Savings After Retirement: A Survey*

Mariacristina De Nardi

UCL, Federal Reserve Bank of Chicago, IFS, and NBER

Eric French

UCL and IFS

John B. Jones

University at Albany, SUNY

June 2015

*De Nardi gratefully acknowledges support from the ERC grant 614328 "Savings and Risks" and from the ESRC through the Centre for Macroeconomics. We are grateful to Rory McGee and Cormac O'Dea for comments and suggestions. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research, any agency of the federal government, the Federal Reserve Bank of Chicago, or the IFS. This survey has been prepared for the Annual Review of Economics.

Abstract

The saving patterns of retired U.S. households pose a challenge to the basic life-cycle model of saving. The observed patterns of out-of-pocket medical expenses, which rise quickly with age and income during retirement, and heterogeneous lifespan risk, can explain a significant portion U.S. savings during retirement. However, more work is needed to disentangle these precautionary saving motives from other motives, such as the desire to leave bequests. An important complementary question is why households do not buy more insurance against these risks. Going beyond total savings and looking at its components, including housing, and looking at other portfolio choices can help shed light on these questions.

1 Introduction

More than one-third of total wealth (Wolff [98]) in the United States is held by households whose heads are over age 65. This wealth is an important determinant of their consumption and welfare. As the U.S. population continues to age, the way in which its elderly manage their wealth will only grow in importance. Most developed countries face similar circumstances.

Retired U.S. households, especially those with high income, decumulate their assets at a rate slower than that implied by the basic life cycle model, where the time of death is known. This raises the question of which additional saving motives lie behind their behavior. The answers to this question are key to understanding how their savings would respond to potential policy reforms.

In this paper, we present evidence on the potential reasons why so many elderly households hold lots of assets into very old age. Most of these explanations fall into two categories.

The first set of explanations emphasizes the risks that the elderly face late in life, particularly uncertain lifespans and uncertain medical spending. That is, elderly households may be holding onto their assets to cover expensive medical needs at extremely old ages. In fact, the observed patterns of out-of-pocket medical expenses, which rise quickly with age and income during retirement, coupled with heterogeneous lifespan risks, can explain a significant portion of U.S. savings during retirement. It should also be noted that, even if the elderly save exclusively for these reasons, many of them will leave bequests because they die earlier or face lower medical spending than planned.

The second set of explanations emphasizes bequest motives. Individuals may receive utility from leaving bequests to their survivors, most notably their children.

These two sets of motivations have similar implications for savings in old age, making it difficult to disentangle their relative importance. We discuss promising research that attempts to resolve this problem by looking at additional features of the data. We point out the importance of going beyond total savings and looking at housing. We also discuss the roles of insurance, portfolio choice, and rate of return risk.

Section 2 describes the patterns of savings, annuitized income, medical spending, health and mortality, and bequests for retired elderly households in the United States. Section 3 sketches out a life cycle model of single retirees that can illustrate many of the potential saving motivations that face elderly savers. Section 4 analyzes the savings implications of medical expenses and differential mortality within this model. In this section we also discuss possible reasons why households don't buy financial products that address these risks directly, namely annuities and long-term care insurance. Section 5 discusses bequest motives. Section 6 considers the role of housing, as opposed to financial assets, in determining retirees' saving. This section also includes a discussion of portfolio choice and rate of return risk. Section 7 documents some facts on couples and briefly discusses some of the issues involved with modeling their saving. Section 8 reports on the aggregate effects of saving motives and their implications for various policy reforms. Section 9 concludes.

2 Facts for retired households

An important factor determining the elderly's welfare is their consumption, which is financed by savings, Social Security payments, private pensions, and other transfers from government and family. Gustman and Steinmeier [44] show that for households near retirement, wealth is equal to about one third of lifetime income. Examining the same age group, Scholz et al. [92] document the three key funding sources of retiree consumption: net worth, employer-provided pensions, and Social Security benefits. They find that, with the notable exception of people in the bottom lifetime income decile, who rely only on Social Security, net worth is a major source of funds. Love et al. [70] compute the trajectories of net worth and the discounted present value of annuity income during retirement. They too find that net worth is a significant component of total wealth.

We will keep net worth and annuitized income separate in our analysis. As Hurd [51] emphasized, when households cannot borrow against future income such as Social Security benefits, the distribution of total wealth between net worth and annuitized income will affect consumption and saving.

