence process	0.90
σ_υ^2	Variance process	0.16
	Demographics	
j^*	Retirement age	65
ν_j	Survival probability	ABS Life Table
ϵ_j	Age-efficiency profile	Gruen and Garbutt (2003)
o	Homeownership ratio for 20–25 year–olds	8%

Regarding the preference parameters, standard constant relative risk aversion (CRRA)–type utility functions with $\sigma_1 = \sigma_2$ are not consistent with the data on consumer behavior, which show that income increases are more likely to be consumed in housing than in nonhousing consumption. Jeske (2005) observes an increasing ratio of housing services to consumption with age, where a larger fraction is allocated to housing as income increases. Different values for σ_1 and σ_2 may effectively capture the nonlinearity of the housing-to-nonhousing consumption ratio. We follow the method of Chambers et al. (2009) and allow the marginal utility from an increase in housing services to decline more slowly than the marginal utility of nonhousing consumption, which implies that individuals will allocate a larger fraction of a given increase in income to housing.

For the bequest parameters, σ_q and ϕ_2 are extracted from De Nardi (2004), whereas ϕ_1 is selected to account for the slow run-down of wealth during retirement. We pin down the value of ϕ_1 such that the average wealth of cohorts aged 70 and above is approximately 50% of the wealth of cohorts aged 60–69. For λ, which measures the degree of preference for homeownership over renting by households, we select a value of 0.9.[2]

In the aggregate production function, we use the national accounts data for periods 1960 to 2007, to find the share of income attributed to physical capital, α, at 26.4%, whereas the annual depreciation rates of the capital stock and the housing stock are 9.1% and 5.7%, respectively. For the transaction cost parameters, ϕ^s and ϕ^b, we obtain values from the Global Property Guide (http://www.globalpropertyguide.com/). We take the average loan-to-value ratio, κ, to be 75%, which is consistent with the figure used in Jappelli and Pagano (1994) for Australia.

The logarithm of the stochastic productivity process is assumed to be an AR(1) following Huggett (1996):

$$\ln y_t = \rho \ln y_{t-1} + \mu_t. \tag{18}$$

The disturbance term μ_t is normally distributed with mean zero and variance σ_y^2. The persistence parameter ρ is taken from De Nardi (2004) and adjusted to reflect the time difference, whereas the variance σ_y^2 is chosen to match the Gini coefficient for earnings.[3] We approximate the productivity shocks by using a four-point discrete Markov chain as defined by Tauchen and Hussey (1991). The grid points for the income process (normalized to 1) that we use are $\{0.2115, 0.7424, 1.3471, 3.2106\}$, and the transition matrix Q_y is given as

$$\begin{Bmatrix} 0.7722 & 0.2081 & 0.0194 & 0.0003 \\ 0.2081 & 0.5245 & 0.2480 & 0.0194 \\ 0.0194 & 0.2480 & 0.5245 & 0.2081 \\ 0.0003 & 0.0194 & 0.2081 & 0.7722 \end{Bmatrix}.$$

TABLE 2. Parameters to match target ratios

Parameter	Definition	Value
β	Discount factor	0.900
$\underline{H}$	Minimum housing size	46% of average income
ω	Share of nonhousing consumption	0.910

For age pension benefits, we use Australian Centrelink 2007 data for couples to set the maximum annual benefit at $23,754. For homeowners, every additional dollar above the threshold financial asset level of $243,000 reduces the pension benefit by 3.87 cents, whereas for renters, this threshold is $368,000. For homeowners with assets above $856,000, and renters with assets above $981,000, there is no more pension benefit. Equations (19) and (20) summarize the age pension plan for homeowners and renters, with all units being normalized by the annual average household household income ($60,489) derived from the HILDA survey for 2007. Because we assume that the government balances its budget, the resulting payroll tax rate on working households is endogenously determined at 10.7%:

$$b = \begin{cases} 0.39 & \text{if } a \le 4.0 \\ 0.39 - 0.0387(a - 4.0) & \text{if } 4.0 < a \le 14.2, \\ 0 & \text{if } a > 14.2 \end{cases} \tag{19}$$

$$b = \begin{cases} 0.39 & \text{if } a \le 6.0 \\ 0.39 - 0.0387(a - 6.0) & \text{if } 6.0 < a \le 16.2 \\ 0 & \text{if } a > 16.2\,. \end{cases} \tag{20}$$

For demographics, the deterministic age-efficiency profile ϵ_j for Australia is calculated from the mean age-earnings profile from Gruen and Garbutt (2003).[4] For lifetime uncertainty, the conditional survival probabilities for retired households aged 65 and above are taken from the Australian Bureau of Statistics Life Table 2003–2005. We take exogenously the fraction of homeowners for the households entering the life cycle at 8%, which is taken from the HILDA data.[5]

The next three parameters, β, $\underline{H}$, and ω, are jointly chosen so that the predictions generated by the model match a given set of targeted aggregate ratios, as shown in Table 2. The first aggregate target is the physical capital-to-output ratio, $\frac{K}{Y}$. Physical capital stock is the sum of private and government nonresidential fixed assets and inventories, whereas output is defined as gross domestic product minus expenditure on housing services. In Australia, the average capital–output ratio over the period 1960–2007 was 2.29. The second target ratio is the aggregate homeownership ratio, which is around 66% in Australia, based on the HILDA survey. The third target ratio is the housing capital to output ratio, $\frac{H}{Y}$. Housing capital corresponds to the stock of owner-occupied and rental properties. This ratio is 0.96 in Australia over the period 1960–2007.

