Marital Transitions, Housing, and Long-Term Care in Old Age*

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Abstract

While prior research on retirement savings focuses on singles, this study develops and estimates a life-cycle model to investigate savings and long-term care decisions for both singles and couples during retirement. Notably, the model integrates conflicting savings preferences within retired couples, driven by gender-based differences in longevity and medical expenses. We find a substantial impact of marital status on retirees' savings, particularly housing assets, influenced by discrepancies in welfare program eligibility, availability of spousal care, and bequest motives between couples and singles. Through counterfactual experiments, we assess the welfare implications of existing marital-based eligibility criteria for elderly social insurance.

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1 Introduction

Individuals can expect to spend about one-fifth of their lifetime in retirement. The major funding source of consumption in retirement is net worth (Scholz, Seshadri, and Khitatrakun, 2006). With the secular decline of pensions and the unstable financial outlook of Social Security due to an aging population, individuals will increasingly rely on their savings to support their retirement. Understanding retirees' savings decisions is therefore crucial in designing welfare-improving government policies. Existing works on retiree savings primarily focus on singles who are mostly widows and widowers, despite the fact that individuals spend the majority of their retirement as a married couple.[1] Couples' decision to save may differ significantly from that of singles as the household structure can affect the amount of uninsured risks as well as bequest motives. Moreover, husbands and wives might have distinct precautionary savings motives due to heterogeneity in life expectancy, disability risk, and access to spousal care by gender.

In this paper, we study not only singles' but also couples' savings in retirement, incorporating two novel features. First, we take an inaugural attempt in analyzing retired couples' savings and long-term care decisions based on a *non-unitary* model. The few existing works on couples' savings in retirement exclusively employ a unitary model, which fails to account for divergent preferences between men and women. In contrast, we use a collective model that allows for conflicting savings motives based on gender. The primary source of tension is women's longer life expectancy and larger long-term care expenditures, which lead them to have stronger precautionary savings motives. This intrahousehold tension is resolved in our model by the dynamics of spouses' bargaining power, determined by their relative income shares and the realized health status in comparison to that of their partner.

Second, we consider housing as a distinctive asset and investigate divergent housing decisions based on marital status. While most of retirement wealth is tied up in housing, much of the existing work on savings in retirement treats all assets as liquid.[2] The consideration of housing assets is particularly important as we observe a striking difference in decumulation of housing wealth based on marital status: couples dissave housing wealth at a considerably slower rate compared to their single counterparts. This is a puzzling observation as most

[1]According to the actuarial life table provided by the Social Security Administration based on the mortality rates in 2017, men aged 65 can expect to live for another 18 years, while women can anticipate another 21 years. Consequently, married men who retire at age 65 can foresee spending the entire span of their retirement as part of a married couple. Women can expect to spend 85% of their retirement as a married couple, with the remaining 15% spent as single individuals.

[2]There are a few exceptions that explicitly incorporate housing assets which we detail later in the literature review.

singles in retirement are widows and widowers who were previously married and therefore do not differ from married couples in a permanent way.[3] By incorporating various mechanisms through which marital status can affect housing decisions within our model, we provide the first quantitative explanation for the observed disparity in decumulation of housing wealth between couples and singles. The analysis sheds light on the optimal design of social insurance programs for retirees, which often have varying treatments of housing assets based on marital status within their means tests. For example, asymmetrical treatments of homes based on marital status are observed not just in the U.S. Medicaid program studied in this paper but also in Australia's age pension system.[4]

Using data from the Health and Retirement Study (HRS), we begin by documenting empirical patterns that indicate martial status has a substantial impact on retirees' housing decisions. While 75% of couples still own homes toward the end of life, less than 50% of singles (who are mostly widows and widowers) are reported as homeowners. We document a significant reduction in the homeownership rate of 30% around the time of a spousal death, implying varying homeownership motivations based on marital status.

Next, we provide descriptive evidence for potential mechanisms that might account for the observed disparity in housing decisions between couples and singles. First, we demonstrate significant differences in long-term care arrangements based on marital status, which might increase couples' value for homeownership relative to singles. Most disabled couples receive care from their spouse and their probability of ending up in a nursing home is smaller by 45%. Second, we show that Medicaid's differential treatment of home based on marital status could be a significant factor contributing to the slower decumulation of housing assets among couples. Medicaid is a means-tested public insurance program that covers formal long-term care expenses for eligible individuals. For singles who are deemed to stay in a Medicaid-financed nursing home for a long period of time, Medicaid recovers its expenses from the recipients' housing wealth. In contrast, it disregards the value of the house for married individuals who have a community spouse. Using state variations in Medicaid estate recovery programs, we provide evidence that Medicaid's favorable treatment of the house for couples induces them to maintain homeownership. Third, using variations in mortality risk, we provide descriptive evidence that married individuals have a higher value for bequeathing the house relative to singles.

[3] Among single retirees, almost 80% are widows and widowers.

[4] Under Australia's age pension rules, a primary residence is factored into the asset test if a resident stays in a care facility for over two years. However, if a partner or spouse continues to inhabit the home, it remains exempt from asset calculations. More details can be found at https://www.servicesaustralia.gov.au/assets-test-for-age-pension?context=22526.

We also conduct a descriptive analysis to investigate whether married retirees' consumption-savings behaviors align with the commonly used unitary model. According to the unitary model, household behavior should not be influenced by distribution factors such as individual income, conditional on total household resources. The results from our income-pooling test reveal that the wife's income share is positively correlated with the couple's savings in a significant manner. As the wife's income share increases by 10 percentage points, household biannual savings increase by $18,000. While the results contradict the unitary model, they align with a collective model in which distribution factors affect household members' relative Pareto weights. As women have stronger precautionary savings motives, the household's savings will increase in their relative bargaining power.

Motivated by the descriptive analysis, we develop a life-cycle model that allows us to examine diverse savings motives, taking into account both marital status (couples vs. singles) and, within the context of couples, differentiating by gender (husbands vs. wives). All retirees enter the model as a relatively young married couple. They face health and mortality risk, and become a single if they outlive their spouse. Singles in our model therefore refer to widows and widowers, who compromise the vast majority of single retirees in the data. In each period, agents make consumption-savings, housing, and long-term care arrangement decisions. Potential long-term care arrangements include formal care, spousal care, and care provided by adult children. While alive, individuals have preferences over consumption, housing, and long-term care. When dead, they derive bequest utility which depends on the existence of a surviving spouse and the type of assets they bequeath. Motivated by the descriptive evidence, we allow for the possibility that couples place a higher value on bequeathing the house relative to singles. The model incorporates Medicaid as means-tested public long-term care insurance. For individuals who end up in a nursing home, the value of their house is disregarded in Medicaid's means test only if they are married.

Based on the results from our income-pooling test, we adopt a collective model to describe the decision-making process of couples. Each spouse is assigned a relative Pareto weight, representing their bargaining power. We allow the Pareto weights to vary across households and over time. Cross-sectional heterogeneity is captured by the dependence upon the wife's income share, while across-time variations are determined by the realization of relative health within the couple. The latter is to allow for the possibility that disabled spouses may have reduced bargaining power compared to their healthy partner, which may be particularly important as long-term care needs in old age are often triggered by cognitive impairment. Among other things, the Pareto weights act to resolve tensions arising from different precautionary savings motives between husbands and wives. As wives have longer life expectancy and face higher formal care risk, they have stronger incentives to save.

The model is estimated by a two-step procedure. In the first step, we fix or estimate parameters outside the model, including risk aversion, discount factor, health transition probabilities, and formal long-term care prices. In the second step, we estimate the rest of the parameters using the simulated method of moments. The structurally estimated parameters include preferences for bequests, housing, and long-term care, as well as the Pareto weights of men and women. We use variations in couples' savings and spousal care provision across distinct groups categorized by relative health conditions and wives' income share to identify the Pareto weights. The estimation results reveal that couples have stronger bequest motives than singles, consistent with De Nardi, French, Jones, and McGee (2021). The estimates of men's Pareto weights range between 0.68 to 0.92, suggesting that men have higher bargaining power than women. We find that married retirees' bargaining power increases in their income share and the health advantage over the other spouse. The wide range also implies substantial heterogeneity across households and over time.

Using the estimated model, we first conduct a set of counterfactuals to understand the substantial gap in homeownership between couples and singles. We implement following three changes to the baseline model: (i) we shut down Medicaid's favorable treatment of the house for couples, (ii) we eliminate the option of spousal care, and (iii) we change bequest preferences such that couples no longer place a higher value on bequeathing the house compared to singles. The difference in average homeownership rates between couples and singles, initially around 25% in the baseline, substantially reduces to approximately 5% when all three changes are implemented. This suggests that the three factors play a significant role in explaining the observed differences in homeownership between the two groups. A further decomposition analysis reveals that the primary driver of the homeownership gap varies depending on income levels.

Next, we evaluate the welfare effect of alternative Medicaid policies where we change the recipient of the homestead exemption granted to retirees in a nursing home. We find that the current structure of Medicaid, which provides the exemption only to married households, generates larger welfare gains than alternative rules, such as extending the exemption to singles or providing it to singles only. When the homestead exemption is offered to couples, retirees tend to maintain homeownership for a longer period of time. Consequently, there is a slower decumulation of retirement wealth over the life cycle, leading to fewer households ending up in impoverishment. In contrast, when the exemption is offered to singles only, married households with limited resources are likely to liquidate their home early in retirement to spend down to Medicaid eligibility. Early home liquidation results in faster dissaving of retirement wealth and increased impoverishment risk. Consequently, there is a welfare loss of around $14,300 per household, while the Medicaid spending increases by about $2,100 per household due to more people qualifying for benefits.

Lastly, we examine how removing the disparity in health and mortality risks between men and women changes couples' savings decisions. In the baseline, such disparity is crucial in shaping divergent savings motives within a couple. We counterfactually subject men and women to the same health and mortality risk, which is set at the gender mean. Under the counterfacutal, men's savings motives intensify as their life expectancy and disability risk increase compared to the baseline. As husbands exert a greater influence on intrahousehold decisions, captured by their Pareto weight estimates exceeding 0.5, we observe an overall increase in couples' savings. This effect is particularly pronounced in households where the wife has small bargaining power due to holding a low income share.

This paper contributes to the vast empirical literature on savings in retirement, which has primarily focused on single retirees. There are a few exceptions that explore the savings behaviors of couples, including Braun, Kopecky, and Koreshkova (2017), Nakajima and Telyukova (2020), and De Nardi, French, Jones, and McGee (2021). In contrast to the unitary model employed in these studies, we adopt a collective approach to examine how conflicting precautionary savings motives within couples are resolved. Our approach allows for heterogeneity in relative Pareto weights, enabling us to investigate the varying disparity in bargaining power between men and women across households and over time.

Our study is closely related to a body of literature that explores the role of uncertain medical expenses in retirees' savings. While Hubbard, Skinner, and Zeldes (1995) and Palumbo (1999) found relatively small effects, De Nardi, French, and Jones (2010) demonstrated medical expenses that rise with age and income are a significant driver of old-age savings. Kopecky and Koreshkova (2014) separated nursing home expenses from other health expenses and emphasized the importance of nursing home risk on retirement savings. In our model, medical expenses are also uncertain due to a stochastic health process. However, unlike most papers that treat medical expenses as exogenous, they are endogenously determined as an outcome of households' decisions on different types of long-term care, including family care.

Furthermore, we contribute to the literature on the role of bequest motives in elderly savings (Hurd, 1989; De Nardi, 2004; De Nardi, French, and Jones, 2010; Lockwood, 2018). Recently, De Nardi, French, Jones, and McGee (2021) found that couples exhibit stronger bequest motives than singles, which helps explain the higher savings levels of couples. In our analysis, we not only allow bequest utility to depend on marital status as in De Nardi, French, Jones, and McGee (2021) but also vary it based on the type of assets left behind (housing vs. liquid). We provide descriptive evidence that couples place a higher value on bequeathing the house relative to singles, which we incorporate into our structural model.

Our paper is also relevant to the growing literature on home equity in retirement. Venti and Wise (2004) found that retirees typically do not liquidate home equity to support general nonhousing consumption unless they experience the death of a spouse or enter into a nursing home. Using an estimated life-cycle savings model, Nakajima and Telyukova (2020) found that homeowners dissave more slowly than renters because they have a preference for staying in their own home as long as possible and cannot easily borrow against it. A recent work by McGee (2019) used UK data to estimate a retirement savings model that incorporates house price shocks. Additionally, Achou (2021) studied, in the context of single retirees only, the value of Medicaid's homestead exemption. Our contribution to the literature lies in studying varying housing decisions based on marital status and their implications for the design of public policies. To the best of our knowledge, we are the first to assess the welfare impact of Medicaid's differential treatment of housing assets based on marital status.

Related to our analysis of family care is the literature on old-age caregiving. Papers by Barczyk and Kredler (2018), Ko (2022) and Mommaerts (2016) use an intergenerational life-cycle savings model to study long-term care arrangements between elderly parents and adult children. A recent work by Barczyk, Kredler, and Fahle (2022) studies how housing assets can be used by parents as a commitment device to leave larger bequests and to elicit caregiving behaviors from their children. Our model also incorporates the availability of care provided by adult children, but it is modeled as exogenous based on individuals' surveyed beliefs about receiving informal care from children. Instead, we endogenize spousal caregiving decisions, which are important in uncovering the relationship between marital status and housing wealth.

The rest of this paper proceeds as follows. Section 2 presents descriptive evidence. Section 3 presents the model. Section 4 presents our data and estimation results. Section 5 presents the main results. Section 6 concludes.

2 Data and descriptive evidence

2.1 Data

The main dataset for this paper comes from the Health and Retirement Study (HRS) which has surveyed a representative sample of Americans over the age of 50 every two years since

1992. We use biennial interview waves from 1998 to 2014. We only consider individuals who were retired in 1998 and did not miss any interviews while alive.

We measure housing assets as the value of the primary residence less mortgages.[5] We define homeowners as having strictly positive housing assets. We measure non-housing assets as the sum of vehicles, businesses, IRA and Keogh accounts, stocks, mutual funds, investment trusts, checking, savings, money market accounts, CDs, bonds and T-bills.