To describe the saving of the elderly, we use data from the Assets and Health Dynamics of the Oldest Old (AHEAD) data set. The AHEAD is a survey of individuals who were non-institutionalized and aged 70 or older in 1994. It is part of the Health and Retirement Survey (HRS) conducted by the University of Michigan. We use data on assets and other variables, starting in 1996 and updating every two years thereafter.

The graphs in this section, which are taken from De Nardi et al. [24], use data only for singles. Single retirees comprise about 50% of age 70+ people and 70% of age 70+ households. In Section 7 we present some graphs for couples.

We break the data into 5 cohorts. The first cohort consists of individuals who were ages 72-76 in 1996; the second cohort contains ages 77-81; the third ages 82-86; the fourth ages 87-91. We construct life-cycle profiles by computing summary statistics by cohort and age at each year of observation. Moving from the left-hand-side to the right-hand-side of our graphs, we thus show data for four cohorts, with each cohort's data starting out at the cohort's average age in 1996.

Since we want to understand the role of income, we further stratify the data by post-retirement permanent income (PI). Hence, for each cohort our graphs usually display several horizontal lines showing, for example, median assets in each PI group in each calendar year. We measure post-retirement PI as the individual's average non-asset, non-social means-tested insurance income over all periods during which he or she is observed. Non-asset income includes the value of Social Security benefits, defined benefit pension benefits, veterans benefits and annuities. Because non-asset income is generally increasing in lifetime earnings, it provides a good proxy for PI.

2.1 Asset profiles

We calculate net worth (interchangeably called assets or savings in this paper) using the value of housing and real estate, autos, liquid assets (which include money market accounts, savings accounts, T-bills, etc.), IRAs, Keoghs, stocks, the value of a farm or business, mutual funds, bonds, "other" assets and investment trusts less mortgages and other debts. Juster et al. (1999) show that the wealth distribution of the AHEAD matches up well with aggregate values for all but the richest 1% of households. The amounts below are in 1998 dollars.

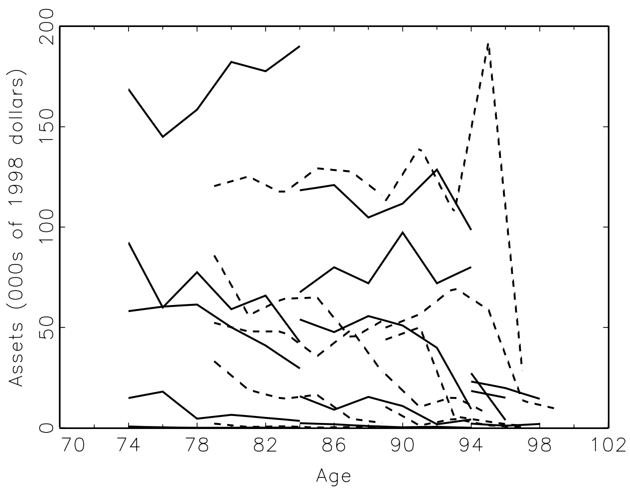

Figure 1: Median assets for singles.

Figure 1 displays display median assets, conditional on birth cohort and permanent income quintile, for singles. It presents asset profiles for the unbalanced panel; each point represents the median for all the members of a particular cell that are alive at a particular date. Median assets are increasing in permanent income, with the 74-year-olds in the highest PI income of the singles holding about $200,000 in median assets, while those at the lowest PI quintiles holding essentially no assets. Over time, those with the highest PI tend to hold onto significant wealth well into their nineties, those with the lower PIs never save much, while those in the middle PIs display some asset decumulation as they age. Thus, even at older ages, richer people save more, a finding first documented by Dynan et al. [28] for the whole life cycle.

2.2 Asset profiles and mortality bias

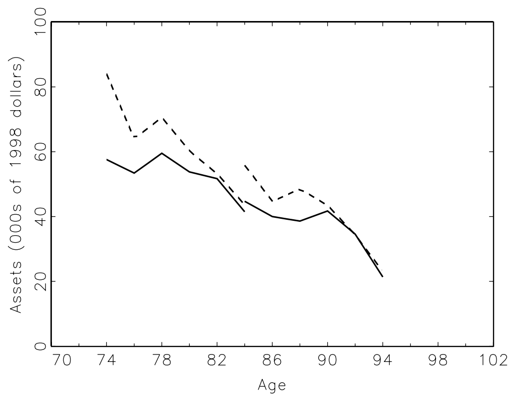

Figure 2: Median assets by birth cohort: everyone in the data (solid lines) vs. survivors (dashed lines).