TABLE 3. Aggregate statistics for benchmark simulation

	Benchmark simulation	Data
Physical capital-to-output ratio ($\frac{K}{Y}$)	2.291	2.29
Housing capital-to-output ratio ($\frac{H}{Y}$)	0.958	0.96
Homeownership ratio	65.9%	66.0%
Consumption-to-output ratio ($\frac{C}{Y}$)	0.694	0.72
Fraction of pensioners receiving		
more than 90% of maximum benefit	78.0%	73%
less than 25% of maximum benefit	7.5%	3%

5. BENCHMARK RESULTS

In this section, the results from the benchmark simulation are presented and the fit of the model is evaluated along the dimensions not specifically matched by model construction, such as consumption-to-output ratio, age–wealth profile, and wealth distribution. A good fit of the model, with respect to the data that were not matched by construction in our calibration procedure, increases the validity of the policy predictions generated by our simulated model.

5.1. Aggregate and Life-Cycle Profiles

Although calibrated to match a number of key aspects of the data, our benchmark framework matches the observed consumption-to-output ratio, and provides a reasonable replication of the distribution of age pensioners.[6] The aggregate statistics of the model-generated data, as well as the empirical counterparts for Australia, are presented in Table 3.

We also construct the life-cycle profiles of net worth, housing assets, and homeownership for an average household from the simulation. Figures 3 and 4 depict the profiles of assets and homeownership rates over the life cycle, respectively. With a bequest motive, the model is able to generate sufficient wealth (and financial assets) at advanced ages, which matches the data-derived counterpart shown in Figure 1. The model also captures the profile of the housing assets observed in the data, with rapid accumulation early in life until the 50s and almost no downsizing after retirement. The former is attributed to the role of housing as collateral, whereas the latter is explained by the existence of transaction costs, and the fact that some older households may take on reverse mortgages and assume debts. For the age profile of homeownership, the model correctly replicates the hump-shaped profile of homeownership over the life cycle.

5.2. Distribution of Wealth

In this section, we consider the summary statistics implied by the model of the distribution of wealth summarized in Table 4. The model produces a close match

 https://doi.org/10.1017/S1365100512000041

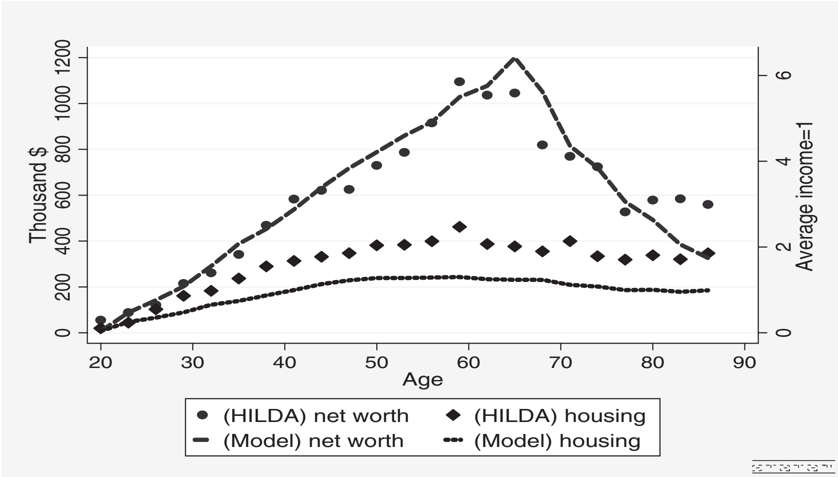

FIGURE 3. Life-cycle profile of assets (wealth accumulation by age; HILDA vs. model).

to the data counterpart in terms of the Gini coefficient of net worth. As for the skewness of the wealth distribution, although the model does not produce sufficient heterogeneity in the upper tail of the distribution, it exactly matches the wealth held by the top 20% and closely replicates the wealth held by the top 40%. For the lower tail of the wealth distribution, our model-generated data produce percentile ratios of the 10th percentile to the median and of the 25th percentile to the median, as

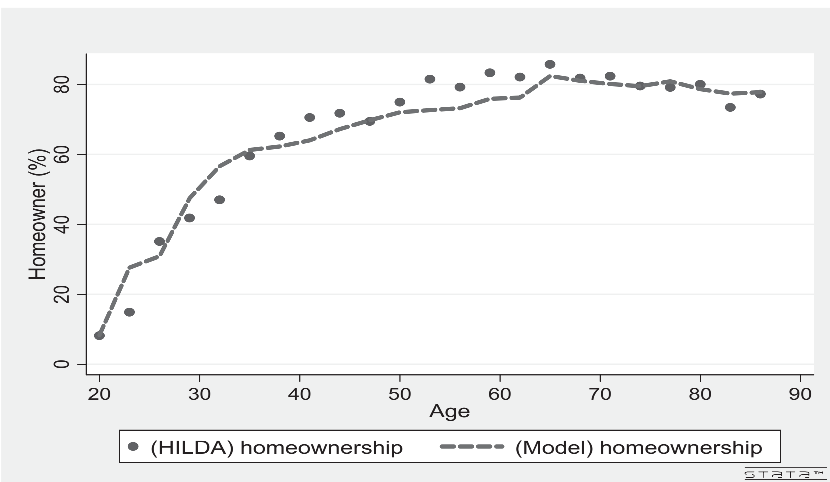

FIGURE 4. Life-cycle profile of homeownership (home owenership by age; HILDA vs. model).

