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

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Abstract

Retired couples dissave housing wealth at a much slower rate than singles, conditional on income. This paper studies mechanisms through which marital transitions affect housing decisions of retirees. We develop and estimate a life-cycle savings model where marital transitions affect long-term care arrangements, bequest motives, and eligibility for means-tested welfare programs. We find that the key driver behind the stark difference in dissaving of housing wealth between retired couples and singles varies substantially by income. For low-income households, how means-tested public insurance treats housing has the most impact on their housing decisions. For middle- and high-income households, family caregiving and bequest motives are the dominant driver, respectively. Our counterfactual policy experiments show that the current structure of the Medicaid estate recovery program which exempts housing wealth only for couples is more desirable than alternative rules, such as extending the homestead exemption to singles or providing the exemption to singles only. By inducing lower-income couples to decumulate housing wealth at a slower rate, the current Medicaid program reduces impoverishment risk in retirement.

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1 Introduction

Substantial progress has been made to understand why retirees dissave wealth at a much slower rate than predicted by a standard life-cycle savings model. Existing explanations for this retirement saving puzzle include large medical expenditure risk at old ages and bequest motives.[1] However, scant attention has been given to understanding how marital transitions affect savings in retirement. As we show in this paper, marital transitions have a huge impact on dissaving of housing wealth, which is the most important asset for most households in the U.S. In particular, we find that retired couples dissave housing assets at a much slower rate than their single counterparts. Understanding mechanisms through which one's marital status affects housing wealth in retirement is crucial in designing welfare programs for the elderly. For example, means-tested social insurance, such as Medicaid, often distinguishes housing from liquid assets and treats married and single individuals asymmetrically in terms of benefits and eligibility. In this paper, we fill the gap in the literature by uncovering mechanisms through which marital transitions change housing decisions of retirees.

One key aspect that differs between married and single individuals is the availability of spousal care which reduces the risk of using formal long-term care services such as nursing home care. The presence of a healthy spouse increases married individuals' chance of receiving long-term care in their own homes which might increase their homeownership incentive relative to singles who are more likely to resort to facility care. At the same time, the presence of a healthy spouse makes it easier to qualify for means-tested public insurance. For example, Medicaid will not recover its nursing home cost from Medicaid recipients' house as long as there is a spouse living in the property. Such protections for the community spouse might also increase couples' homeownership incentive, especially if they have limited assets and want to protect them from a Medicaid "spend down". To quantify the importance of different mechanisms that might explain heterogeneous homeownership incentives of couples and singles, this paper develops and estimates a life-cycle savings model that incorporates marital transitions, long-term care, and bequest motives.

Using data from the Health and Retirement Study (HRS), we start by providing descriptive evidence for potential mechanisms through which one's marital status affects homeownership in retirement. First, we present evidence that spousal care is the dominant mode of long-term care delivery for couples and that the prospect of spousal caregiving increases couples' incentive to own a home. Second, we show that Medicaid's estate recovery programs induce couples to put more assets in housing. Medicaid is a means-tested public insurance program that covers formal long-term care expenses for eligible individuals. For singles who are

[1] A review of the literature is presented later in the section. See also De Nardi, French, and Jones (2016) for a survey of the literature.

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 housing wealth for married individuals who have a community spouse. We provide evidence that Medicaid's asymmetric treatment of housing strengthens couples' homeownership incentive, as found in Greenhalgh-Stanley (2012). Third, we show that singles are likely to sell their home in response to an increase in mortality risk, while couples are not. This evidence suggests that housing as bequests might be more valuable when there is a surviving spouse, which might partially explain couples' higher homeownership rate especially among higher-income retirees.

To assess the quantitative importance of different mechanisms that could affect housing decisions in retirement, we develop a life-cycle savings model that incorporates interactions among housing assets, long-term care, bequests, and Medicaid. All individuals start as a married couple. They face health and mortality risk, and become a single if they outlive their spouse. 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 preference 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. The model incorporates welfare programs including Medicaid as a lower bound on consumption. We use a collective household model, rather than a unitary model to describe couples' decision making process. This is to capture different precautionary savings motives between husbands and wives: as women have longer life expectancy and face higher formal long-term care risk, they have stronger precautionary savings motives.

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, formal long-term care prices, and consumption floors guaranteed by the government. In the second step, we estimate the rest of the parameters using a limited information Bayesian method that matches the model-generated moments to their empirical counterparts. The estimated parameters inform us about preferences for bequests, housing, and long-term care as well as the relative Pareto weights on husbands' and wives' utility. The estimated model is able to replicate key patterns of the data, such as long-term care arrangements and savings of housing and non-housing assets by permanent income and age.

With an estimated model, we first quantify the importance of different mechanisms through which marital transitions affect homeownership. This is done by a decomposition analysis which shuts down each channel conjectured to influence homeownership in retirement. We find that the dominant mechanism that explains the homeownership difference between cou-

ples and singles varies substantially by income. Low-income couples have a stronger incentive to own a home than singles to take advantage of Medicaid's estate recovery program which treats housing assets more favorably for couples. For middle-income households, the prospect of spousal caregiving is the dominant explanation for couples' higher homeownership rate. Middle-income households are neither too poor to qualify for Medicaid, nor too rich to afford paying for formal long-term care out-of-pocket. Consequently, for middle-income couples, spousal caregiving is an important insurance mechanism which drives their housing decisions. High-income couples are much more likely to hold housing assets than singles in late life to leave housing bequests to their surviving spouse.

We then use the estimated model to evaluate welfare effects of counterfacutal policies. We find that the current structure of the Medicaid estate recovery program which provides homestead 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 homestead exemption is offered to couples, households dissave housing assets at a much slower rate, which results in slower decumulation of retirement wealth over the life-cycle. As a result, fewer households end up in impoverishment. In contrast, when homestead exemption is offered to singles only, married households with limited income are likely to liquidate their homes early in retirement in order to spend down to Medicaid eligibility. Early home liquidation results in faster dissaving of retirement wealth and increased impoverishment risk. We also show that providing subsidies to spousal caregivers increases household welfare while remaining almost budget-neutral.

This paper makes contributions to a number of fields in the literature. It is related to papers that study the role of uncertain medical expenses in elderly savings. While Hubbard, Skinner, and Zeldes (1995) and Palumbo (1999) find relatively small effects, De Nardi, French, and Jones (2010) show that medical expenses that rise with age and income are a key driver in old age savings. Kopecky and Koreshkova (2014) separate nursing home expenses from other health expenses and highlight the significance of nursing home risk on savings in retirement. Medical expenses in our model are also uncertain due to a stochastic health process. However, unlike most papers that treat medical expenses as exogenous, they are endogenously determined in our model as an outcome of the household decision on different types of long-term care, including family care.

This paper is closely related to a recent work by De Nardi, French, Jones, and McGee (2018) which studies, using the HRS data, why couples dissave wealth more slowly than singles after retirement. While they aggregate all assets and treat them as liquid, this paper shows that one's marital status affects retirement wealth primarily through its impact on housing decisions. In addition, we use a collective model, rather than a unitary model to

allow for different savings motives between husbands and wives.

We also make a contribution to a growing literature on home equity in retirement. Venti and Wise (2004) find 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) find 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. Achou (2021) builds a life-cycle model of single retirees where he quantitatively assesses the impact of housing liquidity on long-term care insurance demand. A recent work by McGee (2019) uses UK data to estimate a retirement savings model that incorporates house price shocks. In this paper, we make a simplifying assumption that housing assets are risk-free. This is because our primary goal is to understand different homeownership motivation of couples and singles, and house price shocks are aggregate shocks that should have similar effects regardless of marital status. Instead, we allow for richer interactions between housing and other old-age decisions, such as family caregiving.

This paper is closely related to the growing caregiving literature using life-cycle models. Papers by Barczyk and Kredler (2018), Ko (2020) 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 (2019) 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 one's marital status and housing wealth.

Finally, we contribute to the large literature that uses life-cycle models to study the impact of bequest motives on old age savings (Hurd, 1989; De Nardi, 2004; De Nardi, French, and Jones, 2010; Lockwood, 2018). The paper by De Nardi, French, Jones, and McGee (2018) permits a richer structure of bequest motives, where couples might care about not just their children and other heirs, but also their surviving spouse. Similarly, we also allow for heterogeneity in bequest motives by marital status at the time of death. In addition, we allow bequest utility to depend on the type of bequeathed assets.

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 Patterns

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

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. Housing assets are defined as the net value of primary residence, which is equal to the value of primary residence minus mortgages and home loans.