It is well documented that health and wealth are positively correlated (see for instance, Smith [94], Poterba et al. [88], and Adams et al. [1]). As a result, poor people die more quickly and as a cohort ages its surviving members are increasingly likely to be rich. Failing to account for this mortality bias will lead a researcher to overstate asset accumulation. (Shorrocks [93], Mirer [77], and Hurd [50]). Figure 2 compares asset profiles that are aggregated over all income quintiles. The solid line shows median assets for everyone observed at a given point in time, even if they died in a subsequent wave, i.e., the unbalanced panel. The dashed line shows median assets for the subsample of individuals who were still alive in the final wave, i.e., the balanced panel. Figure 2 shows that the asset profiles for those who were alive in the final wave have much more of a downward slope. The difference between the two sets of profiles confirms that people who died during our sample period tended to have lower assets than the survivors.

The first pair of lines in Figure 2 shows that failing to account for mortality bias would lead us to understate the asset decumulation of those who were 74 years old in 1996 by over 50%. In 1996 median assets of the 74-year-olds who survived to 2006 were $84,000. In contrast, in 1996 median assets for all 74-year-olds were $60,000. Median assets of those who survived to 2006 were $44,000. The implied drops in median assets between 1996 and 2006 therefore depend on which population we look at: only $16,000 for the unbalanced panel, but $40,000 for the balanced panel of those who survived to 2006. This is consistent with the findings of Love et al. [70]. Sorting the data by permanent income reduces, but does not eliminate, this mortality bias.

2.3 Income profiles

We allow annuity income to be a flexible function of PI, age, and other variables. Figure 3 presents average income profiles, conditional on PI quintile and thus shows how income evolves over time for the same sample of elderly people. Average annual income ranges from about $5,000 per year in the bottom PI quintile to about $23,000 in the top quintile; median wealth holdings for the two groups are zero and just under $200,000, respectively.

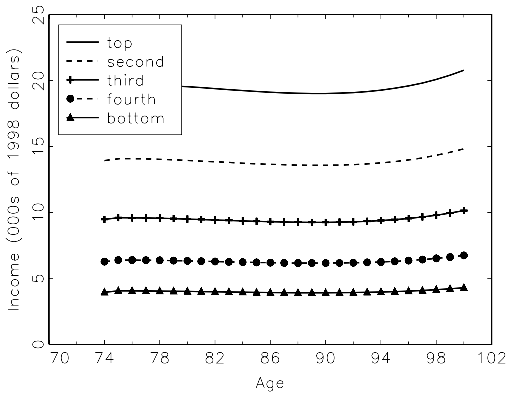

Figure 3: Average income, by permanent income quintile.

2.4 Medical spending profiles

Although Kotlikoff [62] pointed out nearly 30 years ago that medical expense risk could be an important driver of savings, it was not until the late 1990s that top quality panel data on the medical spending of older households became available in the AHEAD/HRS.[1]

As with income, out-of-pocket medical spending is a flexible function of PI, age, and other variables. Figure 4 presents average simulated medical expenses, conditional on age and permanent income quintile. Permanent income has a large effect on average medical expenses, especially at older ages. Average medical expenses are less than $1,000 a year at age 75 and vary little with income. By age 100, they rise to $2,900 for those in the bottom quintile of the income distribution and to almost $38,000 for those at the top of the income distribution. Mean medical expenses at age 100 are $17,700, which is greater

[1]Data from Medicare Current Beneficiary Survey (MCBS) became available at about the same time. De Nardi et al. [21] review the MCBS medical spending data in some detail.

than average income of those of the same age.

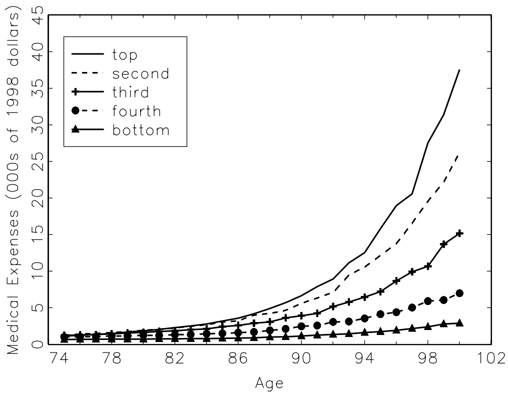

Figure 4: Average out-of-pocket medical expenses, by permanent income quintile.

An individual's out-of-pocket medical spending is a function not only of the medical services she receives, but also of her resources and insurance coverage. In fact, those with low assets on average pay a smaller share of their total medical care costs because they receive more assistance from means tested social insurance programs such as Medicaid. By way of example, consider two people who need to be in a nursing home that costs $50,000. One person is not Medicaid eligible. In most cases neither Medicare nor private insurance will cover her costs and her out-of-pocket medical cost will be the full $50,000. The second person has no income or assets and is thus eligible for Medicaid. Her out-of-pocket cost will be zero.