TABLE 4. Distribution of wealth

	Benchmark simulation	HILDA 2002
Percentage wealth held by top		
10%	41.1%	47%
20%	64.5%	65%
40%	87.7%	85%
Gini financial	0.680	0.75
Gini housing	0.589	0.62
Gini net worth	0.632	0.64
Percentile ratios		
p10/p50	0.016	0.02
p25/p50	0.196	0.22
Avg/p50	2.309	1.93
p75/p50	3.242	2.18

well as a mean-to-median ratio, consistent with that observed in real world data. The fact that the model produces a well-fitted distribution of wealth is derived from the idiosyncratic shocks to productivity during the working life, as well as introducing heterogenous bequest motives during retirement.

6. POLICY EXPERIMENTS

From the previous section, we note that our framework matches the observed aggregate ratios, as well as replicating the distribution of wealth and life-cycle profiles for the average age cross section. The fact that such a simple model successfully achieves this along all of these dimensions increases the validity of the policy implications that it generates, which we consider in this section. Specifically, we consider the effect of changing the age pension benefit plan. First, we explore the possibility of including the housing asset as part of the current means-testing scheme for homeowners. Second, we retain the current means-testing scheme, but introduce a limit on the value of exemption for owner-occupied housing. For the limiting value, we use the difference between the full pension cutoff levels for homeowners versus renters under the current means testing scheme. Any housing assets above this limit are now included in the assets means testing. Finally, we look at the case of replacing the current means-testing scheme with a constant pension benefit scheme for all retired households.

For every experiment, we distinguish what we consider "short-run" and "long-run" effects of an unexpected policy change. In the former, we calculate how many agents will be immediately affected in pension benefits and also summarize the distribution of assets for each types of agents when the new policy is announced under the benchmark steady state. On the other hand, in the latter, we compute the new steady state where agents will reoptimize and prices and government payroll taxes will readjust, and compare the aggregate and life-cycle statistics, wealth

TABLE 5. Housing assets in means testing: short-run impacts

	Percentage (%)	Financial	Housing	Net worth
Full pensioner → full pensioner	58.3	13.3	48.8	22.5
Full pensioner → part pensioner	9.6	90.1	122.6	98.5
Part pensioner → part pensioner	22.1	188.4	173.8	184.6
Part pensioner → no pensioner	4.0	336.9	210.3	303.7
No pensioner → no pensioner	6.0	472.8	216.6	405.8

distribution, and disaggregated welfare. To maintain the condition of revenue neutrality, we adjust the payroll tax rate in the first two experiments, whereas in the final experiment, we fix the tax rate to be the same as in the benchmark case, and adjust the pension level instead.

6.1. Full Inclusion of Housing into the Assets Means Testing

We first explore the implications of including housing assets to the current means-testing scheme. We assume that the taper rate on the housing asset is identical to that on the financial asset, which will now affect all homeowners. The new age-pension plan for homeowners is summarized as follows:

$$b = \begin{cases} 0.39 & \text{if } \ a + h \leq 4.0 \\ 0.39 - 0.0387(a + h - 4.0) & \text{if } \ 4.0 < a + h \leq 14.2 \\ 0 & \text{if } \ a + h > 14.2\,. \end{cases} \qquad (\mathbf{21})$$

For renters, we maintain the current scheme.

First, we look at the short-run effect by identifying which agents among homeowners aged 65 and above will be directly affected by the policy reform. Roughly 14% of the population group who are full pensioners will face reductions in their pension benefits, whereas 15% of the part pensioners will no longer be eligible for pension benefits. In Table 5, we report the percentages of different types of households as a fraction of total owner-occupied households aged 65 and above in the first column. Those who are currently receiving a full pension but will now be subject to a lower pension benefit, as well as those who are currently receiving a part pension benefit but will no longer be subject to an age pension, are reported in the second and the fourth row, respectively. In the other columns, we report the average portfolios of these subgroups in comparison with the average owner-occupied retirees (normalized to 100 for each types of assets).

For the long-run effects, we first report the changes in the aggregate statistics as well as the distribution of wealth in Table 6.