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 capital income, pension, annuity, Social Security disability (SDI), Supplemental Security income (SSI), Social Security retirement income, unemployment income, worker's compensation, government transfers and other income.

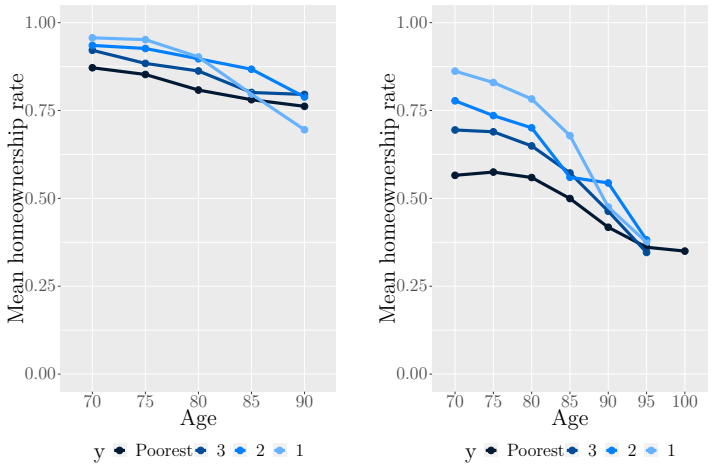
Our definition of singles includes individuals who are divorced or have never been married, as well as widows and widowers.

The HRS asks respondents whether they receive help from their spouses or children to perform activities of daily living (ADLs). If they do, then the survey asks about the number of help hours and days. Due to inconsistencies in questions in the 1998 wave, we only use data from 2000 to measure spousal caregiving.

2.1 Empirical puzzle

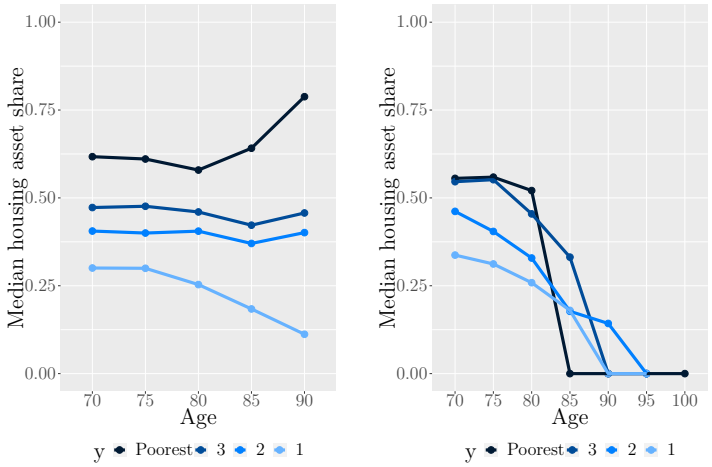
Figure 1 shows a substantial difference in homeownership between married and single households in retirement, conditional on age and permanent income quartiles. Panel A in Figure 1 reveals that among married households, the mean homeownership rate does not decrease much in age, and about 75% are still 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. Panel B in Figure 1 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 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.1 in Appendix A shows that the evolution of non-housing assets over age indeed looks quite similar between couple and single households.

Figure 1: Housing assets by marital status



Currently couples Currently singles

Panel A: Homeownership rate

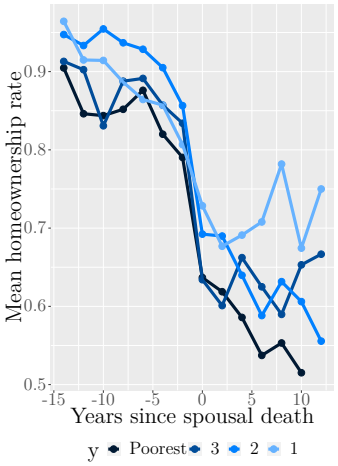


Currently couples Currently singles

Panel B: Housing asset share

Notes: Data = HRS 1998-2014. Panels A and B present the homeownership rate and median housing asset share by marital status, income (y) and age group, respectively. Housing asset share is defined as the ratio of housing assets to total assets.

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 mean homeownership rate before and after spousal death.

Figure 2 is drawn using households that transition from couples to singles due to spousal death over the sample period. The figure reveals that there is a substantial reduction in the homeownership rate around the time of spousal death.

2.2 Potential mechanisms

In this section, we describe potential explanations for the stark difference in homeownership between couples and singles in retirement. We use the HRS data to provide descriptive evidence for each possible mechanism.

2.2.1 Long-term care and housing

Elderly individuals face substantial risk of having functional limitations and hence requiring long-term care. In the U.S., about three fourths of 60-year-olds will have chronic conditions resulting in daily activity limitations, while the other one fourth will have no such conditions until death. Individuals with long-term care needs receive assistance from either family members or formal care services, such as nursing homes. In this section, we descriptively explore how the difference in long-term care arrangements between couples and singles affects their homeownership incentives.

To compare long-term care arrangements between couples and singles, we define our care sample as a set of disabled individuals who receive either formal or informal care. We consider

Table 1: Long-term care arrangements by marital status

	Married	Single
Nursing home care	0.30	0.53
Paid home care	0.38	0.42
Caregiving by spouse	0.82	0.00
Caregiving by children	0.34	0.71
Homeowner	0.76	0.34
Observations	2433	4274

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

Table 2: Informal care and homeownership

Panel A	Married homeowners	Married renters
Caregiving by spouse	0.89	0.79
Observations	1344	348
Panel B	Single homeowners	Single renters
Caregiving by children	0.82	0.81
Observations	914	1115

Notes: From the care sample, we further restrict to non-nursing home residents.

an individual as disabled if the individual reports having two or more limitations in carrying out activities of daily living (ADLs).[2]

Table 1 shows long-term care arrangements by marital status in our care sample. First, informal care by family members plays a critical role in delivering long-term care. For married individuals, spousal caregiving is dominant with over 80%. For singles, caregiving by adult children is dominant with over 70%, while it only accounts for less than 35% for married individuals. Second, singles are more likely to enter a nursing home. While over 50% of disabled singles use nursing home care services, only about 30% of disabled couples rely on nursing home care. As residing in a nursing home prevents one from deriving a consumption flow from owned houses, higher nursing home risk for singles could reduce their homeownership incentive relative to couples.

Provision of informal care can be made easier by home modifications, adaptations or improvements, and they can be done more conveniently in owned houses than in rented properties. Panel A in Table 2 explores whether data suggest complementarity between spousal caregiving and married households' homeownership. It shows that the spousal caregiving

[2]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.

rate is higher among homeowners, suggesting possible complementarity. Panel B in Table 2 explores whether there is complementarity between caregiving by adult children and single parents' homeownership. Children's informal care rate is almost the same between single homeowners and single renters. This suggests weak complementarity between caregiving by adult children and singles' homeownership, if any.

To better explore the relationship between spousal caregiving and homeownership, we implement a reduced-form analysis. Suppose the prospect of spousal caregiving indeed strengthens homeownership among couples. Then, once their spouse passes away, widows/widowers who provided careigving will be more likely to sell home than their counterparts who did not provide care. To test this hypothesis, we construct a sample that consists of individuals who are initially a couple, experience spousal death over the sample period, and own a home before spousal death. The dependent variable is whether the newly widow or widower sells home upon spousal death. The key control is provision of informal care to the deceased spouse. Table 3 reports the results. Consistent with the hypothesis, there is a positive correlation between caregiving and home sales upon spousal death. The results suggest that the prospect of spousal caregiving increases homeownership incentive, which could be one of the explanations for the higher homeownership rate among retired couples than singles.

2.2.2 Medicaid's estate recovery program and housing

Formal long-term care services in the U.S. are expensive with the median annual cost for nursing homes exceeding $90,000 in 2017. According to a report by the Kaiser Family Foundation, formal long-term care expenses totaled over $310 billion in 2013, which is close to 2% of GDP. Medicaid is a means-tested program jointly funded by the federal and state governments and pays for formal long-term care costs to eligible individuals. It is the biggest payer accounting for 51% of the total long-term care payments.