If we look at the out-of-pocket medical expenses for the Medicaid-eligible person, we would conclude that she faces no medical risk. However, to study the effects of health insurance, public or private, one cannot describe the underlying medical expense risk without data on Medicaid payments. Figure 5, taken from De Nardi et al. [21], uses Medicare Current Beneficiary Survey (MCBS) data to summarize total medical expenditure over the age-65+ component of the life cycle. Figure 5 shows that Medicaid spending is significant, especially at older ages when nursing home expenses become larger. Ignoring Medicaid spending would lead us to significantly understate total medical expenditure risk.

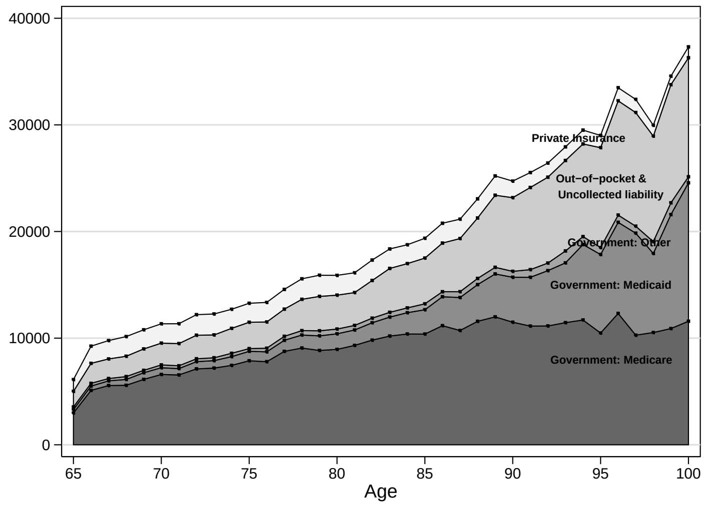

Figure 5: Average total medical expenditure, by age and payor type.

2.5 Mortality and health status

We treat health as a binary variable (good or bad), which we derive from respondents' self-assessments of their overall health status. As with income and medical spending, we allow the probabilities of bad health and death to

Income Quintile	Healthy Male	Unhealthy Male	Healthy Female	Unhealthy Female	All[a]
bottom	7.6	5.9	12.8	10.9	11.1
second	8.4	6.6	13.8	12.0	12.4
third	9.3	7.4	14.7	13.2	13.1
fourth	10.5	8.4	15.7	14.2	14.4
top	11.3	9.3	16.7	15.1	14.7
By gender:[b]			By health status:[c]		
Men	9.7		Unhealthy	11.6	
Women	14.3		Healthy	14.4	

Notes: Life expectancies calculated through simulations using estimated health transition and survivor functions; [a]Calculations use the gender and health distributions observed in each permanent income quintile; [b]Calculations use the health and permanent income distributions observed for each gender; [c]Calculations use the gender and permanent income distributions observed for each health status group.

Table 1: Life expectancy in years, conditional on reaching age 70.

be flexible functions of PI, age, previous health status and gender. Table 1 presents predicted life expectancies. Rich people, women, and healthy people live much longer than their poor, male, and sick counterparts. Two extremes illustrate this point: an unhealthy male at the bottom quintile of the permanent income distribution expects to live only 6 more years, that is, to age 76. In contrast, a healthy woman at the top quintile of the permanent income distribution expects to live 17 more years, thus making it to age 87.[2] Our estimated income gradient is similar to that in Waldron [97], who finds that those in the top of the income distribution live 3 years longer than those at the bottom, conditional on being 65. Attanasio and Emerson [7] document similar findings for the for UK, while Hurd et al. [53] and Gan et al. [40] do so for the US.

We also find that for rich people, the probability of living to very old ages, and thus facing very high medical expenses, is significant. For example, we find that a healthy 70-year-old woman in the top quintile of the permanent income distribution faces a 14% chance of living 25 years, to age 95.

2.6 Bequests

Gale and Scholz [39] show that intergenerational transfers are large in the aggregate. However, while many people die with positive assets, leaving bequests to their heirs, most of these bequests are very modest. For example, De

[2]Our predicted life expectancy at age 70 is about three years less than the aggregate statistics imply. This discrepancy stems from using data on singles only: when we re-estimate the model for both couples and singles, predicted life expectancy is within a year of the aggregate statistics for both men and women.

