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Abstract

Several targeted welfare programs across the world have made owner-occupied housing exempt from the means test, such as the Supplementary Social Income (SSI) in the US and the age pension scheme in Australia. Relatively little is known about the impact of such exemption on household portfolio choice. We study the case of the Australian age pension scheme, and argue that current uncapped exemption may lead to distortionary incentives for very high levels of housing wealth to be sheltered from the means test. We set up a quantitative lifecycle framework, with business and housing investment, borrowing constraints, and wealth inequality, that is able to match a number of key features in the Australian economy. We find that abolishing the current exemption of owner-occupied housing in the assets test increases aggregate output, capital accumulation, and welfare, while lowering housing investment and homeownership. However, removing such distortions, however, does not necessarily imply that all households would be better off. The lowering of other taxes to maintain fiscal balance would result in households at the top of the wealth distribution experiencing a large welfare loss, however the majority of the population would benefit.

JEL classification : D31, E21, E62, H3, H55
Keywords : means-tested age pension, homeownership, lifecycle model, portfolio choice

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1 Introduction

Several targeted welfare programs across the world have designated owner-occupied housing as exempt from the means test, including the Supplementary Social Income (SSI) and Medicaid in the United States and the Pension Credit in the United Kingdom. Such exemption is likely to impact the portfolio choice 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 payment. The owner-occupier home is exempt from the means-test, and different asset test schedules apply to homeowners and non-homeowners.[1] About two million elderly Australians, or 75 percent of those aged 65 and above, receive the age pension (Harmer, 2008).

If exemption of the family-home does lead to over-investment in housing, then this may be a source of economic inefficiency, and has implications on 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 does comprise 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.[2] According to Bradbury (2008), high rates of home-ownership continue into post-retirement years in Australia, while they decline 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, Saez, and Shephard, 2008). In Australia, discussions have been centered around putting a cap on the exemption of housing from the means test (Henry, 2009). While the impact that owner-occupied exemption has on 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 lifecycle 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. While

[1] As of September 2010, a single home-owner can have non-housing assets worth \$181,750 and an income of less than \$146 per fortnight and receive the full pension. The pension is reduced by \$1.5 for every \$1,000 above \$181,750 up to \$659,250, the part-pension cut off, beyond which the person ceases to be a pensioner. The cut-offs for non-homeowners are higher. There are similar cut-offs for the income test, and the pension is reduced by 50 cents in the dollar for income over the full-pension cut-off.

[2] Australian Bureau of Statistics, Household Expenditure Survey, 2004.

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 that well along all of these dimensions helps validate the policy implications that are generated.

This paper evaluates the effects of three different alternative reforms to the current means-testing scheme. All three alternatives share a common feature to remove 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, while the second policy is more modest in the sense that we introduce a limit on the value of 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 asset into the current means-testing scheme implies that we remove the wedge that distorts household portfolio decision over the lifecycle. In the aggregate, we do find a three percent reduction in the housing capital to output ratio, and a 0.4 percent increase in the physical capital to output ratio. Aggregate output rises as a result of increased savings, while consumption increases due to a lower payroll tax rate on labor earnings. As less wealth is invested into 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 one percentage points.

Abolishing the distortion caused under 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 non-housing consumption. When divided into wealth quintiles, we find that households in the top quintile suffer, while all other households will gain from this policy reform. The majority of households who are not rich enough, benefit from the reform due to a lower tax rate and a higher wage rate. The welfare gains for the lower four quintiles range from 0.6 to 2.0 percent. On the contrary, wealthy households that are typically homeowners with large financial assets will either experience 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 0.8 percent.

In the policy version in which, perhaps more realistically, we introduce a limit on the value of exemption of owner-occupied housing, the aggregate and distributional implications are similar to the previous reform, but to a lesser magnitude. 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 emerging literature that documents the implications of means-testing with respect to household consumption and savings decisions. Since the seminal work of Hubbard, Skinner, and Zeldes (1994, 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 (Neumark and Powers, 1998, 2000; Powers, 1998; Gruber and Yelowtiz, 1999). More recent work by Sefton, van de Ven, and Weale (2008) concludes that in the UK, 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. One of the few papers that investigate the portfolio effects of pension reforms is Bottazzi, Jappelli, and Padula (2010). Using the Italian household survey data, this study estimates that the portfolio of households is adjusted by increasing non-financial wealth in response to cuts in pension benefits. In the current paper, we raise similar questions, but with a theoretical framework, in order to conduct various counter-factual policy experiments. An empirical study on the impact of portfolio adjustment in the Australian means-tested age pension system is shown in Cho and Sane (2010). In the Australian context, some studies have used quantitative approaches similar to that used in this paper. For example, Kudrna and Woodland (2011) study the implication of counter-factual experiments, including removing the means test, reducing the income taper rate, and removing labor earnings from the income test. Furthermore, Tran and Woodland (2010) explore the trade-off between insurance and incentive in a means-tested pension program with alternative tax financing instruments. However, neither paper investigates the impact on homeownership and portfolio decisions, which are the focus of the current study.

The paper is organized as follows. Section 2 presents an overview of aggregate wealth and wealth-transitions of households a few years prior to retirement. Section 3 presents the general equilibrium life-cycle model, and Section 4 details the calibration of the model. Section 5 shows the benchmark results, while the results of our policy experiments are shown in Section 6. The conclusions of the study are presented in Section 7.