For each individual, we compute his or her permanent retirement income as the average income observed over the sample period. This measure of income includes Social Security retirement income, pension, annuity, capital income, and other income.

The HRS asks respondents about their use of formal long-term care services including nursing homes and paid home care. It also asks about the receipt of informal long-term care, defined as unpaid help associated with managing daily tasks. We observe the identity of informal caregivers, most of whom are either spouses or adult children.[6]

2.2 Marital status and housing in retirement

We start by providing empirical patterns that suggest that one's marital status has a substantial effect on the ownership of a home, the major source of retirement wealth for most retirees. Figure 1 shows the homeownership rate conditional on current marital status and permanent income quartiles.[7] Singles refer to those who are currently not married, most of whom are widows or widowers in the data.[8] Income quartiles are based on individuals' permanent retirement income as explained earlier.

Figure 1 reveals that among married households, the mean homeownership rate does not decrease much in age, and about 75% are still homeowners at the age of 90. In contrast, singles show fast dissaving of housing assets, and by the age of 90, less than 50% are reported as homeowners. Figure A.1 in the Online Appendix shows that the median housing asset share, which is the ratio of housing assets to total assets, is maintained at over 50% among couples, except for the highest income group. In contrast, the median housing asset share

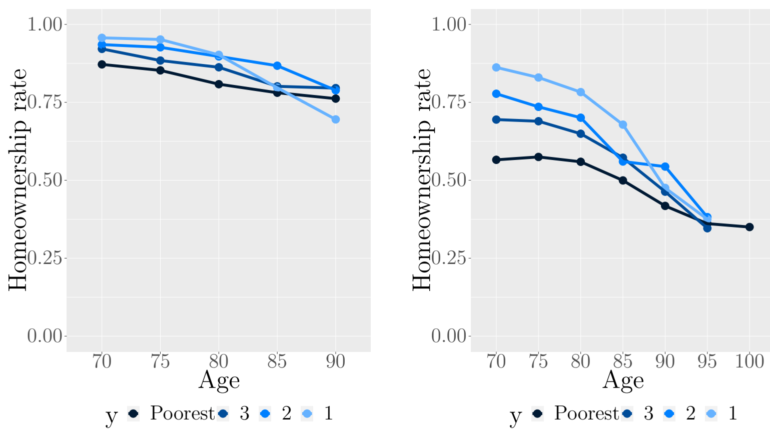
[5]Most retirees in our data have zero outstanding mortgages: the mean ratio of mortgage to housing value is 5%.

[6]Due to inconsistencies in questions in the 1998 wave, we only use data starting in 2000 to measure spousal caregiving.

[7]This is not a balanced sample as individuals often move from married to single over the sample period due to spousal death.

[8]Among single retirees, about 80% are widows and widowers, 6% are people who have never been married, and the remaining 14% are either divorced or have an unknown ending status for their last marriage (divorce or widowhood). When we restrict our definition of singles to widows and widowers only, the pattern in Figure 1 remains almost unchanged.

Figure 1: Homeownership rates by marital status



Couples Singles

Notes: Data = HRS 1998-2014. In each graph, the darker the color, the lower the permanent retirement income (y).

among singles reaches zero for most income quartiles by the age of 90. The stark difference in the housing asset share over time implies that the faster dissaving pattern among singles is restricted to housing assets only. Figure A.2 in the Online Appendix shows that the evolution of non-housing assets over age is similar between couple and single households.

Exploiting the panel nature of the data, we examine how the homeownership rate changes as individuals transition from being married to single due to a spousal death. Figure 2 is drawn using a balanced sample which consists of individuals observed before and after their spousal death. The figure reveals that there is a substantial reduction in the homeownership rate around the time of spousal death across all income groups.

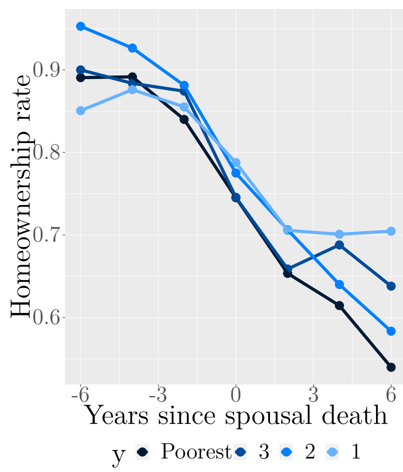
2.3 Potential mechanisms

We now provide descriptive patterns that may shed light on the stark difference in housing decisions between couples and singles in retirement. In doing so, we exploit plausibly exogenous variations including mortality shocks, sudden deterioration in health, and states' Medicaid estate recovery policies.

2.3.1 Long-term care and housing

We first examine how different long-term care arrangements are by marital status as the type of care received can significantly impact housing decisions. For instance, a high likelihood of

Figure 2: Homeownership rate before and after spousal death



Notes: Data = HRS 1998-2014. Sample consists of initial couples who experience spousal death and never remarry. The figure presents the homeownership rate before and after spousal death across household income quartiles (y). The darker the color, the lower the household income.

a lengthy nursing home stay might increase the incentive to sell one's home. We define our care sample as a group of disabled individuals who receive either formal or informal care. We consider an individual to be disabled if they report having two or more limitations in carrying out activities of daily living (ADLs).[9]

Table 1 demonstrates significant differences in long-term care arrangements based on marital status. Firstly, spousal caregiving is the primary mode of long-term care for married individuals, with over 80% of couples in the care sample receiving care from their spouse. While singles do not have access to spousal care by definition, over half of them rely on care provided by their adult children. Among married individuals, the share relying on children's care is lower at 30%. As couples have a higher chance of receiving informal care at home due to their access to spousal care, they may place a higher value on homeownership. Indeed, as reported in Table B.1 of the Online Appendix, we find that widows and widowers who provided careigving to their deceased spouse are more likely to sell their home than their counterparts who did not provide care. The result provides suggestive evidence that spousal caregiving strengthens homeownership among couples.

Secondly, singles have a higher likelihood of receiving institutional care. While over 50% of disabled singles use nursing home care services, only about 30% of disabled couples rely

[9]The HRS asks about difficulty in carrying out five ADLs, which are bathing, dressing, eating, getting in/out of bed and walking across a room.

Table 1: Long-term care arrangements by marital status

	Married	Single
Caregiving by spouse	0.82	0.00
Caregiving by children	0.30	0.55
Nursing home care	0.30	0.53
Homeowner	0.76	0.35
Observations	2429	4220

Notes: Care sample is used which consists of disabled retirees who receive either informal or formal long-term care.

on nursing home care. As residing in a nursing home prevents individuals from deriving a consumption flow from their house, singles' increased risk of nursing home care may reduce their homeownership relative to couples.

2.3.2 Medicaid's treatment of the home

We now explore how Medicaid, a means-tested public long-term care insurance program, can shed light on the varying housing decisions between couples and singles. In the U.S., formal long-term care is costly, with median nursing home costs exceeding $90,000 annually in 2017.[10] Medicaid, funded by federal and state governments, is the main payer for nursing homes, supporting 6 out of 10 residents in 2015.

When determining Medicaid eligibility, the home is an excluded resource regardless of its value (Department of Health and Human Services, 2005). However, if a recipient no longer has a living spouse in the home or an unmarried recipient moves into a nursing home without the intention to return, the house loses its protected status as it is no longer a "home".[11] In principle, there are two ways Medicaid can make recipients pay for nursing home expenses from their housing wealth when the house is no longer a home. The first is to deny coverage by counting the housing value against Medicaid eligibility. However, as individuals can easily obtain an exemption by stating their intent to return from a nursing home, in practice this rarely happens (Department of Health and Human Services, 2005). The second is to place liens on the home and recover Medicaid-paid long-term care costs from the recipient's estates upon death. A study by Greenhalgh-Stanley (2012) used policy variations across states and found that estate recovery indeed reduces singles' homeownership.

[10] Genworth, https://www.genworth.com/aging-and-you/finances/cost-of-care.html.

[11] Medicaid also counts the value of the home if it is transfered within a specified period (3-5 years) prior to applying for Medicaid long-term care.

Using a longer sample period encompassing more policy changes compared to Greenhalgh-Stanley (2012), we examine potentially heterogeneous impact of the estate recovery program on retirees' housing decisions based on marital status.[12] The most popular component of the program is known as a TEFRA (Tax Equity and Fiscal Responsibility Act) lien, which is placed on the homes of permanently institutionalized beneficiaries to ensure that states can recover their costs from the estates (Greenhalgh-Stanley, 2012). Consistent with Medicaid's treatment of housing assets for couples, TEFRA liens cannot be placed when there is a surviving spouse living in the home (Greenhalgh-Stanley, 2012). We estimate

$$Y_{ist} = \beta D_{ist}^{TEFRA \times Single} + \delta D_{st}^{TEFRA} + \eta D_{ist}^{Single} + \rho X_{ist} + \gamma_s + \phi_t + u_{ist} \tag{1}$$

The outcome variable is the homeownership status of individual i living in state s in year t. D_{st}^{TEFRA} is an indicator variable for whether a TEFRA lien is in place. D_{ist}^{Single} is an indicator variable for whether the individual is single. $D_{ist}^{TEFRA \times Single}$ is an indicator variable for whether the individual is single *and* a TEFRA lien is in place. The coefficient β therefore represents how TEFRA liens affect homeownership of singles relative to couples. We control for state and year fixed effects and include individual demographics contained in X_{ist}. We estimate equation (1) using restricted HRS data that contain geographic information.

Table 2 reports the results. We find that TEFRA liens discourage homeownership among singles relative to couples. Specifically, a state's implementation of TEFRA liens reduces singles' homeownership rate by 8.9 percentage points. The results are consistent with Greenhalgh-Stanley (2012) who also find that Medicaid estate recovery programs reduce singles' homeownership relative to couples.[13]

We conduct additional descriptive analyses using variations in estates recovered and the timing of spousal death, reported in Tables B.3 and B.4 in the Online Appendix. The results consistently provide descriptive evidence that Medicaid's differential treatment of homes based on marital status could be a significant factor contributing to the higher home-ownership rate among retired couples compared to singles.

[12] The sample period in our study is from 1998 to 2014, while the sample period in Greenhalgh-Stanley (2012) is from 1993 to 2004. By 2014, TEFRA liens were adopted by 25 states, whereas by 2004, 19 states had implemented them.

[13] According to Greenhalgh-Stanley (2012), the homeownership rate for singles in TEFRA lien states decreases by 3 percentage points compared to couples. This finding is based on analyzing the AHEAD cohort, which consists of elderly individuals aged seventy and older in 1993, and tracking them until 2004 or their death.

Table 2: TEFRA liens and homeownership

	Own home	
TEFRA x Single	-0.089	(0.036)
TEFRA	0.036	(0.054)
Single	-0.175	(0.025)
Mean of dependent variable	0.68	
Observations	1947	

Notes: Standard errors are in parentheses and are clustered at the household-state level. Restricted HRS data from years 1998-2014 used. Linear probability model is used. Not all controls shown including age, gender, number of children, income, non-housing assets, and year, state, and birth cohort fixed effects. See Table B.2 in the Online Appendix for the estimated coefficients of other independent variables. The sample consists of respondents living in states that adopted TEFRA liens before and during the sample period.

2.3.3 Bequest motives and housing

Couples and singles may have heterogeneous bequest motives, which could contribute to the difference in their housing decisions. For example, bequest utility from leaving housing assets relative to liquid assets may differ depending on whether the recipient is a child or a surviving spouse. To explore potential differences in bequest motives based on marital status, we examine changes in housing decisions in response to increased mortality risk.

We conduct a regression analysis where the dependent variable is the sale of an individual's home. The key independent variable is an indicator for a significant increase in mortality risk, interacted with marital status. We identify unanticipated increases in mortality risk based on self-reported changes in health.[14] As individuals might sell their home to prepare for large medical expenditures, we control for income and liquid assets as well as coverage by government health insurance and private long-term care insurance. Additionally, we consider the presence of children as they may influence individuals' decisions to sell their homes.

The results, presented in Table B.5 of the Online Appendix, reveal that an increase in mortality risk significantly increases singles' likelihood of selling their home relative to couples, conditional on other observables. Specifically, the probability increases by 4.8 percentage points which is substantial given the mean selling rate of 6.2%. In contrast, an increase in

[14]In the HRS interviews conducted between 1998 and 2004, respondents were provided with the options of "much better," "somewhat better," "same," "somewhat worse," and "much worse" when reporting their health status. In the interviews conducted between 2006 and 2014, respondents were given the options of "somewhat better," "same," and "somewhat worse." To identify substantial health deterioration, we consider a single individual to have experienced such deterioration if they report "somewhat worse" or "much worse" health compared to their previous interview. For couples, the indicator for substantial health deterioration is set to one if either the respondent or their spouse reports "somewhat worse" or "much worse" health.

mortality risk does not make couples more likely to liquidate their housing assets. The result suggests singles might have a weaker preference for leaving housing bequests than couples.

2.4 Income-pooling test

In this final descriptive exercise, we investigate whether married retirees' consumption-savings behaviors align with a unitary model, a widely used approach in the literature (e.g., Braun, Kopecky, and Koreshkova (2017), Nakajima and Telyukova (2020), and De Nardi, French, Jones, and McGee (2021)). According to the unitary model, household behavior should not be influenced by distribution factors such as individual income, once total household resources are taken into account. However, numerous studies have tested and rejected the income-pooling implication of unitary models.[15] Nevertheless, there is a lack of evidence specifically focusing on retired couples. We examine the income-pooling hypothesis in our HRS sample by analyzing the impact of the wife's relative retirement income on household consumption and savings, while controlling for household resources and the survivor's expected benefits.

We measure the wife's relative income as the ratio of her retirement income to the household retirement income.[16] On average, the wife's income accounts for 35% of the household income. To measure consumption, we use the subsample of the HRS respondents that were selected at random and surveyed about their consumption behaviors in the Consumption and Activities Mail Survey (CAMS). Our measure of consumption is the sum of all of the consumption in the household, including nondurable, durable, housing and transportation consumption. We also compute the household savings as the change in total assets from the previous interview wave, which include liquid and housing assets.