While Medicaid typically does not count housing assets in determining eligibility, it requires states to recover Medicaid-financed long-term care costs from the beneficiary's home upon permanent nursing home entry or death through Medicaid estate recovery programs (Department of Health and Human Services, 2005a,b). The major exception to this rule is when the beneficiary is survived by a community spouse. In this case, recoveries from home are prohibited during the lifetime of a surviving spouse. While the government can recover the costs once the surviving spouse passes away, in practice, the remaining married spouse in the home is exempted as it is too expensive to track the surviving spouse (Greenhalgh-Stanley, 2012). Therefore, unless the surviving spouse becomes a Medicaid long-term care recipient herself, the home will not be recovered against. This suggests that Medicaid's asymmetric treatment of home depending on one's marital status favors couples over singles.

Table 3: Caregiving and home sales upon spousal death

	(1) Sell home	(2) Sell home	(3) Sell home
Spousal care before death	0.210***	0.134**	0.102*
	(0.057)	(0.059)	(0.057)
Age		0.020***	0.019***
		(0.004)	(0.004)
Have LTC needs		0.168***	0.167***
		(0.040)	(0.038)
Female		0.031	0.037
		(0.031)	(0.030)
Have children		0.080	0.079
		(0.062)	(0.060)
Income		0.000	0.000
		(0.000)	(0.000)
Non-housing assets		-0.000**	0.000
		(0.000)	(0.000)
Housing assets			-0.000***
			(0.000)
Constant	0.443***	-1.300***	-1.158***
	(0.033)	(0.355)	(0.342)
Mean of dep. var	0.333	0.332	0.332
Observations	1121	1102	1102
Adjusted R^2	0.065	0.102	0.169

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are in parentheses. HRS 2000-2014 used. Linear probability model is used. Year fixed effects and birth cohort fixed effects are included in all specifications. Sample is at the respondent level and consists of individuals who had strictly positive housing wealth before spousal death. Time-varying variables are measured at spousal death.

To study whether Medicaid estate recovery programs increase couples' incentive to own a home, we perform a reduced-form analysis. Suppose Medicaid induces couples to put more assets in housing. Then, once their spouse passes away, widows/widowers will be more likely to sell home if their deceased spouse were a Medicaid beneficiary. To test this hypothesis, we construct a sample that consists of individuals who are initially a couple, experience spousal death over the sample period, and own a home before spousal death. The dependent variable is whether the newly widow or widower sells home upon spousal death. The key control is use of Medicaid before spousal death. Table 4 reports the results. Consistent with the hypothesis, there is a positive correlation between use of Medicaid while the spouse is alive and home sales upon spousal death. The results suggest that Medicaid's asymmetric treatment of home depending on one's marital status could be one of the explanations for the higher homeownership rate among retired couples than singles.

2.2.3 Bequest motives and housing

Couples and singles might have different bequest motives as couples might care about not just heirs, but also their surviving spouse. Furthermore, bequest utility from leaving housing assets relative to liquid assets might differ depending on whether the assets are bequeathed to heirs or surviving spouse. Suppose housing bequests are more valuable when they are left to a surviving spouse than to children. Then, in response to an increase in mortality risk, couples will be less likely to sell home than singles.

To test this hypothesis, we construct a sample that consists of individuals who were reported as a home owner in the previous interview wave. We measure unanticipated increases in mortality risk based on self-reported changes in health.[3] We treat a single individual as having a substantial health deterioration if the individual reports somewhat or much worse health relative to the previous interview. For a couple, the indicator for substantial health deterioration is one if the respondent or the respondent's spouse reports somewhat or much worse health. The dependent variable is whether an individual sells home in the current wave. They key control is an indicator for substantial health deterioration interacted with one's marital status.

Table 5 reports the results. While an increase in mortality risk has a significant and positive effect on home sales for singles, it has no significant effect for couples. The results suggest that in response to an increase in mortality risk, singles are more likely to liquidate housing assets than couples. These findings can be interpreted as suggestive evidence that

[3]For the HRS interviews conducted in 1998-2004, allowed responses were much better, somewhat better, same, somewhat worse and much worse. For the interviews conducted in 2006-2014, they were somewhat better, same and somewhat worse.

Table 4: Medicaid use and home sales upon spousal death

	(1) Sell home	(2) Sell home	(3) Sell home
Medicaid before spousal death	0.128***	0.088***	0.063**
	(0.033)	(0.033)	(0.032)
Age		0.016***	0.015***
		(0.003)	(0.003)
Have LTC needs		0.129***	0.123***
		(0.032)	(0.031)
Female		-0.002	0.006
		(0.026)	(0.025)
Have children		0.087*	0.098**
		(0.052)	(0.050)
Income		0.000	0.000
		(0.000)	(0.000)
Non-housing assets		-0.000***	0.000
		(0.000)	(0.000)
Housing assets			-0.000***
			(0.000)
Constant	0.419***	-0.933***	-0.821***
	(0.029)	(0.252)	(0.244)
Mean of dep. var	0.343	0..40	0.340
Observations	1706	1678	1678
Adjusted R^2	0.042	0.075	0.137

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are in parentheses. HRS 1998-2014 used. Linear probability model is used. Year fixed effects and birth cohort fixed effects are included in all specifications. Sample is at the respondent level and consists of individuals who had strictly positive housing wealth before spousal death. Time-varying variables are measured at spousal death.

Table 5: Increases in mortality risk and homeownership

	(1) Sell home	(2) Sell home	(3) Sell home
Married	-0.048***	-0.042***	-0.039***
	(0.004)	(0.011)	(0.011)
Health deteriorates x Single	0.060***	0.043***	0.041***
	(0.006)	(0.006)	(0.006)
Health deteriorates x Married	0.010***	-0.004	-0.004
	(0.003)	(0.003)	(0.003)
Have children x Single		0.022***	0.023***
		(0.008)	(0.008)
Have children x Married		0.016*	0.018**
		(0.008)	(0.009)
Age		0.004***	0.004***
		(0.000)	(0.000)
Have LTC needs		0.071***	0.066***
		(0.005)	(0.005)
Income		0.000	0.000*
		(0.000)	(0.000)
Non-housing assets		-0.000***	0.000**
		(0.000)	(0.000)
Housing assets			-0.000***
			(0.000)
Constant	0.104***	-0.223***	-0.211***
	(0.005)	(0.033)	(0.032)
Mean of dep. var	0.062	0.062	0.062
Observations	38087	37576	37576
Adjusted R^2	0.039	0.054	0.073

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. 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 in all specifications. Sample is at the respondent-wave level and consists of individuals who had strictly positive housing wealth in the previous wave.

singles have a weaker preference for leaving housing bequests than couples. One caveat in interpreting the results is that singles may liquidate housing to prepare for large medical expenditures as they have less cash at hand than couples. To deal with such a concern, Columns (2) and (3) in Table 5 control for non-housing assets. We have also verified that the results are robust to using a restricted sample of individuals who have Medicare coverage and therefore face smaller out-of-pocket medical expenditures.[4]

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: $t = 65, 67, ..., 99$. For notational simplicity, we suppress the time index t unless necessary. All individuals are married in the initial period and might become a single if they outlive their spouse. We use a collective household model, rather than a unitary model to describe couples' decision making process. This is to capture different precautionary savings motives between husbands and wives: as women have longer life expectancy and face higher formal long-term care risk, they have stronger precautionary savings motives. The model incorporates welfare programs including Medicaid as a lower bound on consumption. Table 6 describes model variables.

3.1 Timing

At the beginning of each period, health shocks are realized. Homeowners decide whether to sell home, and renters choose housing services. Long-term care arrangements are determined which could be either spousal care, nursing home care, or informal care provided by adult children. After housing and long-term care decisions, the government makes transfers to guarantee a minimum consumption floor. Finally, household consumption is chosen.

3.2 Preferences

Single retirees' flow utility is given as

$$u(c, h) = \frac{c^{1-\gamma} - 1}{1 - \gamma} + \sigma \frac{h^{1-\gamma} - 1}{1 - \gamma} \tag{1}$$

[4] About 95% of the individuals in our sample have Medicare coverage.

Table 6: Model notation

Symbol	Definition
Indices	
$j \in \{H, W\}$	Superscripts: husband/widower (H) or wife/widow (W)
Functions	
u	Utility over general consumption and housing services
v^M	Bequest utility when die as married
v^S	Bequest utility when die as single
Choice variables	
$D \in \{0, 1\}$	House selling choice: 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)
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}, h_b	Parameters governing bequest utility when die as married
δ_2, a_{b2}	Parameters governing bequest utility when die as single
Others	
c_{nh}, h_{nh}	Basic consumption and housing value from nursing home care
ρ	Economies of scale for married households' consumption
ω	Homeownership premium
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

Notes: The table describes variables used in the model specification.