We expect that our policy reform will remove the distortionary incentive to overinvest and overconsume in housing. Our experiment results in an increase in the physical capital-to-output ratio and a reduction in the housing capital-to-output ratio. This shift from housing to physical capital reflects the fact that the current

TABLE 6. Housing assets in means testing: comparing the steady states

	Benchmark	Housing in means testing
Physical capital-to-output ratio (K/Y)	2.291	2.307
Housing capital-to-output ratio (H/Y)	0.958	0.928
Homeownership ratio	65.9%	65.6%
Consumption-to-output ratio (C/Y)	0.694	0.694
Percent changes in		
Output (Y)	—	0.25%
Physical capital (K)	—	0.94%
Housing capital (H)	—	−2.83%
Consumption (C)	—	0.38%
Interest rate (r)	3.23%	3.12%
Payroll rax rate (τ)	10.7%	10.1%
Fraction of pensioners receiving		
More than 90% of maximum benefit	78.0%	73.4%
Homeowners	58.1%	52.5%
Renters	19.9%	20.9%
Less than 25% of maximum benefit	7.5%	12.2%
Percentage wealth held by top		
10%	41.1%	41.6%
20%	64.5%	64.7%
40%	87.7%	87.6%
Gini financial	0.680	0.685
Gini housing	0.589	0.590
Gini Net worth	0.632	0.635

exemption of owner-occupied housing from means testing acted as a wedge on the portfolio choice between financial and housing assets, and the removal of this wedge lowered the fraction of wealth held in housing. A higher stock of physical capital implies that more funds are invested in the more productive technology, which in turn will raise the aggregate output. As we include housing in means testing, government pension expenditure decreases. Hence, to maintain the budget balance condition, we note that the tax rate is reduced by 0.6 percentage point. In the long run, a lower tax rate subsequently raises total output and physical capital stock, as well as consumption. The increase in investment is further amplified by a reduction in the interest rate, which will have a welfare impact across different households. As for the aggregate homeownership, the ratio decreases, but only marginally, by 0.3 percentage point. Although the inclusion of housing in means testing will lower homeownership, this is partly offset by a decrease in the interest rate, which will reduce the borrowing cost for potential first-time home buyers and increase homeownership for younger cohorts.

For the distribution of pensioners, including housing in means testing removes the opportunity for very high levels of wealth to be sheltered from the means test. This implies that some homeowners, who previously received a full pension

TABLE 7. Housing assets in means testing: comparing age profiles

Age cohort	Housing (%)	Net worth (%)	Homeownership (%)	High pension (%)	Low pension (%)
53–58	0.42	0.48	2.30	—	—
59–64	−6.13	0.98	2.15	—	—
65–70	−13.44	1.20	−4.96	−5.34	0.85
71–76	−16.65	−0.83	−0.36	−5.77	0.26
77+	−15.05	−5.23	−0.89	−5.40	0.70

benefit, will no longer be eligible, and those who received a part pension benefit will no longer receive an age pension. Quantitatively, the fraction of households receiving less than 25% of the maximum benefit increases by 4.7 percentage points, whereas the number of pensioners receiving close to the maximum benefit decreases by 4.6 percentage points.

As for distribution of wealth, it is interesting to note that wealth inequality changes very little, but with a higher percentage of wealth held by the top percentiles of the population, as well as higher Gini coefficients, implying, if anythings, worsening inequality.

We also report the average profiles of wealth and homeownership in Table 7 for different age cohorts: those close to retirement are represented in the first two cohorts (aged 53–58 and 59–64), and the retirees are grouped into three cohorts (aged 65–70, 71–76, and 77 and above). The first two columns show the percentage change in the profiles of housing and net worth, whereas the third column shows the percentage change in the homeownership ratio. The last two columns show the fraction of age cohorts that receives more than 90% of the full pension benefit (denoted as "High pension") and less than 25% of the full pension benefit (denoted as "Low pension"). For the housing profile, the downward adjustment starts in the cohort prior to retirement and gains pace for households after retirement, as housing no longer offers a shelter for wealth from means testing. Shifting household portfolios toward interest-bearing financial assets increases the overall profile of net worth for all households aged below 70. For cohorts aged 71 and above, the profile of net worth is smaller than the benchmark profile, which indicates that retired households decumulate wealth more quickly when housing is included in means testing. As for the homeownership ratio, the profile is consistently higher for all age cohorts prior to retirement and lower for those after retirement. This is in part due to a decline in the interest rate and a lower rental price that makes renting a more attractive option than homeownership for working-age households. The greatest decline in homeownership takes place among those who just enter into retirement.

Finally, Table 8 displays the welfare gains and losses for this reform. For our welfare analysis, we take an approach similar to the method employed by Cagetti and De Nardi (2009). In that paper, at the time of the announcement of the reform,

Table 8. Housing assets in means testing: welfare changes

	Housing in means testing (%)
Lowest quintile	1.77
Second quintile	0.94
Middle quintile	0.77
Fourth quintile	0.01
Highest quintile	−1.17
Top 10%	−2.06
Average	0.43