The regression we estimate is

$$Y_{it} = \beta \, \text{wife's income share}_i + \delta \, \text{survivor's expected income}_i + \rho X_{it} + \phi_t + u_{it} \tag{2}$$

For the outcome variable of married household i in year t, we consider logged consumption and savings. The vector X_{it} includes household income and assets, as well as various individual characteristics.[17] The key coefficient of interest is β for the wife's income share.

[15] See Chiappori and Mazzocco (2017) for an excellent review of the literature.

[16] In the HRS, all incomes are reported at the individual level except for capital and other income which are reported at the household level. To define each spouse's individual income, we divide these two measures by two.

[17] We include household members' age, health, education, insurance coverage, number of children etc.

Table 3: Intrahousehold income distribution and savings

	(1) Log of consumption		(2) Change in assets	
Wife's income share	-0.26	(0.08)	181620	(52475)
Mean of dependent variable	10.92		-49541	
Observations	2654		15927	

Notes: Standard errors are clustered at the household level and are in parentheses. HRS 1998-2014 used. Not all controls are shown, including survivor's expected income, household assets and income, cohort and year fixed effects, and various individual characteristics. See Table B.6 in the Online Appendix for the coefficient estimates of other independent variables.

According to a unitary framework for retired couples, the budget constraint will be written with pooled resources. Each spouse's retirement income will matter only through the survivor's benefits that enter the continuation value in the presence of mortality risk. We construct and include the survivor's expected benefits based on the policies associated with each retirement income source, detailed in the Online Appendix B.4.

Table 3 reports the results. Column (1) shows that as the wife's relative income increases by 10 percentage points, log of consumption decreases significantly by 0.026. Column (2) reports that as the wife's relative income increases by 10 percentage points, household biannual savings increase significantly by about $18,162. While the results in Table 3 contradict the unitary model, they align with a collective model in which individual income shares affect household members' relative Pareto weight. Due to women's stronger precautionary savings motives, household savings are expected to increase in their bargaining power. Motivated by such evidence, our non-unitary model presented in the next section allows for varying Pareto weights across households and over time.

3 Model

The model presented in this section describes retirees' housing, long-term care arrangement, and consumption-savings decisions in the face of health and mortality shocks. Time, t, is discrete and finite and represents the household head's age. As the HRS interviews are carried out biannually, each period lasts two years: $t = 65, 67, ..., 99$. All individuals are married in the initial period but might become a single in subsequent periods if they outlive their spouse. We use a collective household model to describe couples' decision making process. The model incorporates welfare programs including Medicaid as a lower bound on consumption. Table C.1 in the Online Appendix summarizes model variables.

3.1 Timing

All individuals are married in the initial period. At the start of each subsequent period, mortality shocks are realized. In the event of death, if there is a surviving spouse, he or she keeps the household assets. If there is no surviving spouse, the household assets are bequeathed to children. In the event of survival, health risk is first realized. If there is a sick member in the household, long-term care arrangements are determined which could be either spousal care, nursing home care, or informal care provided by adult children. Homeowners then decide whether to sell their home, and renters choose housing services. The government makes transfers to guarantee a minimum consumption floor. Finally, the household chooses consumption.

3.2 Preferences

Single retirees' flow utility is given as

$$u(c_t, h_t) = \frac{{c_t}^{1-\gamma} - 1}{1-\gamma} + \sigma \frac{{h_t}^{1-\gamma} - 1}{1-\gamma} \tag{3}$$

They have additively separable preferences for consumption c_t and housing services h_t similar to Fisher and Gervais (2011), which follow a constant relative risk aversion utility function.

Married individuals are endowed with their own separate utility:

$$\text{Husbands:} \qquad u(c_t^H, h_t^H) \tag{4}$$

$$\text{Wives:} \qquad u(c_t^W, h_t^W) - \psi_{\tilde{h}_t, y} P_t^W \tag{5}$$

We use superscript H for husbands and W for wives. We index each spouse's consumption and housing services separately because as we will describe shortly, the two spouses might enjoy different levels of consumption and housing services depending on their nursing home residency. P_t^W is an indicator for providing spousal care to a disabled husband. As most spousal caregiving hours are provided by wives, we assume only wives can provide spousal care. $\psi_{\tilde{h}_t, y}$ represents wives' caregiving disutility. It could potentially depend on housing assets $\tilde{h}_t$ to capture possible complementarity between homeownership and spousal caregiving.[18] The caregiving disutility is also allowed to vary by household income y.

[18] Home modifications or improvements facilitate long-term care, and they can be done more conveniently in owned houses than in rented properties.

When there is no surviving spouse, utility from bequests depends only on total assets that the individual leaves behind, b_t. Specifically, if the individual's non-housing wealth at the time of death is a_t and housing wealth is $\tilde{h}_{t-1}$, then

$$b_t = a_t + (1-\tau)\tilde{h}_{t-1} \tag{6}$$

where τ represents the transaction cost from selling home. Utility from bequests when there is no surviving spouse is

$$v^S(b_t) = \delta_1 \frac{(a_{b1} + b_t)^{1-\gamma} - 1}{1-\gamma} \tag{7}$$

The parameter $a_{b1} \geq 0$ represents the threshold of consumption level below which the individual does not leave any bequests under conditions of perfect certainty. This is a commonly used functional form to model single retirees' bequest utility in the literature (e.g., De Nardi (2004), De Nardi, French, and Jones (2010), and Lockwood (2018)).

If a deceased individual is survived by a spouse, utility from bequests is

$$v^M(a_t, \tilde{h}_{t-1}) = \delta_2 \left(\frac{(a_{b2} + a_t)^{1-\gamma} - 1}{1-\gamma} + \sigma \frac{(h_b + \tilde{h}_{t-1})^{1-\gamma} - 1}{1-\gamma} \right) \tag{8}$$

There are two things to note about the utility specification above. First, we take a "warm-glow" approach where the bequest utility is determined by the assets that the deceased individual leaves behind.[19] Second, in contrast to (7), non-housing (a) and housing assets ($\tilde{h}$) are not perfect substitutes. This is to incorporate the possibility that the value married individuals derive from bequeathing home to their surviving spouse might be higher than the value singles derive from bequeathing home to their children. For example, Table B.5 in the Online Appendix shows that an increase in mortality risk induces singles to liquidate their home relative to couples, conditional on other observables.[20]

[19]The bequest utility when there is no surviving spouse, specified in equation (7), also takes a warm-glow utility approach.

[20]We have estimated the model using alternative functional forms for bequest utility. For example, we have used the functional form in (7) for couples' bequest utility, allowing the values of (δ_1, a_{b1}) to be different by marital status. We have also used the functional form in (8) for singles' bequest utility, allowing the values of (δ_2, a_{b2}, h_b) to be different by marital status. We found that in both cases, the predicted homeownership rate from the high-income group was very far from the empirical counterpart.

3.3 Consumption

Individual consumption of non-housing goods depends on nursing home (NH) residency:

$$c_t = \begin{cases} \hat{c}_t & \text{if not in NH} \\ c_{nh} & \text{if in NH} \end{cases} \tag{9}$$

When the individual is not in a nursing home, the individual gets to choose his consumption denoted by $\hat{c}_t$. If the individual is in a nursing home, then his consumption is fixed to the basic consumption level c_{nh} provided by nursing home care.

The household consumption expenditure is given as

$$x_t = \begin{cases} [(\hat{c}_t^H)^\rho + (\hat{c}_t^W)^\rho]^{\frac{1}{\rho}} & \text{for couples} \\ \hat{c}_t & \text{for singles} \end{cases} \tag{10}$$

$\rho \geq 1$ means there are economies of scale for couples' consumption. When none of the spouses is in a nursing home, then each spouse gets an equal share of the household consumption expenditure, i.e., $\hat{c}_t^j = \frac{x_t}{2^{\frac{1}{\rho}}}$ for $j \in \{H, W\}$.[21] If only one spouse is in a nursing home, then that spouse's consumption expenditure is zero, and the other spouse gets the entire household consumption expenditure. If both spouses are in a nursing home, then the household will optimally choose $x_t = 0$.

3.4 Housing

Each family enters period t with initial housing assets denoted by $\tilde{h}_{t-1} \geq 0$. $\tilde{h}_{t-1} > 0$ means the household is a homeowner, and $\tilde{h}_{t-1} = 0$ means the household is a renter. Switching from a renter to a homeowner is rare in retirement, so we assume renting is an absorbing state.[22] Homeowners decide whether they sell home ($D_t = 1$) or keep it ($D_t = 0$). As in Nakajima and Telyukova (2020) and Achou (2021), we do not allow homeowners to switch houses unless they become a renter based on the fact that retired homeowners rarely downsize.

[21] With ideal data, one could make the relative Pareto weights affect each spouse's share of the household consumption expenditure. As we lack individual-level consumption data, we impose the equal division rule when both spouses are living in community.

[22] In the HRS data, less than 10% of retirees purchase a new home.

After homeonwers' liquidation decision, housing assets are updated as the following:[23]

$$\tilde{h}_t = \begin{cases} \tilde{h}_{t-1} & \text{if } \tilde{h}_{t-1} = 0 \text{ or } (\tilde{h}_{t-1} > 0 \text{ and } D_t = 0) \\ 0 & \text{if } \tilde{h}_{t-1} > 0 \text{ and } D_t = 1 \end{cases} \tag{11}$$

Households with $\tilde{h}_t = 0$ decide on renting services, denoted by R_t.

Individual consumption of housing services depends on homeownership, marital status, and nursing home residency:

$$h_t = \begin{cases} \omega_{couple}\tilde{h}_t & \text{if not in NH, homeowner, and couple} \\ \omega_{single}\tilde{h}_t & \text{if not in NH, homeowner, and single} \\ R_t & \text{if not in NH and renter} \\ h_{nh} & \text{if in NH} \end{cases} \tag{12}$$

If an individual is a homeowner, then the individual's housing consumption is equal to the home's value multiplied by the homeownership premium which varies by marital status. This premium is lower for singles ($\omega_{couple} > \omega_{single}$) due to their higher likelihood of moving into their child's home, representing a greater opportunity cost of homeownership.[24] The lower premium also accounts for potentially higher maintenance costs for singles (de Ruijter, Treas, and Cohen, 2005). For renters, they derive utility from the rented housing service R_t. For individuals in nursing homes, housing consumption is determined by the basic housing value from nursing home care h_{nh}.

Housing expenditure in each period is

$$e(\tilde{h}_t, R_t) = \begin{cases} \delta\tilde{h}_t & \text{if } \tilde{h}_t > 0 \\ (r+\delta)R_t & \text{if } \tilde{h}_t = 0 \end{cases} \tag{13}$$

where δ is the depreciation rate, and r is the real interest rate. Liquidating housing assets worth of $\tilde{h}$ incurs transaction costs $\tau\tilde{h}$.

[23]Housing assets are risk-free in our model. Admittedly, this is a simplifying assumption. However, our primary goal is to understand different homeownership incentives between couples and singles. As house price shocks are aggregate shocks that should have similar effects on housing decisions of couples and singles, we abstract from them.

[24]In the HRS data, 18% of singles who sell their house upon spousal death move into their children's home.

3.5 Household income

In the initial period, all individuals are married and receive household retirement income y. We consider three values of y to capture cross-sectional income heterogeneity. Households keep receiving y in each period as long as they remain a couple. When an individual becomes a single followed by spousal death, the individual's per-period income becomes $0.5y$ for the remaining life cycle, based on the empirical change in household income after spousal death.

3.6 Health and mortality risk

We consider three health statuses: $s_t \in$ {healthy, require long-term care, dead}. Health transition probabilities follow a Markov chain and depend on the individual's current health, age, gender, and initial household income:

$$\pi(s_{t+1}|s_t, age_t, sex, y). \tag{14}$$

The health transition process is exogenous and does not depend on the receipt of care. This is based on previous studies which find that the evolution of elderly health is largely unaffected by the receipt of care (Finkelstein and McKnight, 2008; Card, Dobkin, and Maestas, 2008).

3.7 Long-term care arrangements

We model different long-term care options based on marital status and gender. To reduce the computational burden, we assume disabled individuals receive one type of care at a time. Table 1 shows that for singles, children are the major source of long-term care.[25] As previous studies find that individuals prefer family care over formal care (Barczyk and Kredler, 2018; Mommaerts, 2016; Ko, 2022), we assume disabled singles rely on care provided by children if it is "available" ($ic_{child} = 1$) , and resort to formal care only when it is not ($ic_{child} = 0$).[26]

[25] While papers like Barczyk and Kredler (2018), Ko (2022), and Mommaerts (2016) have children as active agents taking a part in long-term care arrangement decisions, we do not pursue that route as our focus is not on intergenerational interactions.

[26] The HRS asks "Suppose in the future, you needed help with basic personal care activities like eating or dressing. Will your daughter/son be willing and able to help you over a long period of time?" If the answer is positive for any of the respondent's children, we assume informal care from children is available ($ic_{child} = 1$). Otherwise, we assume it is not ($ic_{child} = 0$) and the single individual uses nursing home care whenever the individual becomes sick. We have verified that the reported beliefs are reasonable by comparing them to the actual receipt of informal care from children.

We abstract from the possibility that children help their parents pay for formal care services as such transfers are negligible in the data.[27]

A disabled husband can either use formal care or receive spousal care from his healthy wife. We abstract from the possibility that the disabled husband receives informal care from his children. This is based on the empirical fact that care from children is rarely used as a single source of care for disabled husbands.[28] Whether the husband receives formal care or spousal care will be determined by the household's collective decision making process. Women usually develop long-term care needs after their husband has passed away.[29] In the unlikely scenario that a female individual requires long-term care while still married, she uses formal care.[30]

We focus on nursing home care as the sole form of formal long-term care, based on the following grounds. First, nursing homes are the largest financial long-term care risk faced by the elderly: Kemper, Komisar, and Alecxih (2005/2006) find that a person turning 65 in 2005 can expect to spend about \$47,000 on formal care before death, most of which is on facility care at about \$39,000. Second, the lion's share of Medicaid long-term care spending (about 70%) is attributed to nursing homes. Third, Medicaid's asset test rules regarding housing change dramatically by nursing home residency, but not by paid home care use.