2 A Brief Overview of Wealth and Homeownership in Australia

We examine in detail the wealth and wealth transitions of the elderly between 2002-2006, from the Household, Income and Labour Dynamics (HILDA) panel data set in Australia. Detailed wealth estimates of households were collected during the second wave of 2002, and then in the sixth wave of 2006. We therefore use household data from these two waves (Waves 2 & 6) for our wealth estimates.

We begin by presenting a snapshot of wealth accumulation across all age groups in Australia. Household age is determined as that of the oldest person in the household. We focus on housing equity, non-housing equity, and total net-worth. Housing equity is calculated as the value of the owner-occupied home minus the mortgage on the home. Non-housing equity consists of financial and non-financial assets (excluding the family home) minus household debt.

As presented in Figure 1, there is a fall in non-housing starting at the age of 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 who are homeowners, or the homeownership ratio across age cohorts. The average homeownership ratio in Australia is around 66%. Similar to the profile of housing equity in Figure 1, homeownership peaks around the age of 60 and does not decline much during retirement.

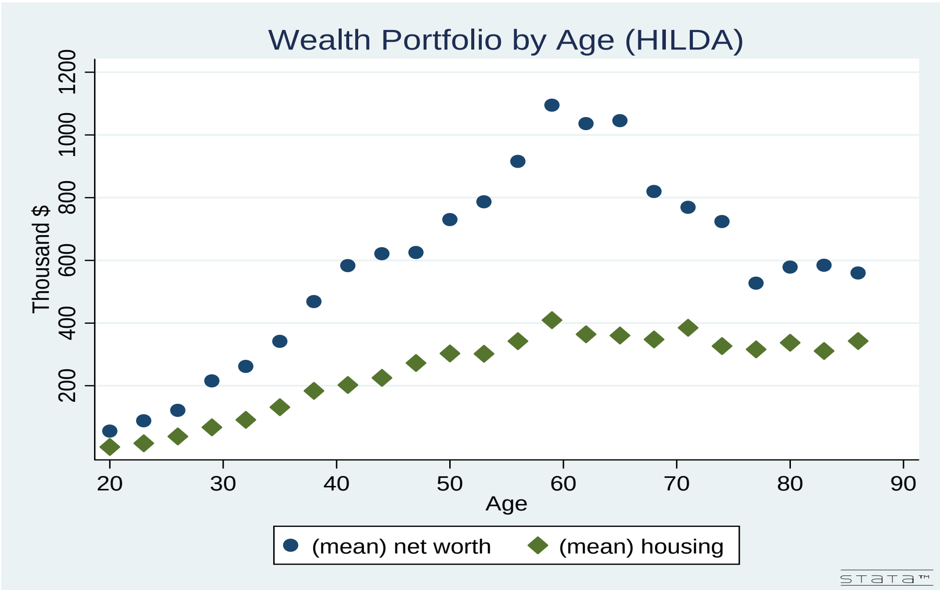

Figure 1: Wealth portfolio by age

To analyze wealth composition by income, we follow the methodology of Hubbard, Skinner, and Zeldes (1995), and divide respondents by education category. This is because education is a good proxy for earnings potential and lifetime income. We define the term 'School' as households who have studied less than or equal to high school, we define 'Certificate' as households who have some trade qualifications, and we term 'Graduate' as those with a Bachelor's degree or above. In Table 1, we present the median values for total net-worth and divide it by non-housing and housing wealth.

Median non-housing equity drops between the age-groups of 55-59 and 60-64 for households in the School category. In contrast, housing equity shows an increase for these two age-groups. For the other two categories, both non-housing equity and housing equity rise for the age-group 55-59 onwards. For all households, the drop in housing-equity is smaller than for that of non-housing equity.