They have additively separable preferences for consumption c and housing services h, which follow a constant relative risk aversion utility function.

Married individuals are endowed with their own separate utility:

$$\text{Husbands:} \quad u(c^H, h^H) \tag{2}$$

$$\text{Wives:} \quad u(c^W, h^W) - \psi_{\tilde{h},y} P^W \tag{3}$$

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^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 are able to provide spousal care. $\psi_{\tilde{h},y}$ represents wives' caregiving disutility. It could potentially depend on housing assets $\tilde{h}$. This is to capture possible complementarity between homeownership and spousal caregiving, as suggested in Section 2. The caregiving disutility is also allowed to vary by household income y.

When hit by a mortality shock, a married individual derives utility from leaving both non-housing (a) and housing assets ($\tilde{h}$) :

$$v^M(a, \tilde{h}) = \delta_1 \left(\frac{(a_{b1} + a)^{1-\gamma} - 1}{1-\gamma} + \sigma \frac{(h_b + \tilde{h})^{1-\gamma} - 1}{1-\gamma} \right) \tag{4}$$

The parameters a_{b1} and h_b represent the threshold of non-housing and housing consumption level below which the individual does not leave any bequests under conditions of perfect certainty (Lockwood, 2018). This is a commonly used functional form in the literature (e.g., De Nardi (2004), De Nardi, French, and Jones (2010), and Lockwood (2018)), but we are the first to explicitly separate bequest utility from leaving housing and non-housing wealth.

We assume that bequeathed housing wealth of singles is liquidated, and singles derive bequest utility that depends on non-housing wealth only. This is based on the descriptive evidence presented in Section 2 that singles are likely to sell their home when they perceive an increase in their mortality risk. A single retiree's bequest utility is given as

$$v^S(b) = \delta_2 \frac{(a_{b2} + b)^{1-\gamma} - 1}{1-\gamma} \tag{5}$$

where b is the total cash bequeathed. It is given as

$$b = a + (1 - \tau)\tilde{h} \tag{6}$$

where τ represents the transaction cost from selling home.

3.3 Consumption

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

$$c = \begin{cases} \hat{c} & \text{if not in NH} \\ c_{nh} & \text{if in Medicaid NH} \\ c_{nh} + \hat{c} & \text{if in private NH} \end{cases} \tag{7}$$

where $\hat{c}$ represents the individual's consumption expenditure, and c_{nh} is the consumption value from nursing home care which includes basic food. When the individual is not in a nursing home, the individual gets to choose his consumption. If the individual is in a Medicaid nursing home, then his consumption is fixed to the basic consumption level c_{nh}. If the individual is in a privately paid nursing home, then he might have access to more amenities. We therefore assume individuals in a privately paid nursing home consume not only c_{nh} but also get to choose $\hat{c}$.

The household consumption expenditure is given as

$$x = \begin{cases} [(\hat{c}^H)^\rho + (\hat{c}^W)^\rho]^{\frac{1}{\rho}} & \text{for couples} \\ \hat{c} & \text{for singles} \end{cases} \tag{8}$$

$\rho \geq 1$ means there are economies of scale for couples' consumption. We assume that when none of the spouses is in a Medicaid-financed nursing home, then each spouse gets an equal share of the household consumption expenditure, i.e., $\hat{c}^j = x/2^{\frac{1}{\rho}}$ for $j \in \{H, W\}$. If only one spouse is in a Medicaid nursing home, then that spouse's consumption expenditure is zero as described in Equation (7), and the other spouse gets the entire household consumption expenditure. If both spouses are in a Medicaid nursing home, then the household will optimally choose $x = 0$.

3.4 Housing

Individual consumption of housing services depends on homeownership ($\tilde{h} > 0$ means homeowner; $\tilde{h} = 0$ renter) and nursing home residency:

$$h = \begin{cases} \omega\tilde{h} & \text{if not in NH and } \tilde{h} > 0 \\ R & \text{if not in NH and } \tilde{h} = 0 \\ h_{nh} & \text{if in NH (Medicaid or private)} \end{cases} \tag{9}$$

If the individual is not in a nursing home, then the individual derives utility from his/her owned or rented house. $\omega \geq 1$ captures homeownership premium, and R is the rented housing service. If the individual is in a nursing home (public or private), then his housing consumption is equal to the basic housing value from nursing home care h_{nh}.

We assume renting is an absorbing state, and liquidating housing assets worth of $\tilde{h}$ incurs transaction costs $\tau\tilde{h}$. Housing expenditure in each period is

$$e(\tilde{h}, R) = \begin{cases} \delta\tilde{h} & \text{if } \tilde{h} > 0 \\ (r+\delta)R & \text{if } \tilde{h} = 0 \end{cases} \tag{10}$$

where δ is the depreciation rate, and r is the real interest rate.

3.5 Health and mortality risk

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

$$\pi(s_{t+1}|s_t, age_t, sex, y). \tag{11}$$

The health transition process is treated as exogenous and does not depend on the receipt of informal or formal care. This is based on previous studies that find the evolution of long-term care needs and mortality is largely unaffected by the receipt of care; the primary role of long-term care lies in reducing discomfort experienced by the elderly with everyday task limitations (Byrne, Goeree, Hiedemann, and Stern, 2009).

3.6 Long-term care arrangements

Disabled husbands can either enter a nursing home or receive care from their wife. Wives can provide care only when they are healthy. As most spousal caregiving hours are provided by wives, we assume when a wife becomes sick, she enters into a nursing home.

Singles with long-term care needs use nursing home care if and only if caregiving from children is not "available". We proxy for the availability of informal care (ic_{child}) based on individuals' surveyed beliefs about receiving long-term care from children. 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 ($ic_{child} = 0$).

3.7 Welfare programs

Government guarantees a minimum consumption floor through means-tested welfare programs such as Medicaid, SSI, and SNAP. To simplify notations, we define the household's cash-at-hand after housing and long-term care decisions:

$$\tilde{a} = a + y + \underbrace{I[D=1](1-\tau)\tilde{h}_{-1} - e(\tilde{h}, R)}_{\text{net proceeds from housing decisions}} - \underbrace{m}_{\text{cost of NH}} \tag{12}$$

where D is an indicator for whether the household sells home, and m represents the cost of nursing home care.

Singles qualify for the means-tested government transfers if

$$\tilde{a} \leq \bar{a}_{nh=0} \quad \text{and not in NH, or} \tag{13}$$

$$\tilde{a} + (1-\tau)\tilde{h} \leq \bar{a}_{nh=1} \quad \text{and in NH.} \tag{14}$$

Note that for singles, the government counts post-sales housing assets, $(1-\tau)\tilde{h}$. This is consistent with Medicaid's estate recovery program which recovers Medicaid-financed long-term care costs upon singles' prolonged nursing home entry. As nursing home residents receive basic food and housing, the minimum consumption floor is lower for nursing home residents ($\bar{a}_{nh=0} > \bar{a}_{nh=1}$).

Couples qualify for the means-tested government transfers if

$$\begin{aligned} \tilde{a} &\leq 2\bar{a}_{nh=0} && \text{and none in NH} && (15)\\ \tilde{a} &\leq \bar{a}_{nh=0} + \bar{a}_{nh=1} && \text{and one in NH} && (16)\\ \tilde{a} + (1-\tau)\tilde{h} &\leq 2\bar{a}_{nh=1} && \text{and both in NH} && (17) \end{aligned}$$

The inequality (16) means that as long as there is a community spouse, the government does not recover Medicaid-financed long-term care costs from housing wealth. This is consistent with Medicaid's estate recovery program, as described in Section 2. The only case where the government recovers from a married household's housing wealth is when both of the spouses are Medicaid recipients.

3.8 Asset accumulation law

Cash-at-hand after government transfers becomes

$$\hat{a} = \begin{cases} \tilde{a} & \text{if not on welfare programs} \\ \text{RHS of relevant (13)-(17)} & \text{if on welfare programs} \end{cases} \tag{18}$$

Non-housing assets tomorrow become

$$a_{t+1} = (1+r)(\hat{a}_t - x_t) \tag{19}$$

where x_t is the household consumption expenditure described earlier in Equation (8). We assume there is no borrowing.

3.9 Recursive formulation

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

$$z_t = (a_t, \tilde{h}_{t-1}, s_t^H, s_t^W; y, ic_{child}) \tag{20}$$

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

$$q_t = (D_t, R_t, P_t^W, x_t) \tag{21}$$

where D_t represents the house selling choice, R_t is the rent choice, P_t^W is the spousal care-giving choice, and x_t is the household consumption expenditure.