3.8 Medicaid and government transfers

Government guarantees a minimum consumption floor through means-tested welfare programs such as Medicaid and SSI. To simplify notations, we define the household's cash-at-hand before government transfers as

$$\tilde{a}_t = a_t + I[n_t = 2]y + I[n_t = 1]0.5y + \underbrace{I[D_t = 1](1-\tau)\tilde{h}_{t-1} - e(\tilde{h}_t, R_t)}_{\text{net proceeds from housing decisions}} - \underbrace{m_t}_{\text{cost of NH}} \tag{15}$$

[27]Among disabled parents who use formal long-term care, the mean financial transfer received from their children is merely \$300 annually (Ko, 2022).

[28]Among disabled husbands that receive informal care from their children, 80% also receive care from their wife. In contrast, spousal care and nursing home care are often used as the only source of care.

[29]In the HRS data, among male individuals that develop long-term care needs, about 70% have their onset while they are married. Among female individuals that develop long-term care needs, only about 20% have their onset while married.

[30]We abstract from the possibility that husbands provide care as most spousal caregiving hours are provided by wives. We could alternatively have the disabled wife receive informal care from her children if it is available. However, in the HRS data, the formal long-term care usage rate is higher than the informal care rate from children among married women.

n_t represents the number of members in the household where $n_t = 2$ means a couple and $n_t = 1$ means a single. $D_t = 1$ means the household sells home. $e(\cdot, \cdot)$ is the housing expenditure. m_t represents the cost of nursing home care and is strictly positive only for nursing home users.[31]

The amount of government transfers that singles receive is

$$tr_t = \begin{cases} \max\{0, \bar{a}_{nh=0} - \tilde{a}_t\} & \text{if single and not in NH} \\ \max\{0, \bar{a}_{nh=1} - (\tilde{a}_t + (1-\tau)\tilde{h}_{t-1})\} & \text{if single and in NH} \end{cases} \tag{16}$$

For non-institutionalized singles, the government offers the homestead exemption by excluding housing assets from the eligibility test. Only the liquid assets at hand $\tilde{a}_t$ are considered, and the government makes transfers to ensure the consumption floor for non-institutionalized singles denoted by $\bar{a}_{nh=0}$. For singles in a nursing home, their post-sales housing assets are counted. Eligible single homeowners must first liquidate their home to pay for nursing home care, and then the government makes transfers to ensure the consumption floor for institutionalized singles $\bar{a}_{nh=1}$.[32] This is how the model incorporates the fact that for institutionalized single retirees, Medicaid treats the house as an asset available to pay for long-term care.[33] Alternatively, we can have Medicaid pay first and then have it recover from beneficiaries' house upon death, which is closer to the reality as described in Section 2.3. As recovering from housing estates is almost identical to making the beneficiary pay with their housing wealth before Medicaid benefits, we model the latter to avoid keeping track of Medicaid-paid costs as an additional state variable.[34]

[31] We abstract from private long-term care insurance which pays for formal long-term care costs before Medicaid. In the data, the private insurance ownership rate is less than 10%. In contrast to a common misconception, Medicare does not pay for prolonged nursing home stays.

[32] As nursing home residents already receive basic food and housing from the facility, we have $\bar{a}_{nh=0} > \bar{a}_{nh=1}$.

[33] To keep the computation tractable, we do not model different states and assume the Medicaid estate recovery program is effective. As of 2014, estate recovery programs were implemented in all 50 states, plus the District of Columbia, with around one half of them incorporating TEFRA liens. If we were to relax the effectiveness of the estate recovery program, the program's impact on retirees' housing decisions would be reduced.

[34] The alternative specification will yield a similar equilibrium outcome where most singles liquidate their home before becoming a Medicaid nursing home resident. This is because nursing home events happen towards the end of life and the probability of moving back home is very small. As one cannot derive consumption utility from homeownership while living in a nursing home, the estate recovery will induce singles to sell their home.

The amount of government transfers that couples receive is

$$tr_t = \begin{cases} \max\{0, 1.5\bar{a}_{nh=0} - \tilde{a}_t\} & \text{if couple and none in NH} \\ \max\{0, \bar{a}_{nh=0} + \bar{a}_{nh=1} - \tilde{a}_t\} & \text{if couple and one in NH} \\ \max\{0, \bar{a}_{nh=1} - \tilde{a}_t\} & \text{if couple and both in NH} \end{cases} \tag{17}$$

The consumption floor for non-institutionalized couples is assumed to be 1.5 times the consumption floor for non-institutionalized singles, $\bar{a}_{nh=0}$, as in De Nardi, French, Jones, and McGee (2021).[35] The key difference from equation (16) is that housing assets are disregarded by Medicaid when a married individual ends up in a nursing home. This is consistent with the Medicaid rules which provide the homestead exemption to married households in a nursing home, as explained in Section 2.[36] The favorable treatment of the house for couples could induce them to maintain homeownership for a longer period of time relative to singles.

3.9 Asset accumulation law

Non-housing assets tomorrow become

$$a_{t+1} = (1 + r)(\tilde{a}_t + tr_t - x_t) \tag{18}$$

x_t is the household consumption expenditure described in equation (10). We assume there is no borrowing. Furthermore, we abstract from reverse mortgages which enable households to borrow against their home equity. The choice is based on the empirical fact that almost no retirees use such loans: according to Nakajima and Telyukova (2017), only 1.9% of eligible homeowners were reported to use reverse mortgages in 2013.[37]

[35] Later, we calibrate $\bar{a}_{nh=1}$ to be zero as in Lockwood (2018). Hence, the consumption floor for institutionalized couples would be zero regardless of the constant in front of $\bar{a}_{nh=1}$.

[36] In the unlikely scenario that both spouses end up in a nursing home, we could alternatively have Medicaid count the value of the house in its means test. However, as the probability of both the husband and the wife becoming disabled is small, the alternative specification has little impact on model outcomes.

[37] Nakajima and Telyukova (2017) find that bequest motives, uncertain medical expenses, and loan costs account for low demand of reverse mortgage loans.

3.10 Recursive formulation

We provide a recursive formulation for a couple's problem. In each period, a married household's state vector is given as

$$z_t = (a_t, \tilde{h}_{t-1}, s_t^H, s_t^W; y, ic_{child}) \tag{19}$$

where a_t is the non-housing wealth, $\tilde{h}_{t-1}$ is the housing wealth at the beginning of the period, and s_t^j is the health status of each spouse, $j \in \{H, W\}$. Time-invariant state variables are household income y and the availability of informal care from children ic_{child}.

The household's choice vector is

$$q_t = (D_t, R_t, P_t^W, x_t) \tag{20}$$

where $D_t \in \{0, 1\}$ represents the house selling choice, $R_t \geq 0$ is the rent choice, $P_t^W \in \{0, 1\}$ is the spousal caregiving choice, and $x_t \geq 0$ is the household consumption expenditure.

Denote the survival probability by χ which depends on current health, age, gender, and income, as stated in equation (14). A recursive formulation for a couple's problem is:

$$\begin{aligned}
V_t^M(z_t) \quad &= \max_{q_t} \quad \kappa_{it} u(c_t^H, h_t^H) + (1-\kappa_{it}) \left[u(c_t^W, h_t^W) - \psi_{\tilde{h},y} P_t^W \right] \\
&+\beta \chi_t^H \chi_t^W E[V_{t+1}^M(z_{t+1}) | z_t, q_t] \\
&+\beta (1-\chi_t^H) \chi_t^W E\left[\kappa_{it} v^M(a_{t+1}, \tilde{h}_t) + (1-\kappa_{it}) V_{t+1}^{S,W}(z_{t+1}) | z_t, q_t \right] \\
&+\beta \chi_t^H (1-\chi_t^W) E\left[\kappa_{it} V_{t+1}^{S,H}(z_{t+1}) + (1-\kappa_{it}) v^M(a_{t+1}, \tilde{h}_t) | z_t, q_t \right] \\
&+\beta (1-\chi_t^H)(1-\chi_t^W) E\left[v^S(b_{t+1}) | z_t, q_t \right]
\end{aligned} \tag{21}$$

subject to budget constraints. V^M represents a married household's value function. β is the discount factor. The expectation operator is taken with respect to health statuses of the next period. $V^{S,j}$ represents a single retiree's value function when the retiree's gender is $j \in \{H, W\}$, which we derive in the Online Appendix.

The variable κ_{it} represents the relative Pareto weight on the husband. To emphasize cross-sectional heterogeneity, we subscript it with the household index i. Specifically, we allow the Pareto weights to depend on whether the wife's retirement income exceeds 50% of the household income. Additionally, the Pareto weights can change over time (indexed by t) based on the realized health gap between the two spouses: i) the husband is disabled while the wife is not, ii) the wife is disabled while the husband is not, and iii) both spouses are in the same health state. Allowing variations in the relative health of the spouses accounts for the possibility that disabled spouses may have reduced bargaining power compared to their healthy partners, which may be particularly important as long-term care needs in old ages are often triggered by cognitive impairment. As we have two values of cross-sectional heterogeneity and three values of across-time variations, we have six values of κ_{it} in total. Among other things, the Pareto weights act to resolve the tension that arises from different precautionary savings motives between husbands and wives.

4 Estimation

To estimate our model, we employ a two-step estimation procedure as frequently done in the literature. In the first step, we fix or estimate parameters outside the model. In the second step, we use the simulated method of moments to estimate structural parameters within the model. For estimation, we use nine interview waves which happened biannually from 1998 to 2014. We include details on sample selection procedure and summary statistics of initial conditions in Section D.1 of the Online Appendix.

4.1 First-stage parameters

The model assumes health transition probabilities follow an exogenously given Markov process, where the health status in the next period is determined by the current health, age, gender, and permanent income. We estimate the health transition probabilities by maximum likelihood estimation using a flexible logit. The estimates show that life expectancy is longer for women and higher-income people, and the probability of developing long-term care needs over the life-cycle is higher for women and lower-income individuals.[38] The OECD modified equivalence scale assigns a value of 1 to the household head and 0.5 to the spouse. Based on this, we set the parameter on economies of scale in consumption for couples at 1.5.

We assume a coefficient of relative risk aversion of 3 for both consumption and housing. Following Brown and Finkelstein (2008), we use 3% time preference rate per year and 3% annual real interest rate. We consider three values of permanent income which correspond to the 20th, 55th and 80th percentiles of the income distribution in the sample.

We set the depreciation rate for housing assets at 1% per year. This value compares to the calibrated value of 1.7% in Nakajima and Telyukova (2020). We set the homeownership premium for married couples so that the same magnitude of economies of scale applies to

[38]For healthy 60-year-olds, the life expectancy is 77 years for men while it is 81 years for women; the expected number of years with long-term care needs is 4 years for men while it is 6.5 years for women.

consumption and housing services. Given this condition, we set married couples' homeownership premium at 2.725 and that of singles at 2.162 so that the average homeownership premium is 2.5 as in Nakajima and Telyukova (2020). We set the transaction cost of selling a house at 7% of the house value, following Gruber and Martin (2003).

For formal care prices, we use the average rates in 2008 which was \$230 per day for nursing home care (MetLife, 2008). We set the per-capita consumption floor for nursing home residents to zero (Lockwood, 2018). We set the consumption and housing value of nursing home services to be 40% of the consumption floor of non-nursing home residents, $\bar{a}_{nh=0}$, which we calibrate at \$420 per month. This is comparable to the values in the literature: \$545 per month in Brown and Finkelstein (2008) and \$342 per month in De Nardi, French, Jones, and McGee (2021).

4.2 Structural estimation

4.2.1 Identification strategy

We now provide identification arguments for the parameters that we estimate within the model. We identify the wife's disutilty from providing care ($\psi_{\tilde{h},y}$) using the frequency of spousal care provision conditional on permanent income group and homeownership status.

The housing consumption utility scale (σ) is identified from variations in housing asset shares. This is because the fraction of total assets invested in housing should inform us about individuals' consumption value for housing relative to general consumption.

To identify the parameters governing bequest utility, we use various moments related to dissaving of assets over the life cycle. As the bequest utility parameters differ by marital status, we use the median non-housing assets not just conditional on age group, but also on marital status. To identify married individuals' utility from bequeathing housing assets, we use the mean homeownership rate of couples across age groups.

While couples' savings decisions are influenced by both the Pareto weights and bequest motives, the latter plays a marginal role among low-income couples given that bequests are modeled as luxury goods. Consequently, the savings behavior of low-income couples provides valuable information for separately identifying the Pareto weights from bequest parameters. In this regard, we include the homeownership of low-income households and attempt to match it before and after spousal death as in Figure 2.

Our framework accommodates both cross-sectional and across-time variations in the Pareto weights, κ_{it}. Cross-sectional heterogeneity is captured by the dependence of κ_{it} on whether the wife's income share exceeds 50%. In the data, 16% of couples have the wife's income share greater than 50%. The variations in the evolution of couples' assets and spousal care rates across distinct income share groups are informative about cross-sectional heterogeneity in κ_{it}. As women's bargaining power increases, the model predicts higher savings and lower spousal care provision.

Across-time variations in κ_{it} are generated by the realization of the couple's relative health, which can take three values. To identify, we exploit variations in the savings rate across different relative long-term care states of the couple. Specifically, we use couples' savings rate during the ages 60-73, conditional on (i) exclusive nursing home care usage by the husband during this period; (ii) exclusive nursing home care usage by the wife; and (iii) remaining scenarios, encompassing cases where neither or both spouses utilize nursing home care. The empirical savings rate is the highest for the first group, followed by the third group, with the second group exhibiting the lowest rate. As women have stronger incentives to save, these data patterns inform us that married retirees' bargaining power rises with the health advantage of either spouse over the other.