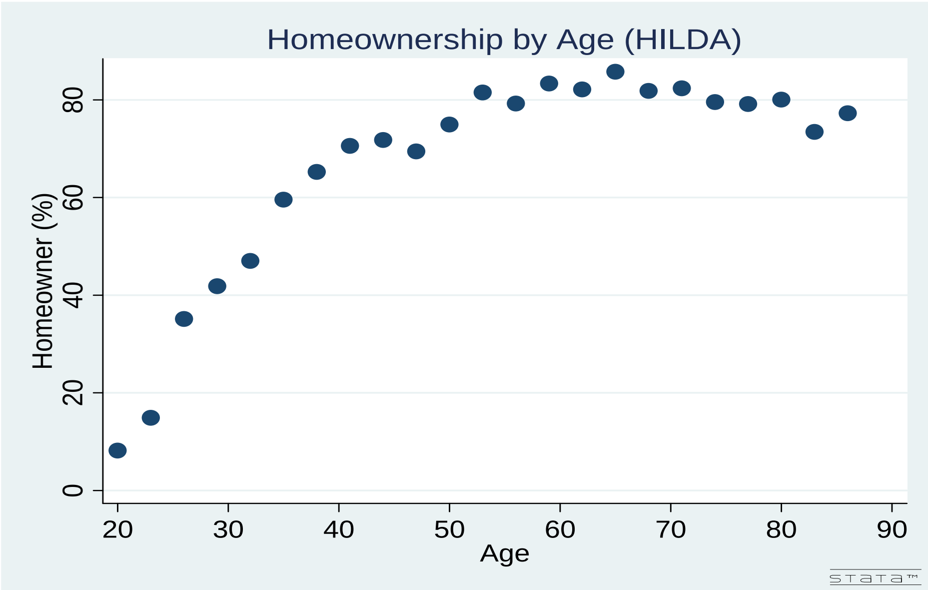

Figure 2: Homeownership by age

	Age							
	< 30	30-39	40-49	50-54	55-59	60-64	65-69	70+
	School							
Net-worth	12	132	268	372	510	478	380	322
Non-housing wealth	10	59	108	200	184	129	87	50
Housing wealth	0	0	102	200	240	272	250	250
Annual income	30	54	57	60	53	38	25	22
Not working (%)	19	25	22	25	35	63	88	97
No. of households	258	303	420	201	222	212	180	658
	Certificate/Diplomas							
Net-worth	33	216	384	560	696	850	768	507
Non-housing wealth	26	91	131	251	333	387	315	134
Housing wealth	0	70	196	261	310	361	350	300
Annual income	44	61	66	72	62	59	37	30
Not working (%)	10	15	12	10	29	49	76	93
No. of households	188	405	631	259	222	163	149	283
	Graduate							
Net-worth	30	268	516	719	1092	898	844	750
Non-housing wealth	22	123	249	381	613	490	438	301
Housing wealth	0	49	266	273	415	393	421	345
Annual income	52	71	82	69	91	50	43	40
Not working (%)	7	12	7	12	20	42	73	86
No. of households	111	230	251	113	78	61	46	72

Median values reported for wealth and income
Source: HILDA

Table 1: Wealth by age and education, 2006

The School category has the maximum percentage of households that are out of the labor force at older ages. In fact, between the age-group of 55-59 and 60-64, there is a huge rise in the percentage of those out of the labor force. A peculiar feature of the Australian retirement policy is that the access age for tax-free withdrawal from superannuation funds is 60, thus allowing people to consume these resources between 60 and 65, and subsequently access the age-pension from the age of 65. Low labor force participation provides one indication that this might be an important strategy for the relatively poor.

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, in which individuals who wish to purchase a home must meet a down-payment requirement and pay a transaction cost that is proportional to the size of the house.

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 an age of 20 (denoted as $j = 1$ in the model), with zero financial assets. Initially, an exogenous fraction o of the households enter as home-owners (with an exogenous housing endowment), and the remaining *1-o* enter as renters. We use an indicator, I, to differentiate homeowners ($I = 1$) versus 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 age 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 into 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:

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

where, C denotes aggregate consumption of non-housing goods, and Π denotes housing transaction costs. 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 non-housing 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 housing to non-housing consumption ratio, as suggested by Jeske (2005) and employed in Chambers, Garriga, and Schlagenhauf (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, while 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, while 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

During each period prior to the mandatory 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 stochastic productivity of a worker in that period and the deterministic efficiency index of the worker at the same age: $y_j\epsilon_j$. Working households also pay social security payroll taxes on their labor earnings. Upon retirement, households receive pension benefit, b, which depends on their assets, homeownership status, and age, and is defined by:

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

where, $\bar{b}$ is the maximum pension benefit. With assets higher than the cut-off levels $\bar{a}_o$ and $\bar{a}_r$ for homeowners (denoted with indicator I) and renters (denoted with indicator $1-I$), 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):

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

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 per unit of housing service to the rental agency. 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 Gervais (2002) and Cocco (2005), among others. The constraint on minimum owner-occupied housing size is as follows:

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

For renters, there is no such lower bound on the size of the rental property.

A homeowner may decide whether to keep their current house 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 was 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 house as collateral and borrow up to a fraction κ of the housing value in the next period. As such, κ is the loan-to-value (LTV) ratio, and $1-\kappa$ is commonly known as the down payment ratio. The collateral constraint for a household of age j is as follows:

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

where a_{j+1} is the financial net worth. On the other hand, renters are not allowed to borrow since they do not own a collateral asset. In addition, homeowners derive higher utility from housing services than renters.[3] Following Platania and Schlagenhauf (2002) and 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 which takes deposits, D_t, in the first period and buys rental properties, S_t, as well as issues 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 for 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:

$$\max_{S_{t+1}, B_{t+1}, D_{t+1}} \quad pS_{t+1} + rB_{t+1} - \delta^h S_{t+1} - rD_{t+1} \tag{10}$$

$$\text{subject to} \quad S_{t+1} + B_{t+1} \leq D_{t+1} \tag{11}$$

[3] This assumption incorporates the fact that homeowners receive various tax benefits, such as tax deductions, on their mortgage interests, as well as being able to modify their housing unit to suit their tastes, whereas renters are restricted in the modifications they may make.

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:

$$p = \delta^h + r \tag{12}$$

This implies that renting out a property and receive 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 & Taxation

The government is infinitely lived. It taxes labor earnings at a proportional rate τ on working households, and uses the tax revenues to provide 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, while 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 the housing tenure of the next period by comparing the values of owning a house versus 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:

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

s.t.

$$c + a' + h' + \phi(Ih, h') \leq y(j, a, I, \upsilon) + (1+r)a + I(1-\delta^h)h \tag{13}$$

$$h' \geq \underline{H} \tag{14}$$

$$a' \geq -\kappa h' \tag{15}$$

$$c \geq 0 \tag{16}$$

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

$$\begin{aligned} V^r(j,a,h,I,\upsilon) &= \max_{c,a',h'} \left[U(c,f(h')) + \nu\beta\mathbf{E}V(j+1,a',0,0,\upsilon') + (1-\nu)\varphi(a')\right] \\ \text{s.t.} & \\ c + a' + ph' + \phi(Ih,0) &\leq y(j,a,I,\upsilon) + (1+r)a + I(1-\delta^h)h \\ c, a', h' &\geq 0 \end{aligned} \tag{17}$$

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:

$$\begin{aligned} r &= F_K(K,L) - \delta^k, \\ w &= F_L(K,L). \end{aligned}$$

(iii) Government budget is balanced:

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

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

(v) All markets clear.

$$\begin{aligned} C &= \int c \;\; m^*(dx), \\ H &= \int_{I=1} h \;\; m^*(dx), \\ S &= \int_{I=0} h \;\; m^*(dx), \\ L &= \int \epsilon\upsilon \;\; m^*(dx), \\ K &= \int a \;\; m^*(dx) - S, \end{aligned}$$

4 Calibration

The set of parameters are divided into those that can be estimated independently of the model or are based on the estimates provided by other literature and data, and those that are chosen such 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 2 lists the parameters provided by other literature and data for the first group of calibrated parameters.