To save on notations, denote survival probability by π_t^j which varies by current health, age, gender and income, as stated in Equation (11). A recursive formulation for a couple's problem is given as:

$$\begin{aligned} V_t^M(z_t) \quad &= \max_{q_t} \quad \kappa u(c_t^H, h_t^H) + (1-\kappa)\left[u(c_t^W, h_t^W) - \psi_{\tilde{h},y} P^W\right] \\ &+\beta \pi_t^H \pi_t^W E[V_{t+1}^M(z_{t+1})|z_t, q_t] \\ &+\beta(1-\pi_t^H)\pi_t^W E\left[\kappa v^M(a_{t+1}, \tilde{h}_t) + (1-\kappa)V_{t+1}^{S,W}(z_{t+1})|z_t, q_t\right] \\ &+\beta \pi_t^H (1-\pi_t^W) E\left[\kappa V_{t+1}^{S,H}(z_{t+1}) + (1-\kappa)v^M(a_{t+1}, \tilde{h}_t)|z_t, q_t\right] \\ &+\beta(1-\pi_t^H)(1-\pi_t^W)\left[v^S(b_{t+1})|z_t, q_t\right] \end{aligned} \tag{22}$$

subject to budget constraints. V^M represents a married household's value function. κ is the relative Pareto weight on the husband, and 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 $j \in \{H, W\}$. As the recursive formulation of $V^{S,j}$ is a simplified version of (22), we skip the derivation here.

4 Estimation

To estimate our life-cycle savings model, we employ a two-step estimation procedure, as frequently done in the literature (e.g., De Nardi, French, and Jones (2010)). In the first step, we fix or estimate parameters outside the model. In the second step, we use a limited information Bayesian method to recover structural parameters within the model.

4.1 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.

Table 7: Summary statistics of initial conditions in the estimation sample

	Married		Single	
	Mean	Median	Mean	Median
Age	70.02		75.43	
Homeowner	0.88		0.58	
Housing assets ($)	127,957	109,200	66,899	31,200
Non-housing assets ($)	299,356	123,240	124,009	15,600
Require long-term care	0.10		0.22	
Income ($)	34,255	25,934	29,743	19,845
Availability of informal care	0.53		0.49	
Female			0.76	
Observations	6,800		4,525	

Notes: The table presents the summary statistics of initial conditions in the estimation sample, constructed from the HRS 1998.

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.[5] 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.[6]

Table 7 presents the summary statistics of initial conditions in the estimation sample, constructed using the 1998 wave. 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.

[5]As described in Section 3, 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 available ($ic_{child} = 0$).

[6]Due to inconsistencies in the 1998 helper file, we use interview waves from 2000 and onward to construct the variable on spousal care provision.

4.2 First-stage parameters

This section describes parameters of the model that are fixed or estimated outside the model. The model assumes health transition probabilities follow an exogenously given Markov process where the next period's health is determined by one's 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.

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 ($\beta = \frac{1}{1.06}$) and 3% annual real interest rate ($r = 0.06$). 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 parameter of homeownership premium at 2.5, which is close to the value of 2.508 set by Nakajima and Telyukova (2020). We set the transaction cost of selling house at 7% of the value of the house, 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). For non-nursing home residents, the floor is higher at $548 per month (Brown and Finkelstein, 2008). The consumption and housing value of nursing home services is also set to $548 per month.

4.3 Structural estimation

4.3.1 Identification strategy

We now provide identification arguments for the parameters that we estimate within the model. We identify the wife's disutiilty 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 variation in housing asset shares. This is because the fraction of total assets that is 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. We divide the households into two age groups based on their household head's age. If the head's age is between 60 and 70, we categorize the household as young; otherwise, we categorize the household as old. 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.

To identify the Pareto weight of couples separately from bequest motives, we use savings decisions of low-income households. As low-income households do not have much asset to leave behind, bequest motives do not play a significant role in their savings decision. Their savings decisions are primarily driven by the tension between husbands' wish to consume and wives' wish to transfer assets to their widowhood. The tension arises because men have weaker precautionary saving motives than women: they have shorter life expectancy and expect smaller medical expenditures due to reliance on spousal care. As this tension is resolved through the relative bargaining power of husbands and wives, savings decisions of married households with limited assets are informative about the Pareto weight. In particular, we use the change in the homeownership rate before and after spousal death. For example, if the Pareto weight of wives were substantially larger, then married households' homeownership would increase as wives would want to lock their assets in illiquid housing. In this case, there would be a greater reduction in the homeownership rate before and after husbands' death.

4.3.2 Estimation strategy

We adopt a limited information Bayesian method as in Fernandez-Villaverde, Rubio-Ramirez, and Schorfheide (2016) and quantify the uncertainty on these parameters by the posterior distributions implied by the data. Based on the identification arguments provided in the previous section, Table 8 shows moments used in estimation and the parameters associated with them. Conditional on permanent income y, we assume the wife's caregiving disutility when she is a homeowner ($\psi^W_{\tilde{h}>0,y}$) is proportional to the her caregiving disutility when she is a renter ($\psi^W_{\tilde{h}=0,y}$). We denote the ratio by $\zeta \equiv \psi^W_{\tilde{h}>0,y}/\psi^W_{\tilde{h}=0,y}$. For the wife's caregiving disutility, we estimate $\psi^W_{\tilde{h}=0,y}$ for each value of y and the ratio ζ.

Table 8: Internally estimated parameters and associated moments

Parameter	Identifying moment
Wife's caregiving disutility	
$(\psi^W_{\tilde{h}=0,y=1}, \psi^W_{\tilde{h}=0,y=2}, \psi^W_{\tilde{h}=0,y=3})$	Spousal care provision rate by permanent income groups
ζ	Spousal care provision rate by homeownership status
Weight on housing consumption	
σ	Mean housing asset share of singles
	Mean housing asset share of couples
Husband's relative Pareto weight	
κ	Homeownership rate before/after spousal death in low income group
Bequest utility	
$(\delta_1, a_{b1}, h_b, \delta_2, a_{b2})$	Median non-housing asset of young singles
	Median non-housing asset of old singles
	Median non-housing asset of young couples
	Median non-housing asset of old couples
	Homeownership rate of young couples
	Homeownership rate of old couples

Notes: The table reports internally estimated parameters and their identifying moments.

Let $\widehat{\psi}$ denote the empirical moments to match. The goal is to choose a parameter vector $\theta \equiv (\psi^W_{\tilde{h}=0,y=1}, \psi^W_{\tilde{h}=0,y=2}, \psi^W_{\tilde{h}=0,y=3}, \zeta, \sigma, \kappa, \delta_1, a_{b1}, h_b, \delta_2, a_{b2})$ 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 $\log f(\widehat{\psi}|\theta) + \log p(\theta)$.

This limited information Bayesian method is closely related to the simulated method of moments in that the objective function is larger when the simulated moments are closer to the

Table 9: Parameter estimates

Parameter	Prior median [5th, 95th Percentile]	Posterior median [5th, 95th Percentile]
Wife's caregiving disutility		
$\psi^W_{\tilde{h}=0,y=1}$	10.0e-9	10.300e-9
	[5.5e-9, 14.5e-9]	[10.219e-9, 10.350e-9]
$\psi^W_{\tilde{h}=0,y=2}$	10.0e-9	7.035e-9
	[5.5e-9, 14.5e-9]	[6.966e-9, 7.203e-9]
$\psi^W_{\tilde{h}=0,y=3}$	10.0e-9	5.737e-9
	[5.5e-9, 14.5e-9]	[5.663e-9, 5.775e-9]
ζ	0.5	0.9388
	[0.05, 0.95]	[0.9143, 0.9455]
Weight on housing consumption		
σ	0.5	0.9942
	[0.05, 0.95]	[0.9823, 0.9990]
Husband's relative Pareto weight		
κ	0.75	0.7813
	[0.5250, 0.9750]	[0.7787, 0.7841]
Bequest utility		
δ_1	0.5	0.3328
	[0.05, 0.95]	[0.3256, 0.3364]
a_{b1}	15,000	8,214
	[1,500, 28,500]	[8,096, 8,249]
h_b	15,000	11,430
	[1,500, 28,500]	[11,365, 11,482]
δ_2	0.5	0.0769
	[0.05, 0.95]	[0.0722, 0.0877]
a_{b2}	15,000	2,904
	[1,500, 28,500]	[2,851, 2,941]

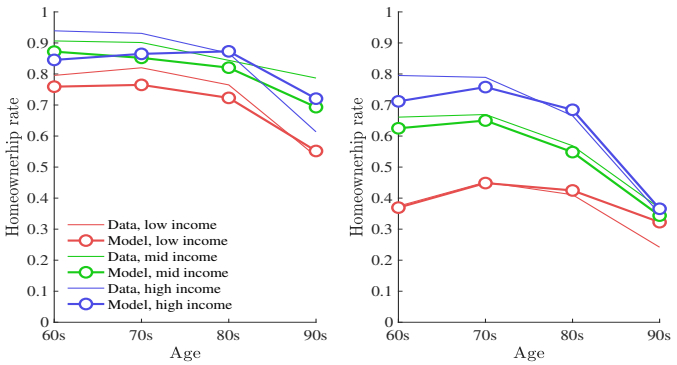
Notes: The table reports the parameter estimates.

empirical moments constructed from the data. Since we adopt the Bayesian approach, one could incorporate prior beliefs. If one uses uniform prior distributions for all the parameters, the estimation results could be interpreted as the estimates from the simulated method of moments using $\bar{V}^{-1}$ as the weighting matrix. We adopt uniform priors for all of the parameters.