4.2.2 Estimation results

We use the simulated method of moments (SMM) for our estimation. The objective function is to minimize the distance between the model-simulated moments and the empirical moments. We implement this method in a Bayesian way as in Fernandez-Villaverde, Rubio-Ramirez, and Schorfheide (2016).[39]

Conditional on permanent income y, we assume the wife's caregiving disutility when she is a homeowner ($\psi_{\tilde{h}>0,y}$) is proportional to her caregiving disutility when she is a renter ($\psi_{\tilde{h}=0,y}$). We denote the ratio by $\zeta \equiv \psi_{\tilde{h}>0,y}/\psi_{\tilde{h}=0,y}$. For the wife's caregiving disutility, we estimate $\psi_{\tilde{h}=0,y}$ for each value of y and the ratio ζ.

Table 4 reports the estimates of the parameters. The posterior median estimates on the wife's disutility from providing spousal care increase with permanent income. The ratio of the wife's caregiving disutility when she is a homeowner to her disutility when she is a renter has the posterior median value of 0.9197, which is less than 1. The result suggests that there is complementarity between homeownership and spousal care. The posterior median

[39] Additional information can be found in Section D of the Online Appendix. We use uniform (noninformative) priors so that the objective function is identical to the one used in frequentist SMM estimation. In cases where prior knowledge or beliefs regarding parameters are available, informative priors can be employed to integrate them into Bayesian estimation. The selection of suitable informative prior distributions remains a subject of debate, representing an avenue for future research.

Table 4: Parameter estimates

Parameter	Posterior median [5th, 95th percentile]	Parameter	Posterior median [5th, 95th percentile]
Wife's caregiving disutility		Single's bequest utility	
$\psi_{\tilde{h}=0,y=\text{high}}$	0.1443e-6 [0.1389e-6, 0.1475e-6]	δ_1	0.7057 [0.6820, 0.7522]
$\psi_{\tilde{h}=0,y=\text{middle}}$	0.1425e-6 [0.1382e-6, 0.1492e-6]	a_{b1}	11,062 [10,277, 11,138]
$\psi_{\tilde{h}=0,y=\text{low}}$	0.1374e-6 [0.1330e-6, 0.1471e-6]	Men's relative Pareto weights	
ζ	0.9197 [0.8988, 0.9359]	$\kappa_{i=\text{low},t=\text{husband sicker than wife}}$	0.6836 [0.6763, 0.7294]
Weight on housing consumption		$\kappa_{i=\text{low},t=\text{wife sicker than husband}}$	0.9229 [0.9165 0.9350]
σ	0.9214 [0.9071, 0.9422]	$\kappa_{i=\text{low},t=\text{same health}}$	0.8553 [0.8353 0.8650]
Couple's bequest utility			
δ_2	1.4961 [1.4685, 1.5020]	$\kappa_{i=\text{high},t=\text{husband sicker than wife}}$	0.6777 [0.6454 0.6801]
a_{b2}	6,083 [5,624 6,141]	$\kappa_{i=\text{high},t=\text{wife sicker than husband}}$	0.8135 [0.8095 0.8276]
h_b	7,419 [6,770, 7,512]	$\kappa_{i=\text{high},t=\text{same health}}$	0.7629 [0.7338 0.7777]

Notes: The values reported in the square brackets represent the 90% credible intervals, constructed using the 5th and the 95th percentiles of the posterior distribution. The index i in κ_{it} indicates whether the wife's income share is high or low, where we use the threshold of 50%.

value for the weight on housing consumption is 0.9214. This is comparable to 1, which is a commonly used value in the literature as in Fisher and Gervais (2011).

To interpret the parameter estimates associated with bequest utility, we follow the practice in the literature and compute the asset threshold below which individuals do not leave any bequests in a two-period model with perfect certainty about mortality risk. The threshold below which a single household does not leave any bequest is $\underline{a}_S = a_{b1}/\varphi_S$ where $\varphi_S = (\beta\delta_1(1+r))^{\frac{1}{\gamma}}$. Based on our estimates, $\underline{a}_S = \$12,425$, which is smaller than the threshold of \$29,600 found in De Nardi, French, Jones, and McGee (2021). We find stronger bequest motives for singles, which might be due to the fact that in our model, singles face smaller long-term care expenditure risk as they can rely on informal care from children when it is available. To rationalize the same savings patterns with smaller medical expenditure risk, our estimation finds stronger bequest motives for singles. For a married household with a surviving spouse, the non-housing asset threshold is $\underline{a}_M = a_{b2}/\varphi_M$ where $\varphi_M = (\beta\delta_2(1+r))^{\frac{1}{\gamma}}$. Based on our estimates, $\underline{a}_M = \$5,319$. The housing asset threshold is $\underline{h}_M = h_b/(\sigma^{\frac{1}{\gamma}}\varphi_M) = \$6,666$. To the best of our knowledge, we are the first to estimate a bequest utility function of this form. Comparing couples' asset threshold $(\underline{a}_M, \underline{h}_M) = (\$5,319, \$6,666)$ to that of singles $\underline{a}_S = \$12,425$, we conclude couples have stronger bequest motives, consistent with De Nardi, French, Jones, and McGee (2021).

Table 5: Distribution of men's relative Pareto weights conditional on age

		Distribution of men's relative Pareto weights		
	Estimates	Age (60-69)	Age (70-79)	Age (80+)
$\kappa_{i=\text{low},t=\text{husband sicker than wife}}$	0.6836	0.0841	0.1505	0.1965
$\kappa_{i=\text{low},t=\text{wife sicker than husband}}$	0.9229	0.0623	0.1059	0.1605
$\kappa_{i=\text{low},t=\text{same health}}$	0.8553	0.6586	0.5471	0.4453
$\kappa_{i=\text{high},t=\text{husband sicker than wife}}$	0.6777	0.0220	0.0370	0.0484
$\kappa_{i=\text{high},t=\text{wife sicker than husband}}$	0.8135	0.0144	0.0258	0.0395
$\kappa_{i=\text{high},t=\text{same health}}$	0.7629	0.1586	0.1337	0.1098

Notes: The column labeled Estimates reports the posterior median estimates of κ_{it} depending on the wife's income share and the realized health differences within the couple. The remaining columns show the distribution of men's Pareto weights conditional on the age group.

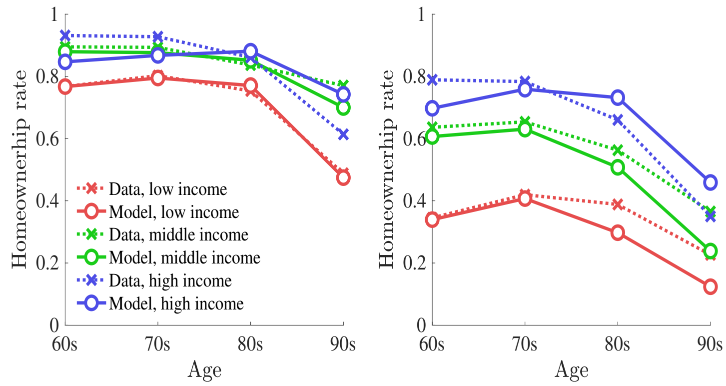
Our estimates for men's relative Pareto weights (κ_{it}) yield several noteworthy results. First, men have larger bargaining power than women. Our six posterior median estimates of κ_{it} are all above 0.5, ranging between 0.6777 to 0.9229. This result is consistent with Voena (2015), who obtained an estimate of 0.7 for men's relative Pareto weight. Second, married retirees' bargaining power increases with their income share. This is evident as $\kappa_{i=\text{high},t} < \kappa_{i=\text{low},t}$ for all t, where i indexes whether the wife's income share is high (above 50%) or low. Third, married retirees' bargaining power increases in their relative health compared to their partner. Our findings therefore align with the notion that disabled spouses generally possess lower bargaining power compared to their healthy partner.

Table 5 reports the distribution of men's Pareto weights over the life cycle. During the early phase of retirement (between ages 60-69), the majority of couples are equally healthy and the distribution of Pareto weights is notably centered around 0.8553 and 0.7629. As couples age, one of the spouses tends to experience a negative health shock, resulting in a more dispersed distribution of the Pareto weights. For example, among the couples where the wife has a low income share which is the majority, the share where the husband has the smallest possible bargaining power ($\kappa_{it} = 0.6836$) increases from just 8% in the 60-69 age group to almost 20% in the 80+ age group. The share where the husband has the largest possible bargaining power ($\kappa_{it} = 0.9229$) also increases sharply from 6% to 16%. The result indicates increasing heterogeneity in bargaining power towards the end of life.

4.2.3 Model fit

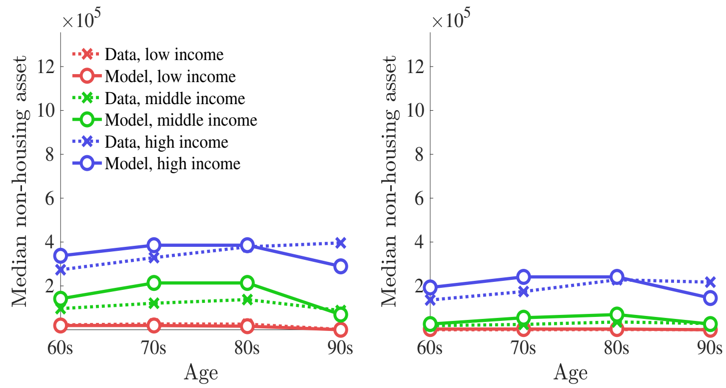
Panel A in Figure 3 illustrates that the model effectively regenerates the life-cycle profiles of the homeownership rate for both couples and singles across different permanent income

Figure 3: Model fit of housing and non-housing savings



Currently couples   Currently singles

Panel A



Currently couples   Currently singles

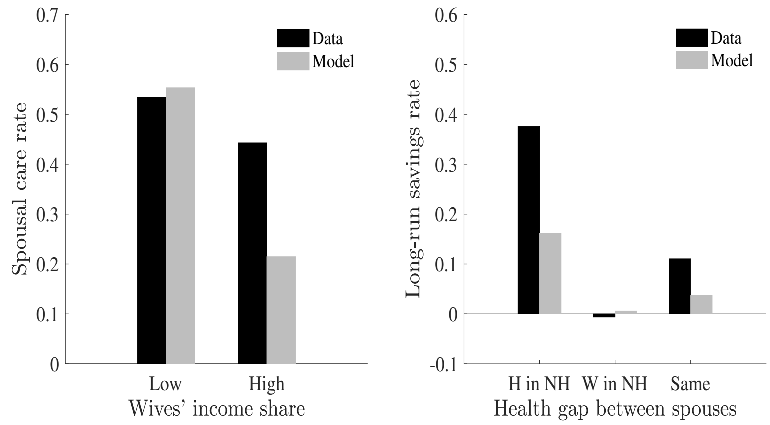
Panel B

Notes: The figure shows the model fit for the life-cycle homeownership rate (Panel A) and non-housing assets (Panel B) by permanent income and marital status. In each graph, dashed lines with cross markers represent empirical moments, and solid lines with circle markers represent model-simulated moments.

groups. Panel B in Figure 3 shows that the model does a reasonable job of matching the life-cycle profiles of non-housing assets conditional on income groups and marital status.

Figure 4 displays the fit of the moments closely related to the Pareto weights of men and women. In the left graph, we report the empirical and simulated spousal care rates conditional on whether the wife's income share is "Low" or "High", using a threshold of 50%. As cross-sectional heterogeneity in the Pareto weights is captured by the dependence on the wife's income share, the variations across distinct income share groups are crucial in identifying heterogeneity in bargaining power. Our model does a decent job of matching the

Figure 4: Model fit of moments associated with Pareto weights



Notes: The figure shows the fit of the moments associated with Pareto weights. The left graph presents the spousal care rate, categorized by the wife's income share. The right graph shows the long-run savings rate between household heads' early 60s and early 70s, conditional on the health gap between spouses. The groups include: "H in NH" couples with only the husband using nursing home care; "W in NH" couples with exclusive nursing home care usage by the wife; and "Same," encompassing scenarios where neither or both spouses use nursing home care.

higher spousal care rate observed among couples where the wife has a low income share.

The right graph in Figure 4 reports the average savings rates across different relative long-term care states of couples, which provide useful information for identifying the time-varying dependence of bargaining power on the realized health gap between spouses. The savings rate is computed as the change in total assets between household heads' early 60s and early 70s. As mentioned in Section 4.2.1, we exploit variations in savings conditional on (i) exclusive nursing home care usage by the husband during this period; (ii) exclusive nursing home care usage by the wife; and (iii) remaining scenarios, encompassing cases where neither or both spouses utilize nursing home care. Our estimated model is able to replicate the empirical pattern that the savings rate increases with the wives' health advantage over their husbands.

Table 6 presents the model fit of untargeted moments associated with Medicaid usage. Our model demonstrates a good fit for the Medicaid recipiency rate among couples. While it slightly underpredicts the Medicaid recipiency rate for singles, it captures the empirical pattern of a higher Medicaid recipiency rate among singles compared to couples. Furthermore, the model accurately reproduces Medicaid nursing home usage among couples with disabled husbands. Additionally, it correctly generates the higher Medicaid nursing home usage rate among disabled singles when compared to the rate among couples.

Table 6: Model fit of untargeted Medicaid usage

	Data	Model
Medicaid recipiency rate		
Couples	0.08	0.09
Singles	0.18	0.12
Medicaid nursing home usage rate		
Disabled couples	0.07	0.07
Disabled singles	0.24	0.32

5 Main results

This section presents the results from simulating forward the estimated model under various counterfactual experiments. We construct the empirical distribution of initial conditions used in counterfactuals in the following manner. Our model assumes everybody is initially married and the husband's age is 62. To ensure a sufficiently large number of observations, we select married households where the husband's age was between 60 and 65 in years 1998 and 2000. Table E.1 in the Online Appendix shows the summary statistics of initial conditions. For each individual in the sample, we make 100 duplicates. We draw the history of idiosyncratic health and mortality shocks using each individual's current health, age, gender, and permanent income.