Nardi et al. [24] show that one year before their death, 30% of people own less than $10,000, 70% of people own less than $100,000, and 98% of people own less than $1,000,000. Hurd and Smith [54] report that the average bequest amounts left by decedents are even lower. French et al. [36] find that part, but not all of this decline can be explained by medical spending in the last year of life and death expenses from burial fees. This decline might also be caused by reporting errors, as children of decedents tends to underreport the value of estates (Gale and Scholz [39], Laitner and Sonnega [66]), or by transfers aimed at reducing estate taxes (Kopczuk [59]).

3 A life-cycle model

We can analyze many potential savings motives by studying a fairly simple version of the life cycle saving model. In this model a single person faces lifespan uncertainty, uncertain medical expenses, bequest motives, and a health-dependent utility function. The person maximizes her expected utility by choosing how much to save in a risk-free asset. Versions of this model have been estimated in De Nardi et al. [23, 24] and have been found to fit the data well.

Consider a retired single person, seeking to maximize his expected lifetime utility by choosing consumption c_t, at age t, $t = t_{r+1}, ..., T$, where t_r is the retirement age. Each period, utility depends on both consumption and health status, h, which can be either good ($h = 1$) or bad ($h = 0$).

The flow utility from consumption is

$$u(c, h) = \delta(h) \frac{c^{1-\nu}}{1-\nu}, \tag{1}$$

with $\nu \geq 0$. The dependence of utility on health status is given by

$$\delta(h) = 1 + \delta h, \tag{2}$$

so that when $\delta = 0$, health status does not affect utility.

As in De Nardi [20], the utility the household derives from leaving assets to his or her heirs is

$$\phi(a) = \theta \frac{(a+k)}{1-\nu}^{(1-\nu)}, \tag{3}$$

where θ is the intensity of the bequest motive, while k determines the curvature of the bequest function and hence the extent to which bequests are luxury goods.

We assume that non-asset income, y_t, is a deterministic function of sex, g, permanent income, I, and age:

$$y_t = y(g, I, t). \tag{4}$$

The individual faces several sources of exogenous risk.

1. Health status uncertainty. The transition probabilities for health status depend on previous health, sex, permanent income, and age,

$$\pi_{j,k,g,I,t} = \Pr(h_{t+1} = k | h_t = j, g, I, t), \quad j, k \in \{1, 0\}. \tag{5}$$

2. Survival uncertainty. Let $s_{g,h,I,t}$ denote the probability that an individual of sex g is alive at age $t+1$, conditional on being alive at age t, having time-t health status h, and enjoying permanent income I.

3. Medical expense uncertainty. Medical expenses, m_t, are defined as out-of-pocket expenses. The mean and the variance of the log of medical

expenses depend upon sex, health status, permanent income, and age. The stochastic, idiosyncratic component of m_t is modeled as the sum of a persistent AR(1) process and a white noise process. French and Jones [37] and Feenberg and Skinner [31] show that having both persistent and transitory medical expense shocks is essential to replicating observed medical expense dynamics.

Assets evolve according to

$$a_{t+1} = a_t + y_n(ra_t + y_t, \tau) + b_t - m_t - c_t, \quad (6)$$

$$a_t \geq 0. \quad (7)$$

where $y_n(ra_t + y_t, \tau)$ denotes post-tax income, r denotes the risk-free, pre-tax rate of return, the vector τ describes the tax structure, and b_t denotes government transfers. Equation (7) imposes a borrowing constraint. Government transfers ensure that this constraint can be met even when medical expenses are large. The transfers bridge the gap between an individual's "total resources" (i.e., assets plus income less medical expenses) and the consumption floor $\underline{c}$:

$$b_t = \max\{0, \underline{c} + m_t - [a_t + y_n(ra_t + y_t, \tau)]\}, \quad (8)$$

If transfers are positive, $c_t = \underline{c}$ and $a_{t+1} = 0$.[3]

The consumer's financial resources are summarized by cash-on-hand, x_t,

$$x_t = a_t + y_n(r\, a_t + y_t, \tau) + b_t - m_t. \quad (9)$$

[3]See De Nardi et al. [25] for a discussion of the Medicaid rules and Hubbard et al. [48] for other means tested social insurance programs.