4.3.3 Estimation results

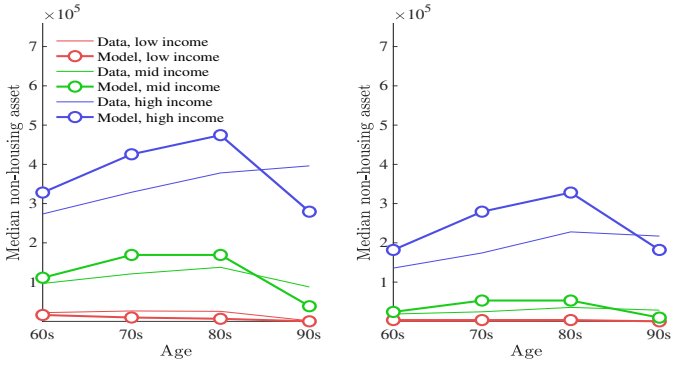
Table 9 reports the estimates of the parameters. The posterior median estimates on the wife's disutility from providing spousal care increase with permanent income. The ratio of the wife's caregiving disutility when she is a homeowner to her disutility when she is a renter has the posterior median value of 0.9388, which is less than 1. The result suggests that there is complementarity between homeownership and spousal care. The posterior median

Figure 3: Model fit of homeownership rate and non-housing assets



Currently couples Currently singles

Panel A: Homeownership rate



Currently couples Currently singles

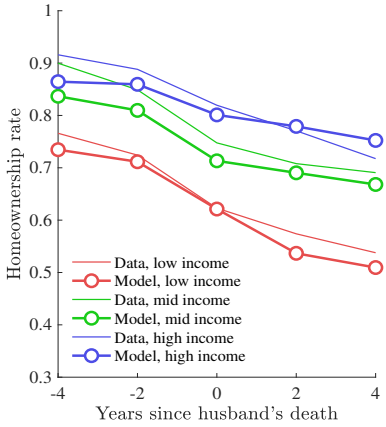
Panel B: Non-housing assets

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, solid lines represent empirical moments, and circled lines represent model-simulated moments.

estimate of the Pareto weight on husbands is 0.7813. Looking at the 90% credible set, the weight on husbands seems to be significantly higher than the equal weight. Bequest utility scale parameters δ_1 for couples and δ_2 for single households are estimated to have posterior median values of 0.3328 and 0.0769, respectively. The asset threshold estimates for non-housing assets (a_{b1} and a_{b2}) and housing assets (h_b) inform us about the consumption values below which individuals do not leave any bequests in a two-period model with perfect certainty about mortality risk.

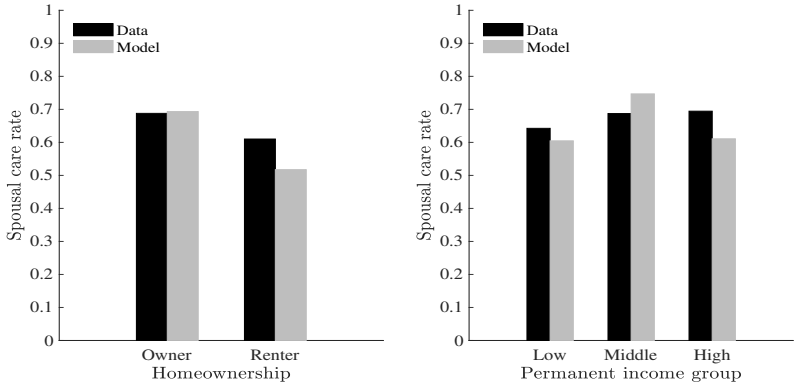
We now discuss the fit of the model reported in Figure 3. The model is able to generate the life-cycle profiles of the homeownership rate of couples and singles across permanent income groups. The model fits life-cycle profiles of non-housing assets closely for the low and middle

Figure 4: Model fit of the homeownership rate around spousal death



Notes: The figure shows the model fit for the homeownership rate before and after spousal death. Solid lines represent empirical moments, and circled lines represent model-simulated moments.

Figure 5: Model fit of spousal care provision



Notes: The figure reports the model fit of the spousal care rate by homeownership (left) and by permanent income (right). In each graph, black bars represent empirical moments, and gray bars represent model-simulated moments.

Table 10: 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.

income groups, whereas it overestimates savings for the high income group.

Figure 4 shows that although the estimation targeted the change in the homeownership rate before and after spousal death from the low income group only, the estimated model is able to replicate the change across all income groups.

Figure 5 reports the model fit of spousal care provision. The estimated model is able to generate the positive correlation between homeownership and spousal caregiving observed in the data. It also does a decent job of matching the spousal care rate across income groups.

5 Main results

In this section, we first use counterfactual experiments to quantify the effects of spousal care, Medicaid's estate recovery programs, and heterogeneous bequest motives on explaining the difference in homeownership between retired couples and singles. Then, we conduct counterfactual policy experiments and assess their effects on welfare and government spending.

We start by constructing a simulation sample to be used in all of our counterfactual simulations. In our model, everybody is initially married, and the husband's age starts from 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 10 shows the summary statistics of our counterfactual sample. For each individual in the sample, we make 400 duplicates. We draw the history of idiosyncratic health and mortality shocks using each individual's current health, age, gender, and permanent income. The same history of health and mortality shocks is used for all counterfactual experiments where we forward simulate the households' optimal decisions over the entire life-cycle in retirement.

5.1 What explains the difference in homeownership between couples and singles in retirement?

In this section, we show how much of the difference in homeownership between couples and singles can be explained by spousal caregiving, Medicaid's estate recovery programs, and heterogeneous bequest motives respectively. To do so, we conduct a decomposition analysis where we shut down one channel at a time.

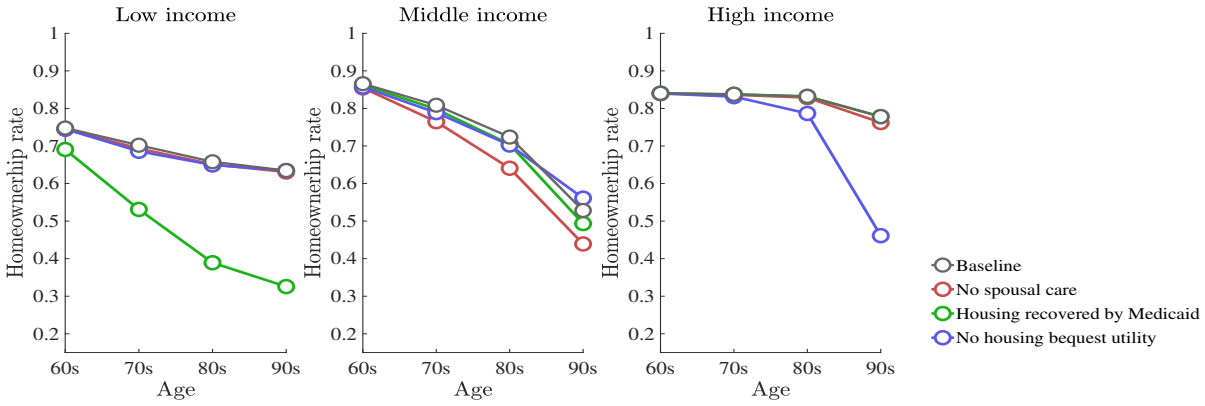
In the first experiment, we assume no wives can provide spousal care to their sick husbands. That is, all disabled husbands must use formal long-term care. This experiment will inform us about the importance of spousal caregiving in couples' homeownership decisions. In the second experiment, we shut down Medicaid's asymmetric treatment of housing assets by marital status, which favors couples. In this counterfactual experiment, the liquidated value of housing assets is always recovered by Medicaid regardless of marital status. This removes Medicaid's favorable treatment of housing assets for couples with a community spouse. In the third experiment, we change married individuals' bequest preferences such that they do not derive utility from leaving housing bequests. In this experiment, married individuals' housing assets are always liquidated before they are bequeathed, just like what we assume for singles. The experiment will inform us about how the heterogeneous value that retired couples and singles place on housing bequests affects their housing decisions.