the distribution of households' net worth (regardless of young or old) is recorded. Then the average welfare cost or benefit expressed in terms of the fraction of consumption needed to have someone indifferent between the pre- and postreform is displayed. Because our model has two consumption goods, we replaced the consumption index with instantaneous average utility (not including utility from bequest). We then look at the cross-sectional distribution net worth in the initial benchmark steady state and order households into different quintiles regardless of age or homeownership status. After the reform, when people reoptimize and prices and government payroll tax rates readjust, we trace the change in the average utility of cohorts in different quintiles.[7] Positive numbers indicate gains from the pension reform. On average, we report a long-term welfare gain from this reform. Despite the fall in housing consumption, the gains in average welfare reflect a larger increase in nonhousing consumption. However, when we disaggregate according to wealth percentiles, we note the presence of some gains and some losses from the reform. The intuition is that an increase in the wage rate will favor those with a higher fraction of wage earnings in their total income, whereas a fall in the interest rate will hurt those with a higher fraction of asset earnings in their income. More specifically, the lowest quintile cohort benefit the most from the reform, whereas the richest lose the most, with the top 10% of the wealth distribution losing up to 2% of their average utility. The fact that the poor benefit more than the rich in this policy may arise as a result of several different channels. One source may be a lower payroll tax rate, benefitting labor income earners, who are typically young but also less wealthy. Working households also benefit, because of an increase in wages resulting from a higher accumulation of aggregate capital. For the working households in the lower tail of the wealth distribution, wage income composes the majority of total income. In comparison, a lower interest rate causes those who derive more of their income from assets to become worse off. Households in the highest wealth quintile also tend to be homeowners, and, depending on their age, they either are likely to receive less pension benefit upon retirement, or are already retired and experience a reduction in pension benefits.

TABLE 9. Means testing with exemption limit on housing: short-run impacts

	Percentage (%)	Financial	Housing	Net worth
Full pensioner → full pensioner	66.6	22.7	56.2	31.4
Full pensioner → part pensioner	1.3	101.3	209.4	129.6
Part pensioner → full pensioner	1.8	117.8	83.2	108.8
Part pensioner → part pensioner	23.7	213.9	185.2	206.4
Part pensioner → no pensioner	0.7	361.9	236.7	329.1
No pensioner → no pensioner	6.0	472.8	216.6	405.8

6.2. Means Testing with a Limit on the Value of the Housing Exemption

In this policy experiment, we retain the current means-testing scheme but introduce a limit on the value of the exemption for owner-occupied housing. As for the limiting value, we use the difference between the full pension cutoff levels for homeowners versus renters.[8] Any housing asset above the limit of \$124,500 is included in the asset means testing. Taking this into account, an alternative pension plan for homeowners is summarized in:

$$b = \begin{cases} 0.39 & \text{if } a + h \leq 6.0 \\ 0.39 - 0.0387(a + h - 6.0) & \text{if } 6.0 < a + h \leq 16.2 \\ 0 & \text{if } a + h > 16.2\,. \end{cases} \qquad \textbf{(22)}$$

Compared to the previous experiment, this reform is considered a moderate alternative to the current means-testing scheme, as the exemption of owner-occupied housing has always been a core feature in the Australian context since the introduction of the assets test in 1985. It would indicate whether the current structure of applying different cutoff rules for homeowners and renters is adequate to minimize possible distortions. Compared to the first policy experiment, where all housing assets are incorporated into means testing, we may consider the second experiment, in which we maintain the exemption of housing assets from means testing but impose a limit to exemption, to be more realistic and plausible. Quantitatively, we expect that the magnitude of changes occurring under the second experiment is smaller than that under the first one, as homeowners with low housing value are still eligible for the maximum age pension benefit.

First, we analyze the short-run effect by identifying which types of agents (homeowners aged 65 and higher) will be directly affected by the policy reform. In the first column of Table 9, we report the percentages of different types of households as a fraction of total owner-occupied households aged 65 and above. In contrast to the first experiment, which causes only a downward mobility for pensioners, in the second experiment, we see both downward and upward mobility for pensioners, as some part pensioners (who had relatively high financial assets but low housing assets) are now eligible for the full pension benefit. In fact, roughly 1.5% of full pensioners will now become part pensioners, whereas 4%

TABLE 10. Means testing with exemption limit on housing: comparing steady states

	Benchmark	Housing with exemption limit
Physical capital-to-output ratio (K/Y)	2.291	2.312
Housing capital-to-output ratio (H/Y)	0.958	0.931
Homeownership ratio	65.9%	65.9%
Consumption-to-output ratio (C/Y)	0.694	0.693
Percent changes in		
Output (Y)	—	0.32%
Physical capital (K)	—	1.21%
Housing capital (H)	—	−2.46%
Consumption (C)	—	0.25%
Interest rate (r)	3.23%	3.12%
Payroll rax rate (τ)	10.7%	10.6%
Fraction of pensioners receiving		
More than 90% of maximum benefit	78.0%	77.9%
Homeowners	58.1%	57.9%
Renters	19.9%	20.0%
Less than 25% of maximum benefit	7.5%	8.7%
Percentage wealth held by top		
10%	41.1%	41.4%
20%	64.5%	64.2%
40%	87.7%	87.7%
Gini financial	0.680	0.682
Gini housing	0.589	0.586
Gini net worth	0.632	0.632

of part pensioners will be full pensioners. As a result, the fraction of owner-occupied pensioners eligible for the full benefit increases slightly from 67.9% to 68.4%. In the other columns, we report the average portfolios of these subgroups in comparison to the average owner-occupied retirees (normalized to 100 for each types of assets). We note that those who move up in the pension scheme (shown in the third row) have significantly lower housing assets than those who move down to become part pensioners (shown in the second row). Compared to the first experiment, which penalizes all homeowners, the second experiment penalizes those who have disproportionately high housing assets but benefits those with relatively low housing assets.