As everybody is married in model period one, when referring to "singles" in the counterfactuals, we specifically mean individuals who were previously married but transitioned into singlehood due to the death of their spouse. We do not consider other categories of single individuals, such as those who have never been married.[40]

5.1 Homeownership gap between couples and singles

To understand the substantial gap in homeownership between couples and singles, we conduct a counterfactual where we shut down the three channels that strengthen married individuals' incentive to own a home compared to singles. Specifically, we make the following changes to our baseline model.

C1 Medicaid no longer provides the homestead exemption to couples in a nursing home.

C2 There is no spousal caregiving.

[40] Among single retirees in the HRS data, less than 6% are individuals who never married.

C3 Couples no longer place a higher value on bequeathing the house compared to singles.

To implement the first change (C1), we modify the government transfer in equation (17) such that the liquidated value of the couple's housing assets is counted when the couple ends up in a nursing home. For the second change (C2), we force disabled husbands to always use formal care. For the third change (C3), we modify the bequest preference in equation (8) such that the second additive term which represents the housing bequest utility is zero. Just like singles, liquid and housing assets are perfect substitutes and only the liquidated value of the total assets (b) matters.

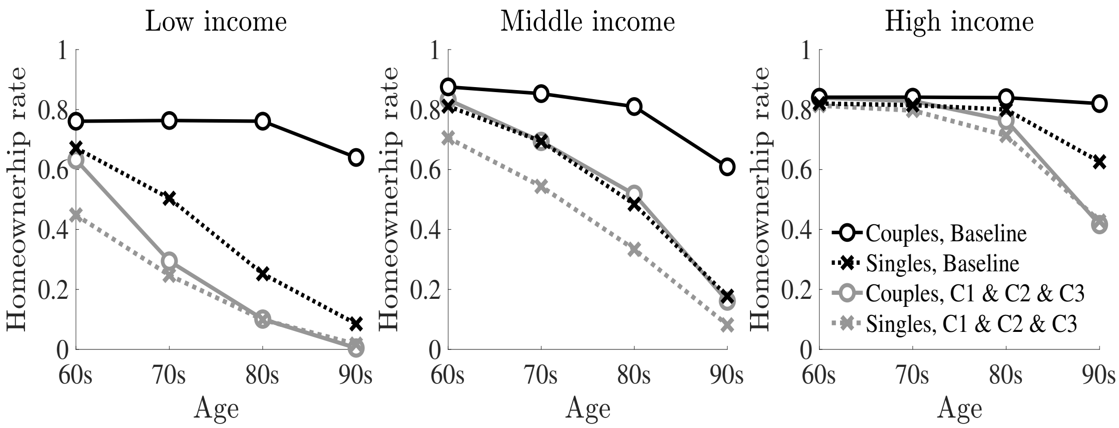
Figure 5 reports the counterfactual homeownership rate conditional on age, current marital status, and income when we implement the three changes above. Compared to the baseline, the homeownership rate among couples shows a significant decline throughout the life cycle. It is worth noting that while the changes C1, C2, and C3 are intended to impact only couples, the homeownership rate of singles also decreases. This is because all of the singles in our simulation are former couples who transitioned into singlehood due to the death of their spouse, as mentioned at the beginning of the section. The homeownership gap between couples and singles significantly decreases across all income groups. The results imply that the three channels incorporated into our model are crucial in explaining different housing decisions by marital status in retirement.

To examine the significance of each mechanism across different income groups, we implement individual changes separately, followed by combinations of two changes. Figures A.1 and A.2 in the Appendix illustrate the resulting homeownership gap, conditional on income and age. Table 7 reports the mean difference in the homeownership rate between couples and singles, calculated by averaging over age cohorts within each income group.

First, when the house loses its protected status in Medicaid's means test for couples (C1), it leads to low-income couples selling their house early in retirement to improve their eligibility for Medicaid benefits (Panel A in Figure A.1). Consequently, the homeownership rate of low-income couples becomes nearly identical to that of singles. As reported in Table 7, the mean gap in the homeownership rate drops substantially from 35.3% to just 5.7%. We find that other channels such as removing spousal care (C2) and altering bequest preferences (C3) have a limited impact on explaining the homeownership gap within this income group. The findings suggest that Medicaid's favorable treatment of the house is the primary driver behind the higher homeownership rate among low-income couples in comparison to singles.

Second, for middle-income households, the combination of Medicaid's treatment of the home (C1) and bequest motives (C3) plays a crucial role in explaining the stronger homeownership incentives among couples. Panel A in Figure A.1 demonstrates that eliminating

Figure 5: Simulated homeownership over the life cycle



Notes: The figure reports the homeownership rate conditional on age, current marital status and income group, simulated from the baseline model (black) and the counterfactual experiment (gray). For the counterfactual, we implement three changes to the model (C1, C2 and C3). C1 changes the model such that Medicaid no longer provides the homestead exemption to couples in a nursing home. C2 removes spousal caregiving. C3 eliminates the higher value that couples place on bequeathing the house relative to singles. As everybody is married in model period one, all singles in the simulation are former couples who transitioned into singlehood due to the death of their spouse.

Table 7: Homeownership gap between couples and singles

	(1) Low income	(2) Middle income	(3) High income
Baseline	0.353	0.245	0.070
C1: No homestead exemption	0.057	0.205	0.071
C2: No spousal care	0.388	0.230	0.071
C3: No housing bequest utility	0.427	0.244	0.109
C1 & C2	0.053	0.187	0.072
C1 & C3	0.078	0.139	0.062
C2 & C3	0.427	0.247	0.098
C1, C2 & C3	0.055	0.135	0.024

Notes: The table reports simulated mean difference in homeownership rate between couples and singles under the baseline model and different counterfactuals. Each row reports the mean difference across different age cohorts conditional on retirement income group.

the homestead exemption granted to couples in a nursing home has a large impact on reducing middle-income couples' homeownership. The mean homeownership gap decreases from 24.5% in the baseline to 20.5%, as reported in Column (2) of Table 7. When we additionally remove the special value that couples place on bequeathing the house, i.e., we simultaneously execute C1 and C3, the gap is further reduced to 13.9%. Interestingly, C3 as a stand-alone mechanism has almost no impact on middle-income households' housing decisions (see Panel C in Figure A.1).

Third, for high-income couples, Medicaid, spousal care, and bequest motives collectively contribute to strengthening their incentive to retain homeownership in comparison to their single counterparts. There is not a single dominant mechanism that explains the gap in the homeownership rate, which is about 7% in the baseline. As reported in Table 7, it is only when we simultaneously implement all three changes that a notable reduction to around 2% is observed. The influence of Medicaid on the savings decisions of high-income retirees might appear counterintuitive due to its means-tested nature. However, the significant cost of nursing homes during the end of life makes the public insurance option relevant even for individuals with high income. Similar findings are reported by Brown and Finkelstein (2008) in the context of private long-term care insurance purchase decisions, where they identify a substantial crowd-out effect of Medicaid on the demand for private insurance, even among retirees with substantial wealth.

5.2 Counterfactual Medicaid policies

In our baseline model, Medicaid disregards the value of the house for nursing home residents only when they are married. We consider alternative Medicaid rules where the recipient of the homestead exemption changes depending on the marital status.

For each counterfactual policy, we compute the initial wealth transfer needed to make a married household under the baseline regime indifferent to the counterfactual regime.[41] To measure the effect on the government budget, we compute the change in the present-discounted value of government expenses over the life cycle of retirees. While De Nardi, French, and Jones (2016) and Achou (2021) also evaluate the value of the Medicaid program for the elderly, they only examine the impact on single retirees. By considering marital transitions during retirement, we evaluate Medicaid's welfare effect from the perspective of a relatively young retired couple, faced with the likelihood of one spouse eventually becoming

[41] As emphasized earlier, our initial conditions used in counterfactual simulations consist only of married individuals as we assume everybody is married in model period one.

Table 8: Counterfactual Medicaid policies

	(1) Homestead exemption	(2) Low income	(3) Middle income	(4) High income	(5) All income	(6) Δ Medicaid
Baseline	Couples	0	0	0	0	0
Medicaid 1	Nobody	-29438	-29482	-1844	-16506	-2651
Medicaid 2	Everybody	7142	7246	1721	4630	6154
Medicaid 3	Singles	-28079	-25844	-239	-14331	2059

Notes: The table reports the household welfare effect and the change in Medicaid spending for alternative recipients of the homestead exemption in Medicaid's means test. All values are in 2013 dollars. We compute the welfare effect by computing the average initial wealth transfer needed to make a married household in the baseline regime indifferent to the counterfactual regime. The change in the Medicaid spending is represented in the mean present-discounted value per household.

single due to spousal death. This is crucial as our focus lies on evaluating the aspect of the Medicaid program that treats individuals differently based on their marital status.

First, we study the welfare impact when Medicaid no longer provides the homestead exemption to couples in a nursing home (Medicaid 1 in Table 8). This is the model change described earlier in Section 5.1 as C1. The stricter Medicaid rules have an impact of reducing an average retiree's initial wealth by $16,506 which is substantial. The negative impact is significant among low- and middle-income households for whom Medicaid is the most relevant. The Medicaid spending decreases by a modest amount of $2,651 per household.

Next, we go to the other extreme and consider what happens when Medicaid provides the homestead exemption not just to couples but also singles in a nursing home (Medicaid 2 in Table 8). The more lenient version of Medicaid has a positive impact on households across all income groups. On average, it is equivalent to increasing baseline retirees' initial wealth by $4,630. However, as more people qualify for Medicaid, the government spending increases substantially by an amount of $6,154.

Finally, we reform Medicaid such that the homestead exemption is given to singles in a nursing home but not to couples (Medicaid 3 in Table 8). The households are much worse off compared to the baseline: it has an impact of reducing an average retiree's initial wealth by $14,331. As expected, low- and middle-income households are much worse off compared to high-income households. The negative welfare effect implies that retirees prefer to enjoy the homestead exemption while they are married than they are single. This is because by the time they are single, they are less likely to be homeowners such that the value of the homestead exemption is lower. As the recipient of the homestead exemption changes from couples to singles, the Medicaid spending increases by $2,059 per household.

To summarize, Table 8 rationalizes the current Medicaid rule which treats housing assets more favorably for couples than singles in a nursing home. By offering the homestead exemption when retirees are relatively young, the current Medicaid program decreases the incentive to liquidate home and spend down to Medicaid eligibility early in retirement, which leads to reduced impoverishment risk over retirement.

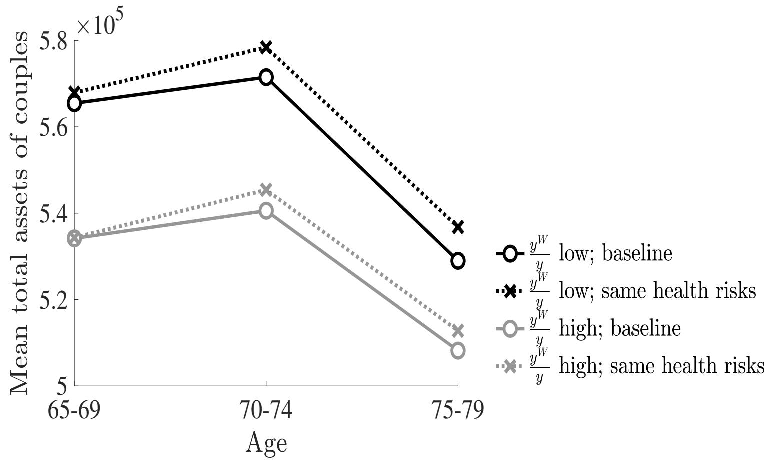
5.3 Intrahousehold precautionary savings motives

We use the estimated model to examine the resolution of conflicting preferences over savings within couples. This tension primarily arises due to gender-dependent health and mortality risks, leading to varying precautionary savings motives within the household. We conduct a counterfactual where men and women face the same health and mortality risk, which is set at the gender mean. Our estimated health and mortality transition probabilities imply that compared to women, men face shorter life expectancies and lower probabilities of developing long-term care needs. This means that under the counterfactual when everyone is subject to the gender average risks, men's precautionary savings motives will be stronger as they need to prepare for a longer retirement and higher disability risk. The opposite will be true for women, and their savings motives will be weaker compared to the baseline. Since men's bargaining power is estimated to be always higher than women's, men's savings motives will dominate, resulting in a net increase in household savings.

Figure 6 illustrates the changes in couples' asset accumulation over time under the counterfactual, conditional on whether the wife's share of retirement is high or low.[42] As expected, couples' savings increase under the counterfactual, despite maintaining the mean mortality and health risks of the sample. The rise in savings is more pronounced among couples where the wife's income share is low, represented by the black lines in the figure. For instance, the mean total assets for couples aged 70-74 increase by about 2% under the counterfactual in households where the wife's income share is low, while the increase is below 1% for couples where the wife's income share is high. This is because men's stronger incentives to save have a larger impact on the collective decision making process of the household when they possess greater bargaining power.

[42] As explained in Section 4, we employ a threshold of 0.50 to determine the categorization of the wife's income share as high or low.

Figure 6: Couples' savings under counterfactual health and mortality risks



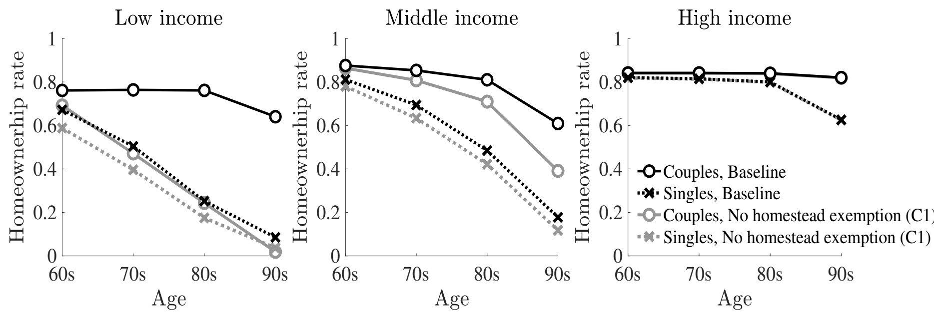
Notes: The solid lines represent couples' simulated mean assets over life cycle in the baseline model, conditional on whether the wife's share of retirement income is low (black solid line) or high (gray solid line). The dashed lines represent counterfactual asset evolution also conditional on whether the wife's share of retirement income is low (black dashed line) or high (gray dashed line), when women and men face the same gender-mean health and mortality risk.