Panel A in Figure 6 reports how couples' life-cycle homeownership rate changes under each of the three counterfactual scenarios, conditional on permanent income. In Panel B, we also report currently singles' homeownership rate. While the three counterfactual experiments considered primarily affect couples' incentive to own a home, singles' simulated homeownership rate will also change as some couples will transition into singles due to spousal mortality shocks. The goal is to see under which counterfactual experiment, the homeownership gap between couples and singles drops the most.

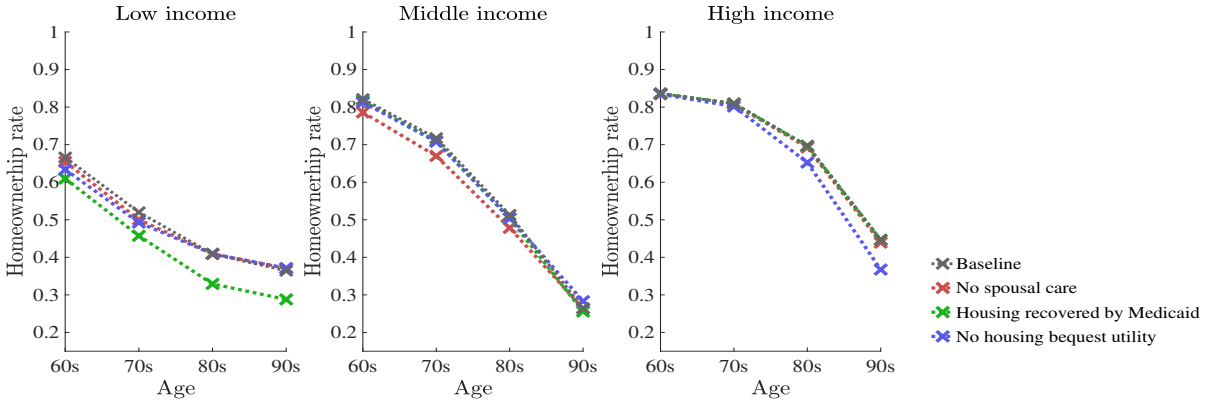
Figure 6 shows that the dominant channel that accounts for couples' stronger incentive to own a home than singles varies across different income groups. For low-income households, the difference in the homeownership rate between couples and singles becomes the smallest when Medicaid's estate recovery program no longer favors couples in its treatment of housing assets. The results imply that low-income couples hold on to housing assets in their retirement to better qualify for Medicaid. As long as Medicaid's favorable treatment of housing for couples remains intact, removing spousal care or housing bequest motives barely change the homeownership rate from the benchmark for the low-income group.

For households belonging to the middle-income group, removing the prospect of spousal caregiving has the biggest impact in decreasing the homeownership gap between couples and

Figure 6: Counterfactual homeownership rate



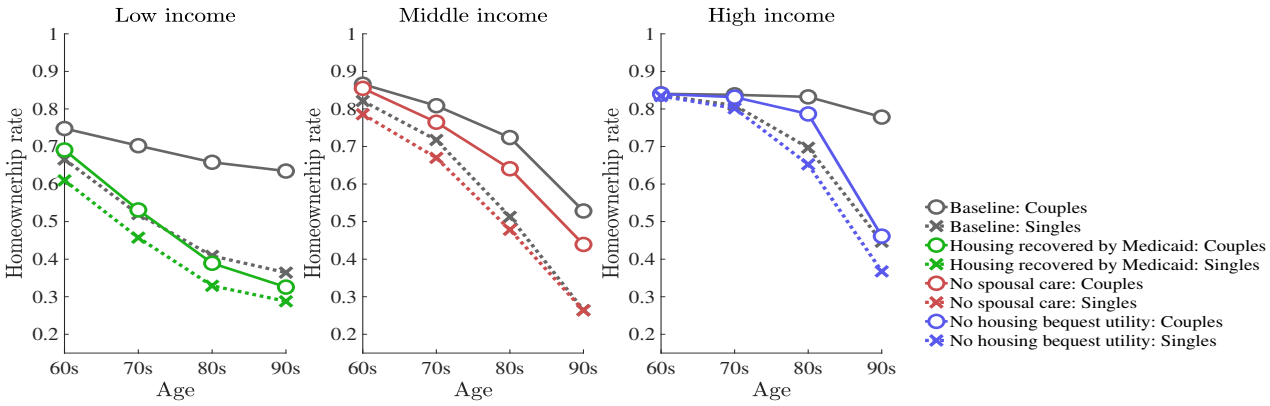
Panel A: Currently couples



Panel B: Currently singles

Notes: Panel A reports currently couples' life-cycle homeownership rate under the baseline model and each of the three counterfactual scenarios, conditional on permanent income. Panel B reports currently singles' life-cycle homeownership rate under the baseline model and each of the three counterfactual scenarios, conditional on permanent income.

Figure 7: Counterfactual homeownership gap: dominant channel



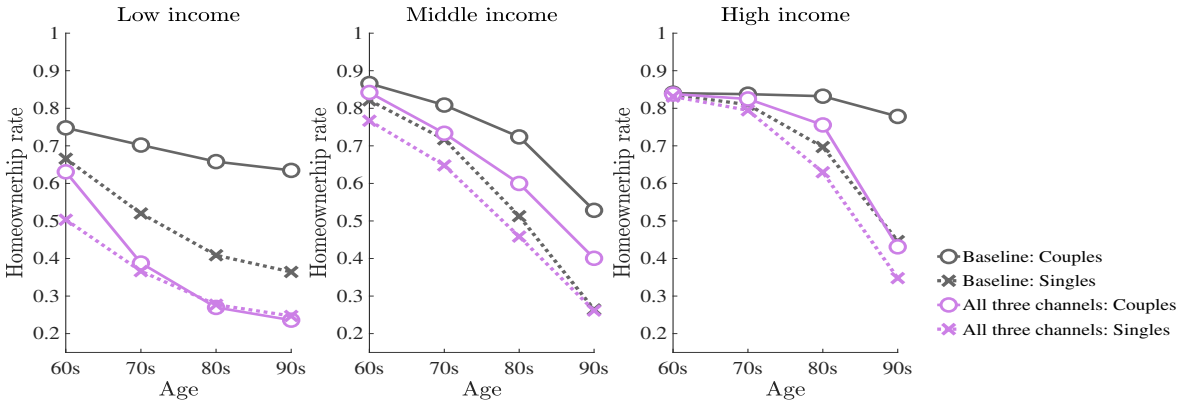
Notes: The figure reports how the baseline difference in homeownership between couples and singles changes under each income group's dominant channel.

singles. Middle-income couples are neither too poor to qualify for Medicaid, nor too rich to afford paying for formal care out-of-pocket. Consequently, for middle-income couples, spousal caregiving is an important insurance mechanism against health shocks, which can be better provided in owned houses. Medicaid's asymmetric treatment of housing assets by marital status is also a relevant factor in explaining middle-income couples' incentive to own a home, but to a smaller extent compared to the low-income group. The housing bequest channel again has a limited effect in explaining the homeownership gap for the middle-income group.

For high-income households, the dominant channel that explains couples' stronger incentive to own a home relative to singles is the housing bequest motives toward their surviving spouse. When we conduct a counterfactual simulation where couples no longer value leaving housing bequests as we assume for singles, high-income couples' homeownership rate drops sharply as they age. For couples with high income, neither Medicaid's estate recovery program nor the prospect of spousal caregiving have a meaningful impact on their housing decisions.