Regarding the preference parameters, although standard constant relative risk aversion (CRRA) type utility functions assume that $\sigma_1 = \sigma_2$, it is not consistent with the data on consumer behavior, which shows that income increases are more likely to be consumed in housing than in non-housing consumption. Jeske (2005) observes an increasing ratio of housing services to consumption with age, where as with respect to income rises the author finds a larger fraction is allocated to housing. Different values for σ_1 and σ_2 may effectively capture the non-linearity of the housing to nonhousing consumption ratio. We follow the method of Chambers, Garriga, and Schlagenhauf (2009), by assuming $\sigma_1 = 3$ and $\sigma_2 = 1.5$, and allow the marginal utility from an increase in housing services to decline more slowly than the marginal utility of non-housing consumption, which implies 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), while 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 percent of the wealth of cohorts aged 60-69.

For λ, which measures the degree of preference for home-ownership over renting by households, we select a value of 0.9.[4]

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%, while 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 assume the selling and buying transaction costs to be 4% and 2% of the property value, respectively, which are obtained from Global Property Guide (http://www.globalpropertyguide.com/). We take the average loan-to-value ratio,κ, to be 75%. The implied average down-payment requirement is 25 percent, which is consistent with the figure used in Jappelli and Pagano (1994) for Australia.

[4]The parameter λ is a critical parameter since it strongly influences the desire to be a home-owner versus a renter. Smaller values of λ should result in more home-ownership, ceteris paribus, and thus higher tax revenues from housing. In order not to bias our results, we choose a value for λ that is consistent with several recent studies, Gervais and Pandey (2008) and Kiyotaki, Michaelides, and Nikolov (2008).

	PREFERENCE	
σ_1	Risk-aversion coefficient (non-housing)	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, σ_υ^2	Stochastic process	See text
	DEMOGRAPHICS	
j^*	Retirement age	65
ν_j	Survival probability	ABS Life Table
ϵ_j	Age-efficiency profile	Hansen (1993)
o	Homeownership ratio for 20-25 year old	8%

Table 2: Parameter Definition and Values

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

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

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), while the variance σ_y^2 is chosen to match the Gini coefficient for earnings.[5] We approximate the productivity shocks by using a four-point discrete Markov chain according to 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 given as:

$$\left\{\begin{array}{cccc} 0.7722 & 0.2081 & 0.0194 & 0.0003 \\ 0.2081 & 0.5245 & 0.2480 & 0.0194 \\ 0.0194 & 0.2480 & 0.5245 & 0.2081 \\ 0.0003 & 0.0194 & 0.2081 & 0.7722 \end{array}\right\}$$

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, while 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 labor earnings set at $30,000, which is around 60% of the average household income ($50,659) derived from the 2002 HILDA survey. Since we assume that the government balances its budget, the resulting payroll tax rate on working households is endogenously determined at 10.2%.

$$b \quad = \quad \begin{cases} 0.79 & \text{if } a \leq 8.1 \\ 0.79 - 0.0387(a - 8.1) & \text{if } 8.1 \leq a \leq 28.5 \\ 0 & \text{if } a \geq 28.5 \end{cases} \tag{19}$$

$$b \quad = \quad \begin{cases} 0.79 & \text{if } a \leq 12.3 \\ 0.79 - 0.0387(a - 12.3) & \text{if } 12.3 \leq a \leq 32.7 \\ 0 & \text{if } a \geq 32.7 \end{cases} \tag{20}$$

[5]The model implied Gini coefficient for earnings is 0.419, which is very close to 0.42 taken from OECD 'Levels and trends in the Gini coefficient of market income inequality among the working-age population' (http://www.oecd.org/dataoecd/48/9/34483698.pdf)

For demographics, the deterministic age-efficiency profile ϵ_j, is calculated from the estimate of the mean age-income profile from Hansen (1993). For lifetime uncertainty, the conditional survival probabilities for the 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 into the life cycle at 8%, which is taken from the HILDA 2002 data.

The next three parameters, β, $\underline{H}$, and ω, are jointly chosen such that the predictions generated by the model match a given set of targeted aggregate ratios as shown in Table 3. The first aggregate target is the physical capital to output ratio, $\frac{K}{Y}$. Physical capital stock is the sum of private and government non-residential fixed assets and inventories, while output is defined as the gross domestic product minus expenditure on housing services. In Australia, the average capital output ratio over the period 1960-2007 was 2.29.[6] 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.