Next, we investigate the changes in the aggregate statistics, as well as the distribution of wealth, as reported in Table 10.

The payroll tax rate adjustment that is needed to balance the government budget constraint in the final steady state is small. This tax decreases from 10.7% to 10.6%. Because only those with high levels of housing assets will be excluded from receiving the full pension benefit, we observe that the aggregate implications are smaller than in the previous case, although the same qualitative results are

TABLE 11. Means testing with exemption limit on housing: comparing age profiles

Age cohort	Housing (%)	Net worth (%)	Homeownership (%)	High pension (%)	Low pension (%)
53–58	−1.05	−0.15	2.21	—	—
59–64	−7.19	−0.08	3.98	—	—
65–70	−13.14	−0.31	−1.33	0.80	0.32
71–76	−14.78	−0.31	0.24	−0.32	0.36
77+	−8.65	0.63	−0.90	−0.88	0.52

retained. In other words, the policy reform partially removes overinvestment in housing and raises total output, physical capital stock, and consumption in the long run, although lowering the aggregate housing stock in the economy. The payroll tax rate is also lower than before, but to a lesser degree than in the first policy experiment.

For the distribution of pension benefits, the fraction of households receiving less than 25% of maximum benefit increases by 0.8 percentage point, whereas the fraction of pensioners receiving close to maximum benefit decreases by 0.1 percentage point. The Gini coefficient of net worth remain unchanged, whereas the percentage of wealth held by the top 10 percentiles records, if anything, a small increase. In contrast to the first experiment, where the Gini coefficients of both types of assets increase, the Gini coefficient of housing asset now falls, reflecting the objective of the second experiment, which targets homeowners with relatively high housing portfolios.

We also report the life-cycle profiles of wealth and homeownership in Table 11. As expected, housing assets decline for all households in the age cohorts, as they have less incentive to overaccumulate housing assets into retirement. As for the profile of net worth, because the decline in the tax rate is negligible, working households do not receive much benefit and the decrease in interest rate and asset income implies less incentive for saving and wealth accumulation. The homeownership ratio falls, with the largest fall occurring within the 65–70 age cohort.

Finally, Table 12 displays the welfare gains and losses for this reform. On the average, the long-term welfare gain from this reform is on the order of 0.1% of average utility. Similarly to the first policy experiment, we see a redistribution of wealth from the rich to the poor, with the largest benefit falling on the poorest fifth quintile, which is favored by a lower tax rate and a higher wage rate. Interestingly, the fourth quintile households gain from this reform, which may in part be due to the short-run impact, under which some previous part pensioner may now receive the full pension benefit. Those affected negatively are the wealthiest group, as they experience lower interest from asset accumulation; hence for the wealthy elderly, their housing assets are now subject to assets testing.

TABLE 12. Means testing with exemption limit on housing: welfare changes

	Housing in means testing with exemption limit (%)
Lowest quintile	0.94
Second quintile	0.27
Middle quintile	−0.06
Fourth quintile	0.40
Highest quintile	−1.05
Top 10 %	−1.29
Average	0.11

6.3. Constant Pension Benefit

We also explore the possible implications of eliminating the current means-testing scheme in favor of a constant–pension benefit scheme. One option for the government is to fix the payroll tax rate to the benchmark level at 10.7%, and adjust the constant benefit level. This results in the constant benefit level being around 34.2% of average household income, which is 12% lower than the full benefit level of the benchmark. The changes in aggregate statistics, as well as the interest rate, are reported in Table 13.

More than 80% of the retired households that once received close to the full pension benefit now receive a reduced benefit. The reduced pension benefit motivates younger working cohorts to save more to finance consumption during retirement. This will increase the overall wealth accumulation and result in a higher capital–output ratio, which is associated with a lower interest rate. A higher capital–output ratio will increase the wage rate, whereas a lower interest rate will reduce the price of rental units and decrease homeownership. Implementing a constant pension benefit will remove the wedge geared toward overinvesting and overconsuming in housing. Therefore, the fraction of wealth invested in housing is reduced, whereas overall physical capital stock increases by more than 6%. With a large increase in physical capital stock, the total output of the economy also increases by 1.67%, whereas aggregate consumption is now lower by on the order of 0.96%. With respect to the distribution of wealth, the magnitude of change is larger than in the previous two experiments, with the percentage of wealth held by the top percentiles and the Gini coefficient of all types of assets all consistently higher, which implies worsening wealth inequality. Part of the worsening of inequality is attributed to rich retirees, who did not previously qualify for pensions, now being eligible for lump-sum pension benefits.