6 Conclusion

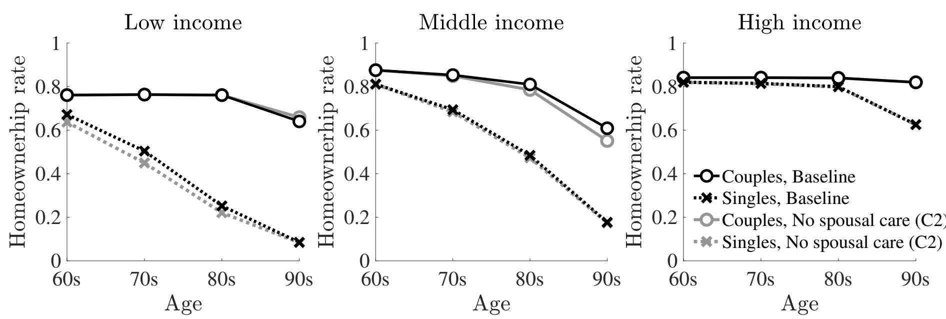
This paper develops and estimates a life-cycle model to examine savings and long-term care decisions of both singles and couples during retirement. The model considers conflicting preferences within couples, particularly addressing the stronger precautionary savings motives among women due to their longer life expectancy and higher disability risk. The estimation results unveil significant heterogeneity in intrahousehold bargaining power, with married individuals' Pareto weight increasing in their income share and health relative to their partner. We use the estimated model to understand why the decumulation of housing assets, the most crucial asset for the majority of retirees, is so different depending on marital status, with married people dissaving at a much slower rate. We provide the quantitative importance of the differences in (i) how welfare programs treat housing assets, (ii) long-term care arrangements, and (iii) bequest motives depending on marital status. Through counterfactual policy experiments, we demonstrate that considering varying savings decisions in retirement based on marital status is crucial when designing welfare-improving social insurance programs, which often have varying benefit and eligibility criteria depending on marital status.

A Appendix

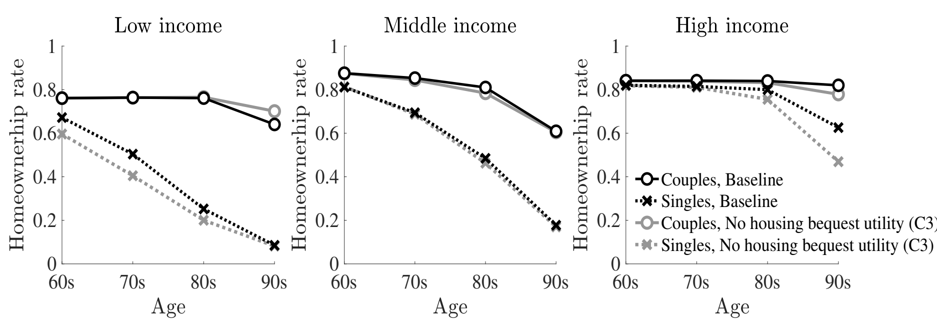
Figure A.1: Counterfactual homeownership (one change at a time)



Panel A



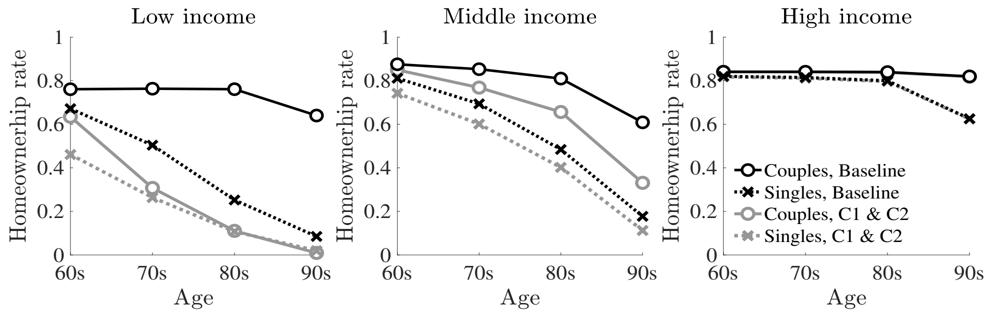
Panel B



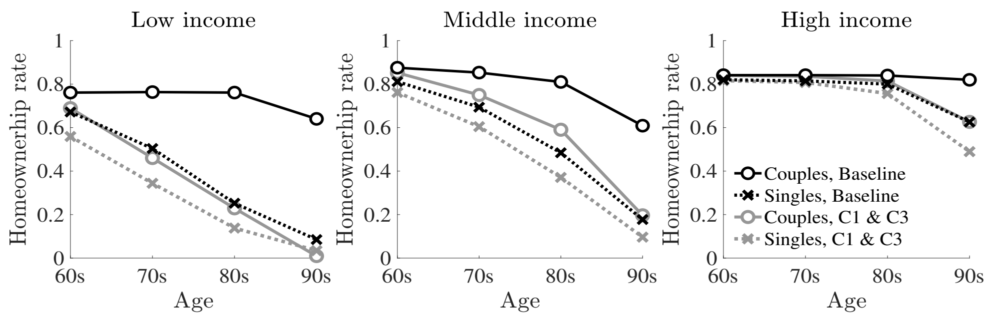
Panel C

Notes: In all graphs, black lines represent the baseline homeownership rate (solid black for couples and dashed black for singles). The gray lines in Panel A represent counterfactual homeownership rates when Medicaid no longer provides the homestead exemption to couples in a nursing home (C1). The gray lines in Panel B represent counterfactual homeownership rates when there is no spousal care (C2). The gray lines in Panel C represent counterfactual homeownership rates when we eliminate the higher value that couples place on bequeathing the house relative to singles (C3).

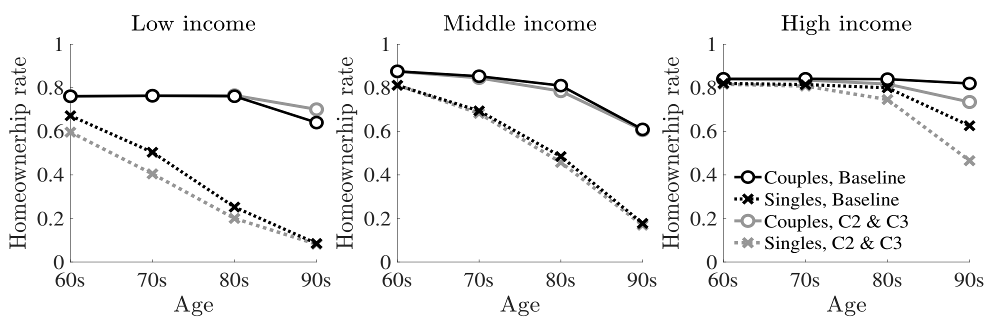
Figure A.2: Counterfactual homeownership (two changes at a time)



Panel A



Panel B



Panel C

Notes: In all graphs, black lines represent the baseline homeownership rate (solid black for couples and dashed black for singles). The gray lines in Panel A represent counterfactual homeownership rates when we implement changes C1 and C2. The gray lines in Panel B represent counterfactual homeownership rates when we implement changes C1 and C3. The gray lines in Panel C represent counterfactual homeownership rates when we implement changes C2 and C3. C1 changes the model such that Medicaid no longer provides the homestead exemption to couples in a nursing home. C2 removes spousal caregiving. C3 eliminates the higher value that couples place on bequeathing the house relative to singles.

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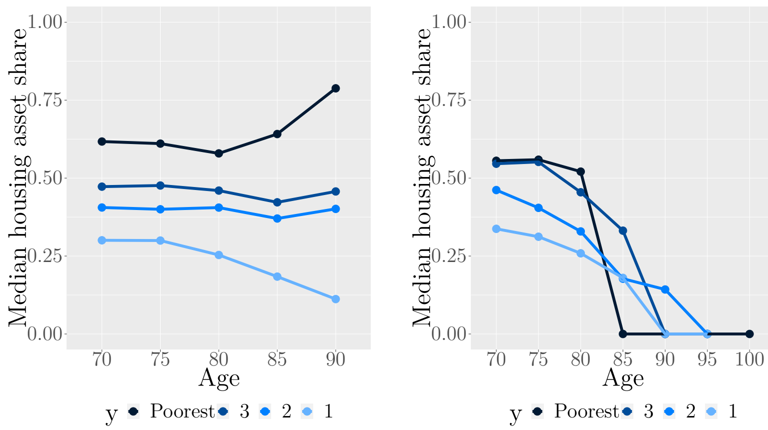
For Online Publication Only

A Empirical facts appendix

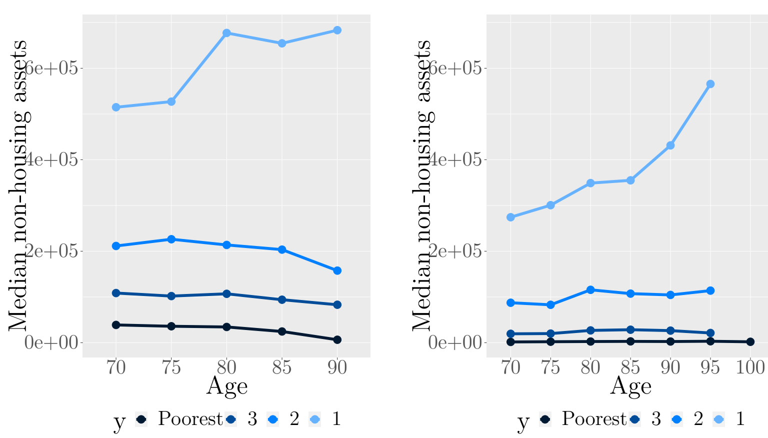
Figure A.1: Median housing asset share



Currently couples Currently singles

Notes: Data = HRS 1998-2014. The figure shows the median housing asset share by marital status, income (y), and age group. Housing asset share is defined as the ratio of housing assets to total assets.

Figure A.2: Median non-housing assets



Currently couples Currently singles

Notes: Data = HRS 1998-2014. The figure shows the median non-housing assets by marital status, income (y), and age group.

B Descriptive evidence appendix

B.1 Long-term care and housing

To better explore the relationship between spousal caregiving and homeownership, we implement a regression analysis. We conjecture that the prospect of spousal caregiving strengthens homeownership among couples. If the hypothesis is true, then widows/widowers who provided careigving to their deceased spouse will be more likely to sell home than their counterparts who did not provide care. To test the hypothesis, we construct a sample that consists of individuals who are initially a couple, experience a spousal death over the sample period, and own a home at the spousal death. The dependent variable is whether the new widow or widower sells home within 4 years since the spousal death.[43] The key control is provision of informal care to the deceased spouse. Table B.1 reports the results. It shows that provision of spousal care is associated with a 13.8 percentage point increase in the probability of liquidating home upon the spousal death. The result suggests that the prospect of spousal caregiving increases homeownership, which could be one of the explanations for the higher homeownership rate among retired couples than singles.

Table B.1: Caregiving and home sales upon spousal death

	Sell home	
Spousal care before death	0.138	(0.059)
Age	0.019	(0.004)
Have LTC needs	0.167	(0.040)
Female	0.034	(0.031)
Have children	0.080	(0.062)
Income (in 100K)	0.006	(0.015)
Non-housing assets (in 100K)	-0.001	(0.001)
Mean of dependent variable	0.332	
Observations	1102	

Notes: Standard errors are in parentheses. HRS 2000-2014 used. Linear probability model is used. Year fixed effects and birth cohort fixed effects are included. Sample is at the respondent level and consists of individuals who had strictly positive housing wealth at the spousal death. The dependent variable is whether the surviving spouse sells the home in the next 4 years. Time-varying variables are measured at spousal death.

[43] We have verified that the results are robust to using different time horizons.

B.2 Medicaid's treatment of the home

Table B.2 presents the estimated coefficients of independent variables that were not included in Table 2 due to limitations in space.

Table B.2: TEFRA liens and homeownership

	Own home	
TEFRA x Single	-0.089	(0.036)
TEFRA	0.036	(0.054)
Single	-0.175	(0.025)
Age	-0.004	(0.002)
Female	0.005	(0.020)
Have children	0.027	(0.043)
Income (in $100K)	0.048	(0.018)
Non-housing assets (in $100K)	0.002	(0.001)
Mean of dependent variable	0.68	
Observations	1947	

Notes: Compared to Table 2, this table reports the coefficients on the full list of independent variables except for year, state, and birth cohort fixed effects. Standard errors are in parentheses and are clustered at the household-state level.

To further examine the relationship between Medicaid estate recovery programs and retirees' housing decisions, we perform two additional regression analyses. First, we use variations in estates recovered. We define the estate recovery rate as the ratio of estates recovered to total Medicaid nursing home expenses in a given state-year combination.[44] This is not our preferred empirical strategy as the estates recovered are endogenous to recipients' saving behavior. Nevertheless, we examine the correlation between the amount of estates recovered and homeownership. Table B.3 in the Online Appendix reports the results. While the estimates are less accurate, we find that a higher estate recovery rate is associated with a lower homeownership rate among singles, consistent with Table 2.

Second, we use the timing of spousal death to study whether the Medicaid program induces couples to maintain homeownership. Suppose the conjecture is true. Then once their spouse passes away, widows/widowers will be more likely to sell home if their deceased spouse were a Medicaid beneficiary. Table B.4 in the Online Appendix reports the results. Consistent with the hypothesis, there is a positive correlation between the use of Medicaid while the spouse is alive and home sales upon spousal death.

[44] We use Warshawsky and Marchand (2017) for information about the estates recovered. We obtain Medicaid nursing home expenses from Medicaid.gov. The estate recovery rate is computed for 2002-2010.