Parameters	Definition	Value
β	Discount factor	0.895
$\underline{H}$	Minimum housing size	70% of average labor earnings
ω	Share of nonhousing consumption	0.918

Table 3: Parameters to Match Target Ratios

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. The aggregate statistics of the model-generated data, as well as the empirical counterparts for Australia, are presented in Table 4. 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

While 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

[6] Given the capital-output ratio, the implied interest rate in stationary equilibrium is derived as $r = \alpha \frac{Y}{K} - \delta^k$.

distribution of age pensioners.[7]

	Benchmark Simulation	Data
Physical capital to output ratio ($\frac{K}{Y}$)	2.29	2.29
Housing capital to output ratio ($\frac{H}{Y}$)	0.96	0.96
Homeownership ratio	66%	66%
Consumption to output ratio ($\frac{C}{Y}$)	0.73	0.72
Fraction of pensioners receiving		
more than 90% of maximum benefit	78.8%	73%
less than 25% of maximum benefit	7.7%	3%

Table 4: Aggregate Statistics for Benchmark Simulation

We also construct the life cycle profiles of net worth, wealth portfolio (housing vs. financial assets), and homeownership, for an average household from the simulation. The net worth is defined as the sum of the financial net worth, housing asset, and transfers. Figure 3 and Figure 4 depict the profile 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 and almost no downsizing after retirement. The former is attributed to the role of housing as collateral, while the latter is explained by the existence of transaction costs, and the fact that some older households take on reverse mortgage and assume debts. For the age profile of homeownership, the model 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 on the distribution of wealth summarized in Table 5. The model produces a very close match to the data counterpart, in terms of the Gini coefficient of net worth. As for the skewness of the wealth distribution, while the model does not produce sufficient heterogeneity in the upper tail of the distribution, it exactly matches the wealth held by the top 20%, while closely replicating the wealth held by

[7]Inclusion of income means-testing would effectively lower the fraction of people receiving age pension benefit. Due to our focus on asset portfolio and homeownership, we abstract information from the income test.

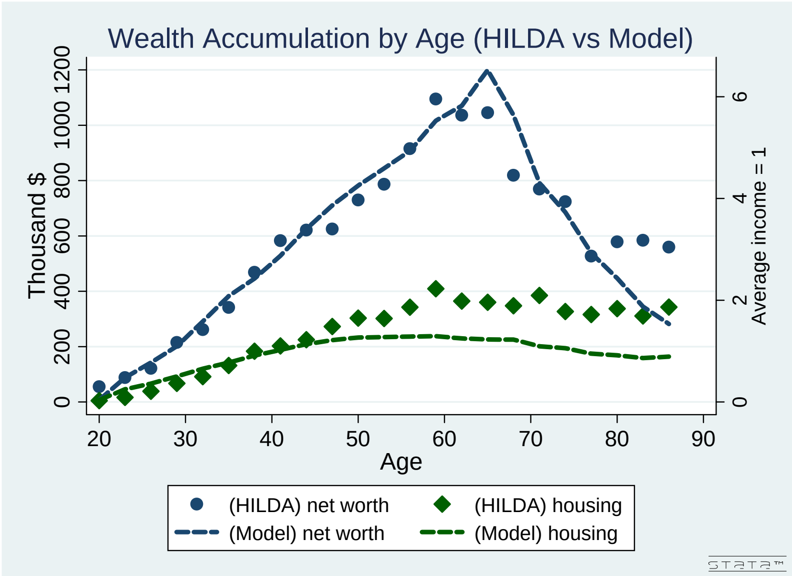

Figure 3: Life Cycle Profile of Assets

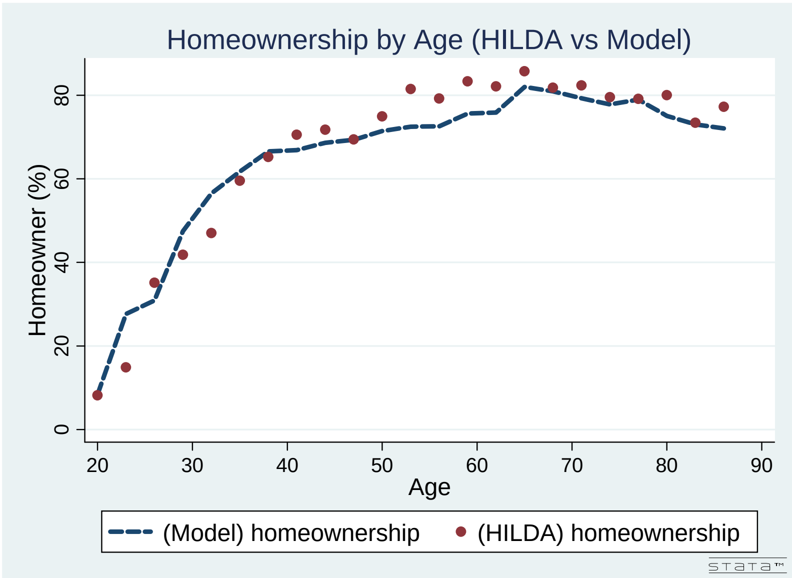

Figure 4: Life Cycle Profile of Homeownership

the top 40%. For the lower tail of the wealth distribution, our model-generated data produces the percentile ratios of the 10th percentile to median, as well as 25th percentile to median, which are 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.

	Benchmark Simulation	HILDA 2002
Percentage wealth held by top		
10 percent	42%	47%
20 percent	65%	65%
40 percent	88%	85%
Gini coefficients		
Financial	0.68	0.75
Housing	0.59	0.62
Net worth	0.63	0.64
Percentile ratios		
$\frac{p10}{p50}$	0.02	0.02
$\frac{p25}{p50}$	0.21	0.22
$\frac{Avg}{p50}$	2.43	1.93
$\frac{p75}{p50}$	3.43	2.18

Table 5: Distribution of Wealth

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 lifecycle 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 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 of owner-occupied housing. As for the limiting value, we use the difference between the full pension cut-off levels for homeowners versus renters. Any housing assets above this limit are now included in the assets means-testing. Finally, we look at the case of substituting the current means-testing scheme with a constant pension benefit scheme for all retired households. For every experiment, we first compute the new steady state, and compare the aggregate and lifecycle statistics, wealth distribution, and disaggregated welfare. To maintain the condition of revenue neutrality, we adjust the payroll tax rate in the first two experiments, while in the final experiment, we fix the tax rate to be the same as the benchmark case, and adjust the pension level instead.