We also report the life-cycle profiles of wealth and homeownership in Table 14. The major trend that we observe is that the housing profiles are unambiguously lower, and the older the household, the larger the decline in housing profile. We also observe a larger net worth for all age cohorts entering into retirement, which

Table 13. Abolishing means testing with constant benefits: comparing steady states

	Benchmark	Abolishing means testing
Physical capital-to-output ratio ($\frac{K}{Y}$)	2.291	2.400
Housing capital-to-output ratio ($\frac{H}{Y}$)	0.958	0.922
Homeownership ratio	65.9%	63.8%
Consumption-to-output ratio ($\frac{C}{Y}$)	0.694	0.676
Percentage changes in		
Output (Y)	—	1.67%
Physical capital (K)	—	6.47%
Housing capital (H)	—	−2.11%
Consumption (C)	—	−0.96%
Interest rate (r)	3.23%	2.70%
Pension benefit (% of average income)	38.7% (maximum)	34.2%
Percentage wealth held by top		
10%	41.1%	42.0%
20%	64.5%	65.2%
40%	87.7%	88.0%
Gini financial	0.680	0.682
Gini housing	0.589	0.596
Gini net worth	0.632	0.637

reflects the fact that abolishing means testing will remove the marginal tax on wealth. As for homeownership ratios, the profile is higher for working households, but lower for retired households, with the largest decline in homeownership for cohorts aged 77 and above.

Finally, Table 15 displays the welfare gains and losses for this reform. On the average, the economy suffers from long-term welfare loss as a result of this reform, on the order of 1.2% of average utility. Unlike the previous reforms, where a lower average utility from housing services was offset by a higher utility from nonhousing consumption, both housing and nonhousing consumption decrease under the

Table 14. Abolishing means testing with constant benefits: comparing age profiles

Age cohort	Housing (%)	Net worth (%)	Homeownership (%)
53–58	−2.86	−0.59	2.08
59–64	−9.14	0.59	4.06
65–70	−11.82	3.96	−5.46
71–76	−16.36	11.07	−15.68
77+	−17.10	25.81	−29.92

TABLE 15. Abolishing means testing with constant benefits: welfare changes

	Abolishing means testing (%)
Lowest quintile	0.94
Second quintile	−1.42
Middle quintile	−1.72
Fourth quintile	−1.65
Highest quintile	−1.37
Top 10%	−1.98
Average	−1.23

constant–pension benefit scheme. As expected, when considering disaggregated households, we observe that wage earners will gain, whereas asset-income earners will lose. As for retired households, most retirees will experience a reduction in their pension benefits, whereas a small group of rich retirees, who were not eligible for pensions, will now earn additional income. Among households of different wealth quintiles, households in the lowest quintile benefit from this reform. This may be explained by the fact that these households are mostly wage earners without any assets, who benefit from a large increase in the wage rate. As for the other quintiles, households that suffer the most are in the middle quintile, which is likely to include retired households. In addition to a reduction in pension benefits, these households are impacted the most, because asset income is also lower (as a result of a reduced interest rate). For households in the highest quintile, the majority receive a lower asset income, whereas retired households are likely to receive higher pension benefits.

7. CONCLUSION

In this study, we consider three different policy alternatives to the current pension scheme under which housing is exempt from assets means testing. Surprisingly, the aggregate implications are not uniformly transmitted to heterogeneous groups of the population. More specifically, removing the distortion caused by the current means-testing scheme generates aggregate welfare gains, but at the same time creates welfare costs for some segments of the population, particularly the wealthiest quintile. However, these costs could be offset by the gains for the remainder of the population, with increases in total output and capital.

It is important to note that the model abstracts from several important issues. In terms of modeling the housing market, our model abstracts from housing price fluctuations, which impacts the size of debt leverage and the distribution of wealth, as well as a number of preferential tax treatments of owner-occupied housing, such as the untaxed nature of imputed rent and capital gains tax provisions. For the latter, Cho and Francis (2011) look at the correlation between preferential tax treatment of owner-occupied housing and overconsumption of housing in the United States, which could be extended into Australian context. Second, this paper does not explicitly model mortgages, as there is no distinction between mortgages and financial assets. One can expect that the distortion embodied in the pension system affects both mortgage decisions and housing purchase decisions such that one can effectively reduce financial asset holding before retirement by paying off a mortgage. Third, one caveat of our welfare analysis is that we do not take into account the fact that some households may move into a different wealth quintile after the reform, nor the fact that demographic changes that might affect the distribution of wealth. An alternative method by Chen (2010) uses compensating variations to track agents differentiated by the types of shocks to labor productivity in the beginning of their life cycles. As for the means testing, the current Australian system also incorporates income tests, which we have abstracted in the current paper. For example, Kudrna and Woodland (2011) study the distortion of income test on labor supply, which gives a natural extension to our current framework to incorporate consumption, labor supply, and portfolio choices. We leave these issues for future development.

NOTES

1. Household age is determined as that of the oldest person in the household.
2. The parameter λ is a critical parameter because it strongly influences the desire to be a homeowner versus a renter. Smaller values of λ should result in more homeownership, ceteris paribus, and thus higher tax revenues from housing. To avoid biasing our results, we choose a value for λ that is consistent with recent studies by Gervais and Pandey (2008) and Kiyotaki et al. (2011).
3. The model-implied Gini coefficient for earnings is 0.419, which is very close to the number reported from OECD, "Levels and Trends in the Gini Coefficient of Market Income Inequality among the Working-Age Population."
4. Although this is not an estimated earnings profile, we find that the age profiles in Australia are similar to those in the United States, as evidenced by studies by Hansen (1993).
5. In the model, we assume that the initial cohorts with the highest productivity shock can start as homeowners with some exogenous probability, and their housing endowment is equal to $\underline{H}$.
6. Inclusion of income means testing would effectively lower the fraction of people receiving age pension benefit. Because of our focus on asset portfolio and homeownership, we abstract information from the income test.
7. We also report the welfare change for the top decile of the wealth distribution as well as the simple average of the welfare changes reported by cohorts in different deciles.
8. The cut-off levels are \$368,000 and \$243,500 for renters and homeowners, respectively.