Letting β denote the discount factor, we can write the dynamic problem recursively

$$V_t(x_t, g, h_t, I, \zeta_t) = \max_{c_t, x_{t+1}} \Big\{ u(c_t, h_t) + \beta s_{g,h,I,t} E_t V_{t+1}(x_{t+1}, g, h_{t+1}, I, \zeta_{t+1}) \\ + \beta(1 - s_{g,h,I,t}) \phi(a_{t+1}) \Big\}, \tag{10}$$

subject to

$$a_{t+1} = x_t - c_t, \tag{11}$$

$$x_{t+1} = x_t - c_t + y_n\big(r(x_t - c_t) + y_{t+1}, \tau\big) + b_{t+1} - m_{t+1}, \tag{12}$$

$$x_t \geq \underline{c}, \quad \forall t, \tag{13}$$

$$c_t \leq x_t, \quad \forall t. \tag{14}$$

De Nardi at al. [22] estimate this model using the Method of Simulated Moments (as done by Gourinchas and Parker [42], Cagetti [15], and French [34]) and find that the model matches the observed asset data very well. In the following sections we show various simulations of the model (for a set of estimated preference parameters that match the data well) when we shut down different combinations of its features in order to show how retirement saving responds to various saving motives.

4 Precautionary motives

We first report results for the case with no bequest motive ($\theta = 0$) and no health-dependent utility ($\delta = 0$).

4.1 Exogenous medical spending

We ask whether the out-of-pocket medical expenditures estimated from the data are an important driver of old age savings. To answer this question, we zero out all out-of-pocket medical expenditures and examine the resulting changes in assets. Figure 6, taken from De Nardi et al. [24], shows median assets with and without medical expenses. We construct this figure by simulating the net worth of the AHEAD birth-year cohort whose members were ages 72-76 (with an average age of 74) in 1995. We take the initial distribution of net worth, permanent income, health status, medical expenses, and sex from the 1995 AHEAD data. As the model reproduces the same mortality bias that is present in the data, for ease of interpretation, we display profiles with no attrition, so that the composition of the simulated sample is fixed over the entire sample period. This allows us to track the saving of the same people over time.

The dashed lines in Figure 6 display the net worth profiles generated by the baseline model with medical expenses. There are five of those dashed lines, representing asset profiles for each PI quintile. As in the data, the assets of those at the bottom quintile are not visible because they are close to zero. Households in this PI group rely on their annuitized income and the government consumption floor to finance their retirement. People with higher PI levels start out with considerably more assets and decumulate their net-worth very slowly, with those in the top PI quintile starting off at $170,000 in median net worth at age 74 and retaining over $100,000 past age 90.

The solid lines in Figure 6 are the asset profiles that result when medical expenses are eliminated. Comparing the dashed and solid lines reveals that medical expenses are a big determinant of retiree saving. Medical expenses are especially important for those with high permanent income, who face the highest expenses and are relatively less insured by the government-provided consumption floor. These retirees are reducing their current consumption in order to pay for the high out-of-pocket medical expenses they expect to bear later in life. If there were no out-of-pocket medical expenses, individuals in the highest permanent-income quintile would deplete their net worth by age 94. In the baseline model with medical expenses their asset holdings at age 100 are almost $40,000. The risk of living long and having high medical expenses late in life significantly increases savings. Our results indicate that modeling uncertain lives and out-of-pocket medical expenses is important in evaluating policy proposals that affect the elderly.

4.2 Endogenous medical spending and health-dependent utility

The results shown in Figure 6 are constructed under the assumption that medical spending is exogenous. This leaves no scope for individuals to cut back on medical spending when in dire financial straights. Several papers address the issue of endogenous medical expenditure. De Nardi et al. [24], McMcClellan and Skinner [75], and Ameriks et al. [4] allow increased medical expenditures to increase current period utility, reflecting channels such as improved nursing care. Yogo [101], Khwaja [57], Davis [19], Halliday et al. [45], Fonseca et al. [33], Hugonnier et al. [49], Scholz and Seshadri [91] and Ozkan [83] build

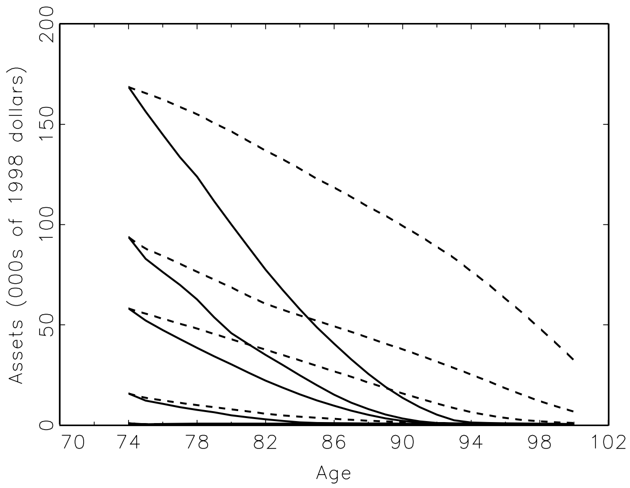

Figure 6: Median assets by cohort and PI quintile: baseline model (dashed lines) and model with no medical expenses (solid lines).

upon the Grossman [43] model of investment in health.