Table B.3: Estate recovery rate and homeownership

	Own home	
ERP rate x Single	-0.065	(0.076)
ERP rate	-0.072	(0.083)
Single	-0.125	(0.159)
Age	-0.003	(0.004)
Female	-0.002	(0.057)
Have children	0.052	(0.105)
Income (in $100K)	0.058	(0.011)
Non-housing assets (in $100K)	0.003	(0.001)
Mean of dependent variable	0.66	
Observations	573	

Notes: Standard errors are in parentheses and are clustered at the household-state level. HRS 2002-2010 used. Linear probability model is used. Year, state, and birth cohort fixed effects are included. The sample consists of respondents living in states that have TEFRA liens in place.

Table B.4: Medicaid use and home sales upon spousal death

	Sell home	
Medicaid before spousal death	0.095	(0.033)
Age	0.015	(0.003)
Have LTC needs	0.130	(0.032)
Female	-0.000	(0.026)
Have children	0.092	(0.052)
Income (in 100K)	0.001	(0.013)
Non-housing assets (in 100K)	-0.001	(0.001)
Mean of dependent variable	0.340	
Observations	1678	

Notes: Standard errors are in parentheses. HRS 1998-2014 used. Linear probability model is used. Year fixed effects and birth cohort fixed effects are included. Sample is at the respondent level and consists of individuals who had strictly positive housing wealth at the spousal death. The dependent variable is whether the surviving spouse sells the home in the next 4 years. Time-varying variables are measured at spousal death.

B.3 Bequest motives and housing

Table B.5 reports the results from regressing whether the household sells their home in response increased mortality risk, conditional on other observables.

Table B.5: Increases in mortality risk and homeownership

	Sell home	
Mortality risk increased x Single	0.048	(0.007)
Mortality risk increased	-0.004	(0.003)
Single	0.037	(0.011)
Have children x Single	0.024	(0.008)
Have children x Married	0.015	(0.008)
Age	0.004	(0.000)
Have LTC needs	0.069	(0.005)
Income (in 100K)	0.002	(0.002)
Non-housing assets (in 100K)	-0.000	(0.000)
Covered by either Medicare or Medicaid	-0.019	(0.007)
Covered by private LTC insurance	-0.006	(0.003)
Mean of dependent variable	0.062	
Observations	36976	

Notes: Standard errors are clustered at the household level and are in parentheses. HRS 1998-2014 used. Linear probability model is used. Year fixed effects and birth cohort fixed effects are included. Sample is at the respondent-wave level and consists of individuals who were homeowners in the previous wave. The dependent variable is whether the individual sold home since the last wave. Non-housing assets are measured using the previous wave when the individual was a homeowner.

B.4 Income-pooling test

For household i, we construct the survivor's expected income as

$$\max\{SS_i^H, SS_i^W\} + \sum_{j \in \{H,W\}} \text{Pension}_i^j + \text{Capital income}_i + \text{Other income}_i \tag{22}$$

where SS stands for social security benefits, and superscripts H and W denote husband and wife respectively. For social security benefits, the survivor can receive the maximum of individual retirement benefits. For pension income, the Employee Retirement Income Security Act (ERISA) requires private pension plans to provide a pension to a worker's surviving spouse. We do not include other government transfers for the survivor's expected income as it is less clear how the survivor benefits work. For instance, a food stamp cannot be used for anyone else if the beneficiary dies. For this reason, we only focus on the households where other government transfers take account of less than 10 percent of individual income.[45]

Table B.6 presents the estimated coefficients of independent variables that were not included in Table 3 due to limitations in space.

Table B.6: Intrahousehold income distribution and savings

	(1) Log of consumption		(2) Change in assets	
Wife's income share	-0.26	(0.08)	181620.01	(52474.88)
Husband's age	-0.00	(0.00)	-1632.28	(2033.83)
Wife's age	-0.01	(0.00)	-199.70	(2098.04)
Husband has LTC needs	-0.09	(0.05)	-74717.48	(19181.80)
Wife has LTC needs	-0.15	(0.05)	-57192.42	(17941.59)
Number of children	-0.00	(0.01)	-6508.00	(3336.15)
Couple's total income (in 100K)	0.69	(0.30)	561828.17	(214965.70)
Survivor's expected income (in 100K)	-0.68	(0.31)	-471738.37	(215802.26)
Assets from the previous period (in 100K)	0.02	(0.00)	-56342.10	(8128.90)
Husband's education years	0.02	(0.01)	22630.03	(4576.69)
Wife's education years	0.04	(0.01)	12868.42	(4561.65)
Number of household members	0.03	(0.02)	-18130.58	(7529.76)
Out-of-pocket medical spending	0.00	(0.00)	0.43	(0.43)
Mean of dependent variable	10.92		-49541	
Observations	2654		15927	

Notes: Standard errors are clustered at the household level and are in parentheses. Compared to Table 3, this table reports estimated coefficients on the full list of independent variables except for cohort and year fixed effects. Consumption questions were asked only to a randomly selected subsample.

[45] The average share of other government transfers out of individual retirement income is 2.2% for husbands and 2.0% for wives.

C Model appendix

C.1 Recursive formulation

We provide a recursive formulation for a single household's problem. In each period, a single household's state vector is given as

$$z_t = (a_t, \tilde{h}_{t-1}, s_t; y, ic_{child}) \tag{23}$$

where a_t is the non-housing wealth, $\tilde{h}_{t-1}$ is the housing wealth at the beginning of the period, and s_t is the health status. Time-invariant state variables are household income y and the availability of informal care from children ic_{child}.

The household's choice vector is $q_t = (D_t, R_t, x_t)$ where $D_t \in \{0, 1\}$ represents the house selling choice, $R_t \geq 0$ is the rent choice, and $x_t \geq 0$ is the consumption expenditure.

Denote the survival probability by χ which depends on current health, age, gender and income, as stated in equation (14). A recursive formulation for a single household's problem is

$$V_t^S(z_t) \quad = \max_{q_t} \quad u(c_t, h_t) + \beta\chi_t E[V_{t+1}^S(z_{t+1})|z_t, q_t] + \beta(1-\chi_t)E[v^S(b_{t+1})|z_t, q_t] \tag{24}$$

subject to budget constraints. V^S represents a single household's value function. β is the discount factor. The expectation operator is taken with respect to health statuses of the next period.

Table C.1: Model notation

Symbol	Definition
Choice variables	
$D \in \{0, 1\}$	House selling choice for homeowners: keep (0) or sell (1)
$R \geq 0$	Rented housing service
$P^W \in \{0, 1\}$	Spousal care from the wife: no care (0) or care (1)
$x \geq 0$	Household consumption expenditure
State variables	
t	Household head's age
$a \geq 0$	Non-housing assets
$\tilde{h} \geq 0$	Housing assets. $\tilde{h} > 0$ implies homeowner, $\tilde{h} = 0$ renter.
s	Health status: healthy, require long-term care, or dead
y	Permanent retirement income
ic_{child}	Availability of informal care from children: available (1) or not available (0)
Functions	
u	Utility over general consumption and housing services
v^M	Bequest utility when there is a surviving spouse
v^S	Bequest utility when there is no surviving spouse
Utility parameters	
$\psi^W_{\tilde{h},y}$	Wife's disutility from providing spousal care
σ	Housing consumption utility scale
γ	Consumption and housing CRRA coefficient
δ_1, a_{b1}	Bequest utility parameters of v^S
δ_2, a_{b2}, h_b	Bequest utility parameters of v^M
Others	
c_{nh}, h_{nh}	Basic consumption and housing value from nursing home care
ρ	Economies of scale for married households' consumption
$\omega_{couple}, \omega_{single}$	Homeownership premium for couples and singles
κ	Relative Pareto weight on husbands
δ	Depreciation rate for housing assets
r	Real interest rate
τ	Home transaction cost
m	Formal long-term care cost
$\bar{a}_{nh=0}$	Per-capita consumption floor for non-nursing home residents
$\bar{a}_{nh=1}$	Per-capita consumption floor for nursing home residents

D Estimation appendix

D.1 Sample selection procedure

For estimation, we use nine interview waves which happened biannually from 1998 to 2014. All monetary values presented henceforth are in 2013 dollars, unless otherwise noted. From 11,721 respondents who were aged 60 and over in 1998 and do not miss any interviews, we restrict to respondents whose wealth and housing value do not exceed 98th percentiles, resulting in the sample size of 11,325.

An individual is considered a homeowner if the value of housing assets is greater than zero. We consider an individual's health status as "require long-term care" if the individual reports having two or more limitations in carrying out activities of daily living (ADLs). The availability of informal care provided by children is a dummy variable which is equal to one if a respondent says the number of children he/she believes will provide care when necessary exceeds zero. The helper file in the HRS contains information about help received regarding one's long-term care needs. We treat a married household as using spousal care if the helper is identified as the wife.

Table D.1: Summary statistics of initial conditions

	Couples		Singles	
	Mean	Median	Mean	Median
Age	69.87	69.00	75.22	76.00
Homeowner	0.88	1.00	0.59	1.00
Housing assets	132582.15	117000.00	68247.77	31200.00
Non-housing assets	313112.15	134160.00	128414.55	16068.00
Require long-term care	0.09	0.00	0.21	0.00
Income	37460.94	27023.48	31631.70	20265.80
Availability of informal care	0.53	1.00	0.49	0.00
Wife's relative income is high	0.16	0.00		
Female			0.76	1.00
Observations	6550		4036	

Table D.1 presents the summary statistics of initial conditions. The mean age of married couples is 70 and that of single households is 75. Compared to single households, married couples are more likely to be homeowners, own more liquid and illiquid assets, and have higher average income over the sample period. Since wives tend to outlive their husbands, the fraction of female observations is 0.76 among singles. The fraction of singles who require long-term care is much higher than that of couples, reflecting that singles are older on average. Finally, the proportion of married couples in which the wife's income share exceeds

50% is 0.16. We apply the 50% threshold to categorize them into two groups: those with a high wife's income share and those with a low wife's income share.

D.2 Estimation procedure

We use the simuated method of moments (SMM) for our estimation. The objective function is to minimize the distance between the model-simulated moments and the empirical moments. We implement this method in a Bayesian way as in Fernandez-Villaverde, Rubio-Ramirez, and Schorfheide (2016). We quantify the uncertainty on parameters by the posterior distribution implied by the data.

Let $\widehat{\psi}$ denote the empirical moments to match. The goal is to choose a parameter vector θ to make the model-simulated moments $\psi(\theta)$ as close as possible to $\widehat{\psi}$. The approximate likelihood of $\widehat{\psi}$ is written as

$$f(\widehat{\psi}|\theta) = \left(\frac{1}{2\pi}\right)^{\frac{M}{2}} |\bar{V}|^{-\frac{1}{2}} \exp\left[-\frac{1}{2}\big(\widehat{\psi} - \psi(\theta)\big)' \bar{V}^{-1} \big(\widehat{\psi} - \psi(\theta)\big)\right],$$

where M is the number of moments in $\widehat{\psi}$. $\bar{V}$ is obtained by a bootstrap approach with N_B bootstrap samples as

$$\bar{V} = \frac{1}{N_B} \sum_{b=1}^{N_B} (\psi_b - \bar{\psi})(\psi_b - \bar{\psi})',$$

where ψ_b stands for the moments from the b-th bootstrap sample, and $\bar{\psi}$ is the mean of ψ_b for $b = 1, \ldots, N_B$. The Bayesian posterior of θ conditional on $\widehat{\psi}$ is derived as

$$f(\theta|\widehat{\psi}) = \frac{f(\widehat{\psi}|\theta)p(\theta)}{f(\widehat{\psi})},$$

where $p(\theta)$ denotes the priors on θ, $f(\widehat{\psi})$ denotes the marginal density of $\widehat{\psi}$, and $f(\widehat{\psi}) = \int f(\widehat{\psi}|\theta)p(\theta)d\theta$. Then we characterize the posterior density using the Random-Walk Metropolis Hastings sampler with the objective function $\log f(\widehat{\psi}|\theta) + \log p(\theta)$.

The objective function we formulate using uniform priors is identical to the one used in frequentist SMM estimation. The objective function is larger when the simulated moments are closer to the empirical moments constructed from the data. In this paper, we abstract from exploration of non-uniform (informative) priors.

Table D.2: Uniform priors

Parameter	[min, max]	Parameter	[min, max]
$\psi_{\tilde{h}=0,y=\text{high}}$	[0.13e-6, 0.15e-6]	δ_1	[0.0, 5.0]
$\psi_{\tilde{h}=0,y=\text{middle}}$	[0.13e-6, 0.15e-6]	a_{b1}	[0.0, 30,000]
$\psi_{\tilde{h}=0,y=\text{low}}$	[0.13e-6, 0.15e-6]	$\kappa_{i=\text{high},t=\text{husband sicker than wife}}$	[0.5, 1.0]
ζ	[0.0, 1.0]	$\kappa_{i=\text{high},t=\text{wife sicker than husband}}$	[0.5, 1.0]
σ	[0.0, 3.0]	$\kappa_{i=\text{high},t=\text{same health}}$	[0.5, 1.0]
δ_2	[0.0, 5.0]	$\kappa_{i=\text{low},t=\text{husband sicker than wife}}$	[0.5, 1.0]
a_{b2}	[0.0, 30,000]	$\kappa_{i=\text{low},t=\text{wife sicker than husband}}$	[0.5, 1.0]
h_b	[0.0, 30,000]	$\kappa_{i=\text{low},t=\text{same health}}$	[0.5, 1.0]

Notes: [min, max] reports the domain of the uniform distribution.

E Counterfactual appendix

Table E.1: Summary statistics of initial conditions

	Mean	Median
Homeowner	0.91	
Housing assets ($)	152,582	115,440
Non-housing assets ($)	474,021	138,705
Require long-term care	0.05	
Income ($)	47,202	33,498
Availability of informal care	0.62	
Observations	3,112	

Notes: The table reports initial conditions used in counterfactual simulations. The sample consists of married households where the husband's age was between 60 and 65 in years 1998 and 2000.