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APPENDIX

A.1. VARIABLE DEFINITIONS

Variable	Definition
Nonhousing assets	Total of equity investments, cash investments, trusts, own bank accounts, joint bank accounts, children's bank accounts, redeemable insurance policies, retirees superannuation, nonretirees superannuation, other property value, collectibles, businesses, vehicles
Nonhousing equity	Nonhousing assets − debt
Housing assets	Value of family home
Housing equity	Housing assets − mortgage on home
Net worth	Housing + nonhousing assets − total debt

A.2. OPTIMAL CONSUMPTION RATIOS UNDER DIFFERENT SOCIAL SECURITY RULES

This section considers how the optimal consumption of housing and nonhousing goods would change under the different social security rules. Here, the social security benefit is denoted by $b_t = b_1 + b_2 a_t + b_3 h_t$, and we consider three possible cases:

1. Constant benefit scheme: $b_1 > 0$, $b_2 = b_3 = 0$.
2. Means testing on total assets: $b_1 > 0$, $b_2 = b_3 < 0$.
3. Means testing on financial assets: $b_1 > 0$, $b_2 < 0$, $b_3 = 0$.

Consider the case of retired homeowners changing housing in the next period $(t + 1)$ as follows:

$$\max_{c_t, h_{t+1}, a_{t+1}} E\left\{\sum_{t=1}^{T} \beta^{t-1}\left(\prod_{j=1}^{t} s_{j-1}\right)[U(c_t, f(h_t)) + (1 - s_t)\varphi(q_{t+1})]\right\}$$

subject to

$$\begin{aligned} c_t + a_{t+1} + h_{t+1} &\leq b_t + (1 + r_t)a_t + (1 - \delta^h)h_t \\ c_t &\geq 0 \\ a_{t+1} &\geq -\kappa h_{t+1} \\ q_{t+1} &= a_{t+1} + h_{t+1} \\ h_{t+1} &\geq \underline{H}\,. \end{aligned} \tag{A.1}$$

Because the household is retired, there are no stochastic shocks to productivity. Using the functional form for the instantaneous utility function shown in equation (3), the first-order conditions with respect to c_t, a_{t+1}, and h_{t+1} result in the following equations (with μ_t

denoting Lagrange multipliers for the budget constraint):

$$c_t: \quad \beta^{t-1}\prod_{j=1}^{t} s_{j-1}\omega c_t^{-\sigma_1} = \mu_t$$

$$a_{t+1}: \quad \beta^{t-1}\prod_{j=1}^{t} s_{j-1}(1-s_t)\varphi'(q_{t+1}) - \mu_t + (1+r_{t+1}+b_2)\mu_{t+1} = 0$$

$$h_{t+1}: \quad \beta^{t}\prod_{j=1}^{t+1} s_{j-1}(1-\omega)h_{t+1}^{-\sigma_2} + \beta^{t-1}\prod_{j=1}^{t} s_{j-1}(1-s_t)\varphi'(q_{t+1}) - \mu_t + (1-\delta^h+b_3)\mu_{t+1} = 0\,.$$

PROPOSITION 1. *Housing service consumption is higher under Plan 2 (means testing on financial assets only) than under other social security plans.*

Proof. Using the first-order conditions, we obtain the marginal rates of substitution between housing and nonhousing consumption,

$$\frac{h_{t+1}^{\sigma_2}}{c_{t+1}^{\sigma_1}} = \frac{1-\omega}{\omega}\frac{1}{r_{t+1}+\delta^h+b_2-b_3},$$

and rearranging gives

$$h_{t+1} = \left(\frac{1-\omega}{\omega}\frac{1}{r_{t+1}+\delta^h+b_2-b_3}\right)^{\frac{1}{\sigma_2}} c_{t+1}^{\frac{\sigma_1}{\sigma_2}}.$$

Under the constant benefit (plan 1), $b_2 = b_3 = 0$, and under means testing on total assets (plan 3), $b_2 = b_3$. Thus, the right-hand side of the equation collapses to $\left(\frac{1-\omega}{\omega}\frac{1}{r_{t+1}+\delta^h}\right)^{\frac{1}{\sigma_2}} c_{t+1}^{\frac{\sigma_1}{\sigma_2}}$. However, when the social security benefit depends on the level of financial assets only, $b_3 = 0$, whereas $b_2 < 0$. This leads to $\left(\frac{1-\omega}{\omega}\frac{1}{r_{t+1}+\delta^h+b_2}\right)^{\frac{1}{\sigma_2}} c_{t+1}^{\frac{\sigma_1}{\sigma_2}}$. Because $b_2 < 0$, the relative housing consumption will be higher under this social security scheme. ■