6.1 Full Inclusion of Housing into the Assets Means-Testing

We first explore at the implication of including housing assets to the current means-testing scheme. We assume the taper rate on housing asset is identical to the financial asset, which will now affect all homeowners. For renters, we maintain the current scheme. The changes in the aggregate statistics as well as the distribution of wealth are reported in Table 6.

	Benchmark	Housing in Means-Testing
Physical capital to output ratio ($\frac{K}{Y}$)	2.29	2.30
Housing capital to output ratio ($\frac{H}{Y}$)	0.96	0.93
Homeownership ratio	66%	65%
Consumption to output ratio ($\frac{C}{Y}$)	0.73	0.73
Percent changes in		
Output (Y)	-	0.60%
Physical capital (K)	-	0.88%
Consumption (C)	-	0.50%
Interest rate (r)	3.23%	3.14%
Payroll rax rate (τ)	10.2%	9.7%
Fraction of pensioners receiving		
more than 90% of maximum benefit	78.8%	74.7%
less than 25% of maximum benefit	7.7%	12.2%
Percentage wealth held by top		
10 percent	41.8%	42.0%
20 percent	64.8%	65.1%
40 percent	87.7%	87.8%
Gini coefficients		
Financial	0.68	0.69
Housing	0.59	0.60
Net worth	0.63	0.64

Table 6: Housing into the Means-Testing - Comparing the Steady States

We expect that our policy reform will remove the distortionary incentive to over-invest and over-consume in housing. In Table 6, it can be seen that 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 in housing to physical capital reflects the fact that the current 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.

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 into means-testing, government pension expenditure decreases. Hence, to maintain the budget balance condition, we note that the tax rate is reduced by a 0.5 percentage point. In the long run, a lower tax rate subsequently raises total output, 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 a 1 percentage point. While the inclusion of housing into means-testing will lower homeownership, this is partly off-set by a decrease in the interest rate, which would reduce the borrowing cost for potential first-time home-buyers and increase homeownership for younger cohorts.

For the distribution of pensioners, including housing into 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 full pension benefit, will no longer be eligible, and those who received part pension benefit will no longer receive age pension. Quantitatively, the fraction of households receiving less than 25% of maximum benefit increases by 4.5 percentage points, while the number of pensioners receiving close to maximum benefit decreases by 4.1 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 top percentiles of the population, as well as higher Gini coefficients, implying, if any, a worsening inequality.

Age Cohort	Housing	Net Worth	Homeownership	High pension	Low pension
53-58	-0.04%	0.82%	-0.21%	-	-
59-64	-0.63%	1.15%	-0.30%	-	-
65-70	-6.71%	1.46%	-5.46%	-5.79%	0.52%
71-76	-11.34%	-0.01%	-4.79%	-6.79%	0.60%
77+	-14.74%	-4.79%	-1.48%	-6.28%	1.04%

Table 7: Housing into the Means-Testing - Comparing Age Profiles

We also report the average profiles of wealth and homeownership in Table 7 for different age cohorts: those close to retirement are represented in two cohorts (aged 53-58 and 59-64), and the retirees are grouped into three cohorts (aged 65-70, 71-76, and aged 77 and above). The first two columns show the percent change in the profiles of housing and net worth, while 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 full pension benefit (denoted as 'High pension') and less than 25% of full pension benefit (denoted as 'Low pension'). For the housing profile, the adjustment increases for households after retirement, as housing no longer offers a shelter of wealth from means-testing. Shifting household portfolio towards 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 lower for all age cohorts prior to and 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 to homeownership.

	Housing in Means-Testing
Average	0.7%
Quintiles	
Lowest fifth	2.0%
Second fifth	0.8%
Middle fifth	1.1%
Fourth fifth	0.6%
Highest fifth	-0.8%
Top 10%	-1.8%

Table 8: Housing into the Means-Testing - Welfare Changes

Finally, Table 8 displays the welfare gains and losses for this reform. The welfare costs and benefits are expressed in terms of the average utility[8] required to have someone indifferent between the new and the current means-testing regime. Positive numbers indicate gains from the pension reform. On average, the long term welfare gain from this reform is in the order of 0.7 percent of average utility. Despite the fall in housing consumption, the gains in the average welfare reflect a larger increase in non-housing consumption. However, when we disaggregate according to wealth percentiles, we note the presence of some gains and some losses from this reform. More specifically, the lowest quintile cohort benefit the most from the reform, while the richest lose the most, with the top 10% of the wealth distribution losing up to 1.8% 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 come from a lower payroll tax rate benefitting labor income earners who are typically young and less wealthy. Plus, working households also benefit, due to an increase in wages resulting from a higher accumulation of aggregate capital. For the working households at the lower tail of the wealth distribution, wage income comprises the majority of their 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 are either

[8]Note that we do not include utility from leaving bequest, thus only focusing on the consumption of housing and non-housing goods.

likely to receive less pension benefit upon retirement, or are already retired and experience a reduction in pension benefits.