The results of De Nardi et al. [24] suggest, first, that whether exogenous or endogenous, medical expenses need to match the data and thus have a similar impact on observed savings. If individuals expect to purchase expensive medical services at the ends of of their lives, they will save to cover these expenditures. Second, when evaluating the effects of counterfactual policy experiments, such as adjusting the consumption floor $\underline{c}$, allowing medical expenses to adjust will mitigate the savings response. Yogo [101] also finds that allowing for endogenous medical spending reduces the precautionary savings motive.

Laitner et al. [65] show that the risk of facing high medical costs is in many ways equivalent to the risk of an increase in the marginal utility of consumption. In both cases, desired spending increases and the risk of higher future spending generates precautionary saving motives. They use this result to construct a simpler version of our model that can be solved analytically. Models of endogenous medical spending in many ways take a similar approach, as medical spending shocks are shifts in the marginal utility of medical spending, either direct as in De Nardi et al. [24], or changes in the returns to investment in health and thus endogenize medical expenses for the purpose of building and preserving health.

A related question is whether the marginal utility of non-medical consumption varies with health, even after controlling for medical spending. In the model at hand, the health-dependent utility parameter δ is identified from the observed evolution of health, the asset profiles, and out-of-pocket medical expenditures. If consumption is the residual in the budget constraint after controlling for asset growth and medical expenses, health-dependent utility is identified from the relationship between implied consumption and health. Palumbo [84] and Low and Pistaferri [72] take similar approaches. In De Nardi et al. [24], this parameter is negative—the marginal utility of consumption is higher in bad health—but estimated very imprecisely. Hong et al. [47] use consumption and health data and find that bad health reduces the marginal utility of consumption at younger ages and increases it at older ages. If the marginal utility of health rises at older ages because of declining health, this could create an additional motivation to hold onto assets at older ages. However, the literature has not yet reached a consensus about whether bad health raises or reduces the marginal utility of consumption, let alone the effect's magnitude (Finkelstein et al. [32]).

4.3 Heterogenous mortality

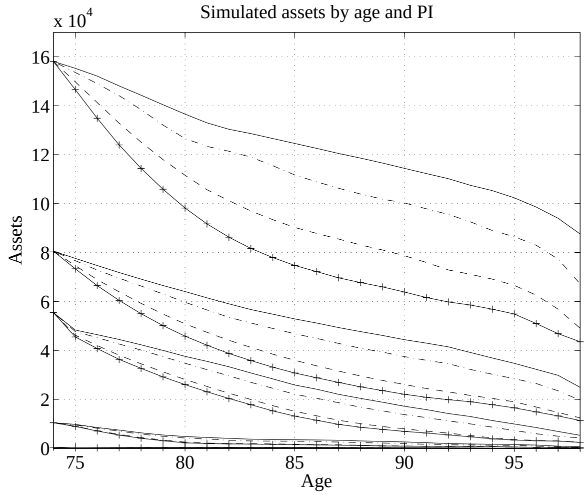

Figure 7: Median net worth under different mortality Assumptions

Notes: —-: baseline. – · –: everyone in bad health. – –: everyone male and in bad health. –+—+–: everyone low permanent income, male, and in bad health.

Figure 7, taken from De Nardi et al. [23], uses our model to show how median assets vary with mortality. There are five clusters of lines in Figure 7, one for each PI quintile. (The asset holdings of the bottom PI quintile are again not visible.) The top line in each cluster shows median assets associated with the baseline mortality assumptions. For each PI level, we also plot the savings generated by the model under three other cases, where we make increasingly pessimistic assumptions about how long people expect to live. This allows us to isolate the effect of the cross-sectional heterogeneity in mortality rates on saving. First, as presented in the top dashed-dot line, everyone is assumed to always be in bad health and have the associated mortality of those in bad health. The resulting drop in life expectancy is 2-4 years, depending on gender and PI. This lower life expectancy generates a noticeable drop in net worth, especially for the highest PI households. The next dashed line corresponds to the mortality expectations of males who are always sick, who on average live 5 years less than a woman of the same health and PI. The bottom crossed line corresponds to the mortality expectations of low income males who are always sick. In summary, differences in life expectancy related to health, gender, and permanent income are important to understanding savings patterns across these groups, and the effect of each factor is of a similar order of magnitude.