To sum, the dominant mechanism that explains the homeownership difference between couples and singles varies substantially by income. Figure 7 shows how the baseline difference in homeownership between couples and singles shrinks when each income group's dominant mechanism is shut down. Low-income couples have a stronger incentive to own a home to take advantage of Medicaid's estate recovery program which treats housing assets more favorably for couples. For middle-income households, the prospect of spousal caregiving is the dominant explanation for couples' higher homeownership rate compared to singles.

Figure 8: Counterfactual homeownership gap: all three channels



Notes: The figure reports how the baseline difference in homeownership between couples and singles changes when all three counterfactual scenarios take place simultaneously. That is, purple lines represent the counterfactual homeownership rate when there is no spousal care, Medicaid always counts housing in its means test regardless of marital status, and no household derives utility from leaving housing bequests.

High-income couples are much more likely to hold housing assets than singles in late life to leave housing as bequests to their surviving spouse. Figure 8 reports the counterfactual difference in homeownership between couples and singles when all three channels are shut down simultaneously.

5.2 Policy experiments

We now conduct a welfare analysis of counterfactual policies. To measure the welfare effect on individuals, we compute the initial wealth transfer needed to make a household under the baseline regime indifferent to the counterfactual regime. 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. Our measure of welfare is the mean initial wealth transfer *minus* the mean change in government spending.

We start by considering the provision of care subsidies to retirees that supply spousal care. While there exists no government policy that provides subsidies to informal caregivers in the U.S., several European countries have adopted policies that provide monetary support to family caregivers (Da Roit and Le Bihan, 2010). Following Barczyk and Kredler (2018), we base the amounts of care subsidies on the German program and consider the provision of $5,000 per year to wives that provide care to their disabled husbands. The results are reported in Column (2) of Table 11. On average, providing care subsidies has the effect of

Table 11: Counterfactual policy experiments

	(1) Baseline	(2) Care subsidy	(3) Medicaid : housing recovered	(4) Medicaid : housing exempt	(5) Medicaid : singles favored
Wealth transfer ($)					
: Low income	0	19,457	-12,450	4,451	-11,462
: Middle income	0	7,250	-168	3,177	1,471
: High income	0	4,451	0	17	1
: All	0	8,667	-2,836	1,980	-2,111
Government expenses ($)					
: Medicaid	51,362	44,891	51,868	64,099	56,662
: Care subsidy	0	6,865	0	0	0
: Total	51,362	51,756	51,868	64,099	56,662
: Change from baseline	0	394	506	12,737	5,300
Welfare ($)	0	8,273	-3,341	-10,757	-7,411

Notes: The table reports the welfare effects of various counterfactual policy experiments. Wealth transfer represents the average initial wealth transfer needed to make a married household in the baseline regime indifferent to the counterfactual regime. Government expenses are represented in the mean present-discounted value over the life-cycle of retirees. Welfare is defined as the mean wealth transfer minus the mean change in government expenses. Column (2) considers the provision of spousal care subsidies. Column (3) considers an alternative Medicaid program where housing assets are always counted against eligibility regardless of marital status. Column (4) reforms Medicaid such that housing assets are always excluded from the means test. Column (5) considers a reverse Medicaid rule where singles' housing assets are excluded from the means test, while couples' housing assets are counted.

increasing a retiree's initial wealth under the baseline regime by $8,667. At the same time, it is almost budget-neutral: while the government incurs care subsidy expenses, less people rely on formal care which consequently reduces formal care costs paid by Medicaid. As a result, the average welfare effect is substantially positive at $8,273 per household.

The next set of counterfactuals considers alternative treatments of housing in Medicaid's means test. While this exercise is similar to Achou (2020) and McGee (2019) who study counterfactual treatment of housing in means-tested public insurance, our emphasis will be on the asymmetric treatment of housing by marital status. Currently, Medicaid essentially counts housing assets in its means test for singles that become permanent nursing home residents by recovering Medicaid-paid expenses from their housing assets. In contrast, it disregards housing wealth for married individuals that have a community spouse.

First, we consider an alternative rule where Medicaid always recovers its cost from recipients' housing wealth. This is one of the counterfactual scenarios considered in the previous section which substantially decreases low-income couples' homeownership rate. Column (3) in Table 11 reports its welfare effect. The alternative Medicaid rule has an effect of reducing an average retiree's initial wealth by $2,836. As Medicaid benefits are most relevant for

those with limited assets, we find that most of the negative effect comes from the low-income group. What matters for the overwall welfare is whether the government saves enough to cancel out the negative effect on household. Column (3) shows that the government actually ends up spending slightly *more* on Medicaid. Without homestead exemption offered to couples, married households liquidate housing early in retirement to spend down to Medicaid eligibility. This results in faster dissaving of retirement wealth which leads to more people qualifying for Medicaid over the life-cycle. Consequently, the average welfare is reduced by $3,341.

Second, we examine what would happen if housing assets were never recovered by Medicaid. This alternative rule makes it easier for singles to qualify for Medicaid benefits. Column (4) in Table 11 reports the welfare results. On average, it has the effect of increasing retirees' initial wealth by $1,980. The positive effect comes primarily from low- and middle-income singles who are much more likely to qualify for Medicaid than those with high income. However, as more people qualify for Medicaid, the government spending increases substantially by an amount of $12,737. The net welfare effect is significantly negative at -$10,757.

Lastly, we reform Medicaid such that singles' housing assets are never recovered by Medicaid, while couples' housing assets are. This rule reverses the current Medicaid rule such that it favors singles rather than couples in its treatment of housing. Column (5) in Table 11 shows that this rule is equivalent to reducing an average retiree's initial wealth by $2,111. However, there is meaningful heterogeneity across income groups. Low-income households prefer to enjoy the homestead exemption while they are married than they are single. This is because by the time low-income households are single, they have very little savings such that they are likely to qualify for Medicaid even without the exemption. In contrast, middle-income households prefer to have the homestead exemption when they become single. While married, middle-income households have "too much" savings to qualify for Medicaid, even when housing is disregarded by Medicaid. While Medicaid expenses for couples decrease under the reverse Medicaid rule, those for newly eligible singles increase substantially such that in net, the government spending increases compared to the baseline. The overall welfare effect is therefore negative at $7,411.

To sum, Columns (2)-(5) in Table 11 rationalize the current Medicaid rule which favors couples than singles in its treatment of housing. By offering homestead exemption when retirees are relatively young, the current Medicaid program decreases the incentive to spend down to Medicaid eligibility early in retirement, which leads to reduced impoverishment risk.

6 Conclusion

This paper uncovers mechanisms through which marital transitions affect housing decisions of retirees. We develop and estimate a life-cycle savings model where marital transitions affect long-term care arrangements, bequest motives, and eligibility for means-tested welfare programs. We find that the key driver behind retirees' housing decisions varies substantially by income. For low-income households, how means-tested public insurance treats housing has the most impact on their housing decisions. For middle- and high-income households, family caregiving and bequest motives are the dominant driver, respectively. Our counterfactual policy experiments show that the current structure of the Medicaid estate recovery program which exempts housing assets only for couples is more desirable than alternative rules, such as providing homestead exemption to singles only. We also show that providing subsidies to spousal caregivers increases household welfare while remaining almost budget-neutral.

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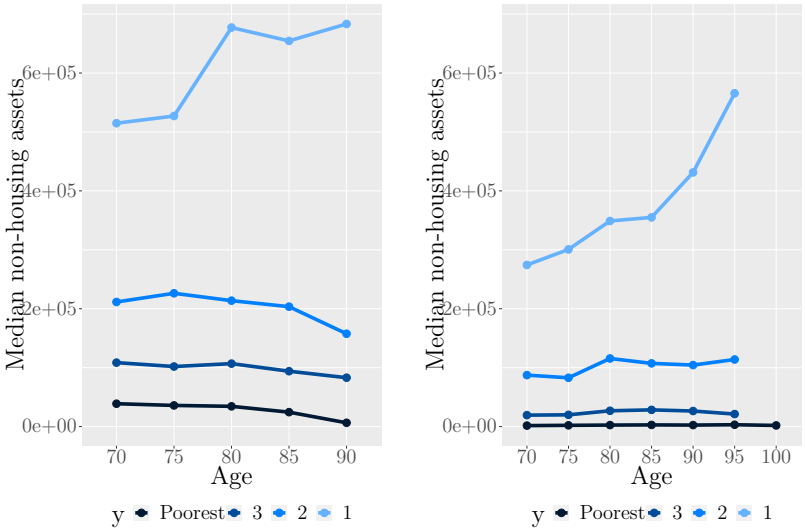
Appendix

A More tables and figures

Figure A.1: 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.