6.2 Current Means-Testing Scheme with a Limit on the Value of the Exemption of Owner-occupied Housing

In this policy experiment, we retain the current means-testing scheme but introduce a limit on the value of the exemption of owner-occupied housing. As for the limiting value, we use the difference between the full pension cut-off levels for homeowners versus renters.[9] Any housing asset above the limit of $124,500 is included in the assets means-testing. This reform is considered as an alternative to the current means-testing scheme, as the exemption of owner-occupied housing has always been a core feature in the Australian context. It would indicate whether the current structure of applying different cut-off rule for homeowners and renters is adequate enough 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 to be more realistic and plausible where we maintain the exemption of housing assets into means-testing but impose a limit to exemption. The changes in the aggregate statistics, as well as the distribution of wealth are reported in Table 9.

The payroll tax rate adjustment that is required to balance the government budget constraint in the final steady state is small. This tax decreases from 10.2% 10.1%. Since only those with high levels of housing assets will be excluded from receiving full pension benefit, we observe that the aggregate implications are smaller when compared to the previous case, while the same qualitative results are retained. In other words, the policy reform partially removes over-investment into housing and raises total output, physical capital stock, and consumption in the long run. As a consequence, the interest rate and payroll tax rate are lower than before, but to a lesser degree when compared to the first policy experiment.

For the distribution of pension benefits, the fraction of households receiving less than 25% of maximum benefit increases by a 0.8 percentage point, while the fraction of pensioners receiving close to maximum benefit decreases by a 0.2 percentage point. The Gini coefficients remain unchanged while the percentage of wealth held by the top percentiles record if anything a small decrease.

We also report the lifecycle profiles of wealth and homeownership in Table 10. As expected, housing assets decline for all households in the age cohorts, as they have less incentive to over-accumulate housing assets into retirement. As for the profile of net worth, since the decline in the tax rate is negligible, working households do not receive much benefit and the decrease in

[9] The cut-off levels are $368,000 and $243,500 for renters and homeowners, respectively.

	Benchmark	Housing with Exemption Limit
Physical capital to output ratio ($\frac{K}{Y}$)	2.29	2.31
Housing capital to output ratio ($\frac{H}{Y}$)	0.96	0.93
Homeownership ratio	66%	66%
Consumption to output ratio ($\frac{C}{Y}$)	0.73	0.73
Percent changes in		
Output (Y)	-	0.46%
Physical capital (K)	-	0.95%
Consumption (C)	-	0.36%
Interest rate (r)	3.23%	3.16%
Payroll rax rate (τ)	10.2%	10.1%
Fraction of pensioners receiving		
more than 90% of maximum benefit	78.8%	78.6%
less than 25% of maximum benefit	7.7%	8.5%
Percentage wealth held by top		
10 percent	41.8%	41.7%
20 percent	65.1%	64.5%
40 percent	87.8%	87.7%
Gini coefficients		
Financial	0.68	0.68
Housing	0.59	0.59
Net worth	0.63	0.63

Table 9: Housing into the Means-Testing with Exemption Limit - Comparing Steady States

Age Cohort	Housing	Net Worth	Homeownership	High pension	Low pension
53-58	-0.73%	-0.34%	-0.01%	-	-
59-64	-2.21%	-0.37%	-0.31%	-	-
65-70	-6.28%	-0.61%	-0.07%	0.95%	0.38%
71-76	-11.13%	-0.34%	-0.04%	-0.85%	-0.04%
77+	-7.58%	1.70%	-0.53%	-1.30%	0.46%

Table 10: Housing into the Means-Testing with Exemption Limit - Comparing Age Profiles

interest rate and asset income implies less incentive for savings and wealth accumulation. The homeownership ratio falls, but the magnitude is less than 1 percentage point for all age cohorts.

Finally, Table 11 displays the welfare gains and losses for this reform. On average, the long term welfare gain from this reform is in the order of 0.4% of average utility. Similar to the first

	Housing in Means-Testing with Exemption Limit
Average	0.4%
Quintiles	
Lowest fifth	1.0%
Second fifth	0.5%
Middle fifth	0.5%
Fourth fifth	0.9%
Highest fifth	-0.9%
Top 10%	-1.4%

Table 11: Housing into the Means-Testing with Exemption Limit - Welfare Changes

policy experiment, the largest benefit falls on the poorest fifth quintile, which is favored by a lower tax rate and higher wage rate. Those affected negatively are the wealthiest group, as they experience lower interests from asset accumulation; hence for the wealthy elderly, their housing assets are now subject to assets testing.

6.3 Constant Pension Benefit

We also explore the possible implications of eliminating the current means-testing scheme with a constant pension benefit scheme. One option for the government is to fix the payroll tax rate to the benchmark level at 10.2%, and adjust the constant benefit level. This results in the constant benefit level being around 35% 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 12. More than 80% of the retired households who once received close to full pension benefit now receive reduced benefit. 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 towards over-investing and over-consuming in housing. Therefore, the fraction of wealth invested in housing is reduced, while overall physical capital stock increases by more than 5%. Despite a large increase in physical capital stock, the total output of the economy only increases by 0.68%, which, from our GDP accounting, implies that aggregate consumption is now lower by an order of 0.64%. With respect to the distribution of wealth, while the magnitude of change is modest, the percentage of wealth held by top percentiles, as well as the Gini coefficient of net worth, are 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 pension, now being eligible for lump-sum pension benefits.

	Benchmark	Abolishing Means-Testing
Physical capital to output ratio ($\frac{K}{Y}$)	2.29	2.40
Housing capital to output ratio ($\frac{H}{Y}$)	0.96	0.95
Homeownership ratio	66%	63.5%
Consumption to output ratio ($\frac{C}{Y}$)	0.73	0.72
Percent changes in		
Output (Y)	-	0.68%
Physical capital (K)	-	5.43%
Consumption (C)	-	-0.64%
Interest rate (r)	3.23%	2.69%
Pension benefit (% of average income)	39.3% (maximum)	34.7%
Percentage wealth held by top		
10 percent	41.8%	42.1%
20 percent	65.1%	65.4%
40 percent	87.8%	88.2%
Gini coefficients		
Financial	0.68	0.68
Housing	0.59	0.60
Net worth	0.63	0.64

Table 12: Abolishing Means-Testing with Constant Benefits - Comparing Steady States

We also report the lifecycle profiles of wealth and homeownership in Table 13. The major trend that we observe is that the housing profiles are unambiguously lower, whereby the older the household, the larger the decline in housing profile. A lower pension benefit implies larger savings into retirement, which leads to a larger net worth for all age cohorts. As for homeownership ratios, the profile is slightly higher for working households, but lower for retired households with the largest decline in homeownership for cohorts aged 77 and above.

Finally, Table 14 displays the welfare gains and losses for this reform. On average, the economy suffers from long term welfare loss as a result of this reform in the order of 1.0% of average utility. Unlike the previous reforms, where a lower average utility from housing services was offset by a higher utility from non-housing consumption, both housing and non-housing consumption decrease under the constant pension benefit scheme. Interestingly, when considering disaggregated households, we observe that wage earners will gain, while asset-income earners will lose. As for retired households, most retirees will experience a reduction in their pension

Age Cohort	Housing	Net Worth	Homeownership
53-58	-0.59%	0.48%	0.50%
59-64	-2.11%	1.65%	1.06%
65-70	-6.07%	4.80%	-3.28%
71-76	-6.08%	13.20%	-8.19%
77+	-7.48%	26.80%	-26.74%

Table 13: Abolishing Means-Testing with Constant Benefits - Comparing Age Profiles

benefits, whereas a small group of rich retirees, who were not eligible for pension, will now earn additional income. Among households of different wealth quintiles, households in the lowest fifth quintile benefit from this reform. This may be explained by the fact that these households are mostly wage earners who benefit from a large increase in the wage rate. As for the other quintiles, households that suffer the most are in the second fifth quintile, which are likely to include retired households. In addition to a reduction in pension benefit, these households are impacted the most, since asset income is also lower (as a result of a reduced interest rate). For households in the highest wealth quintile, the majority receive a lower asset income, while retired households are likely to receive higher pension benefits.

	Abolishing Means-Testing
Average	-1.0%
Quintiles	
Lowest fifth	1.5%
Second fifth	-3.6%
Middle fifth	-1.4%
Fourth fifth	-0.9%
Highest fifth	-0.7%
Top 10%	-1.9%

Table 14: Abolishing Means-Testing with Constant Benefits - Welfare Changes

7 Conclusion

In this study, we consider three different policy alternatives to the current pension scheme where 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 segment of the population, particularly the wealthiest quintile. However, these costs could be off-set with 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. For example, in terms of modeling the housing market, the model abstracts from housing price fluctuations, which impacts the size of debt leverage and 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. As for the means-testing, the current system also incorporates income levels, which we have abstracted in the current paper, which might have implications on our results. We leave these issues for future development of the research frontier.

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Appendix

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 rule is denoted by $b_t = b_1 + b_2 a_t + b_3 h_t$, and we consider three possible situations, as shown below:

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 $(t + 1)$. For simplicity, we assume that there is no transaction cost. Using the functional form for the instantaneous utility function and the 'warm-glow' bequest function, the household problem can be written as follows:

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

subject to

$$
\begin{aligned}
c_t + a_{t+1} + h_{t+1} &\leq b_t + (1 + r_t)a_t + (1 - \delta^h)h_t \qquad (21)\\
c_t &\geq 0\\
a_{t+1} &\geq -\kappa h_{t+1}\\
q_{t+1} &= a_{t+1} + h_{t+1}\\
h_{t+1} &\geq \underline{H}\\
b_t &= b_1 + b_2 a_t + b_3 h_t
\end{aligned}
$$

Since the household is retired, there are no stochastic shocks to productivity. Assuming interior solution and using first order conditions with respect to c_t, c_{t+1}, a_{t+1} and h_{t+1}, results in the following equations:

$$c_t \; : \; \beta^t (c_t^{1-\omega} h_t^{\omega})^{-\gamma} h_t^{\omega} (1 - \omega) c_t^{-\omega} = \mu_t \tag{22}$$

$$c_{t+1} \; : \; s_t \beta^{t+1} (c_{t+1}^{1-\omega} h_{t+1}^{\omega})^{-\gamma} h_{t+1}^{\omega} (1 - \omega) c_{t+1}^{-\omega} = \mu_{t+1} \tag{23}$$

$$a_{t+1} \; : \; (1 - s_t)\varphi'(q_{t+1}) - \mu_t + (1 + r_{t+1} + b_2)\mu_{t+1} = 0 \tag{24}$$

$$h_{t+1} \; : \; s_t \beta^{t+1} (c_{t+1}^{1-\omega} h_{t+1}^{\omega})^{-\gamma} h_{t+1}^{\omega-1} \omega c_{t+1}^{1-\omega} + (1 - s_t)\varphi'(q_{t+1}) - \mu_t + (1 - \delta^h + b_3)\mu_{t+1} = 0 \tag{25}$$

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

Proof. Re-arranging the first order conditions, we obtain

$$\frac{h_{t+1}}{c_{t+1}} = \frac{1 - \omega}{\omega} \frac{1}{r + \delta^h + b_2 - b_3}$$

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