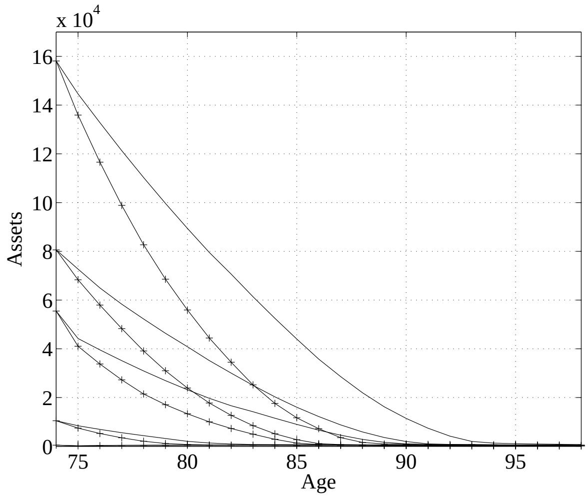

Figure 8: Median net worth under different mortality assumptions when there are no medical expenses

Notes: —-: baseline. –+—+–: everyone low permanent income, male, and in bad health.

Figure 8 shows the asset profiles that arise when there is lifespan uncertainty but no medical costs. The solid line displays asset profiles for the baseline life expectancy case, while the crossed line refers to the case in which everyone has the life expectancy of a sick, poor and male person. Comparing Figure 8 to Figure 7 reveals that when there are no medical expenses the effects of changing life expectancy are much smaller in absolute terms, even if they are larger in relative terms. In absence of medical expenses, giving the richest people the mortality rates of a sick, low-income male reduces assets at age 85 by $32,000. Figure 7 shows that with medical expenses the reduction is $50,000. Medical expenses that increase with age and permanent income prop up old age savings for the richest. When their life expectancy is decreased, rich retirees are less likely to survive to very old age and face very large medical expenses. This has a large effect on their level of savings and the sensitivity of their savings to expected mortality.

In interpreting this finding, it is important to keep in mind that we do not allow medical spending to jump immediately before death. De Nardi et al. [21], Braun et al. [12], French et al. [36] and Marshall et al. [73] show that expenses incurred near the time of death are large. The way in which medical expenses increase with age therefore to some extent reflects higher mortality, a feature not captured in our spending model. However, in our baseline model medical expenses and mortality both increase when health switches from good to bad. Moreover, Spillman and Lubitz [95] and Braun et al. [12] show that end-of-life costs rise with age, probably because of increased long-term care costs.

4.4 The role of lifespan risk

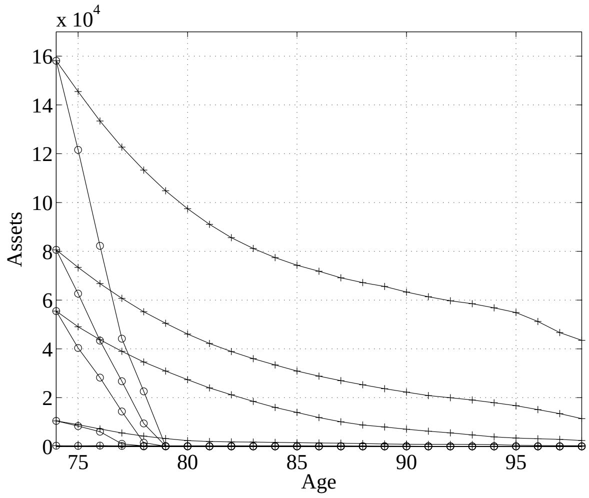

Figure 9: Median Net Worth under Different Mortality Assumptions

Notes: –+—+–: everyone low permanent income, male, and in bad health. –o–o–: everyone low permanent income, male, in bad health, and with a certain lifespan.

In this section we consider the effects of longevity risk—the risk of outliving one's expected lifespan—on saving, an issue first considered by Davies [18]. Figure 9 shows two sets of simulations. As in Figure 7, the crossed line shows predicted net worth when everyone faces the mortality rates of a man with low permanent income who is in bad health. This man has an expected lifespan of 5 years, but faces the risk of living much longer. The circle-dash line eliminates this risk; all individuals in these simulations expect to live exactly 5 years, to age 79. In such a case, there is no value in holding assets after 5 years, hence individuals deplete their net worth by the end of their fifth year, consistent with a basic life cycle model. In contrast, most individuals facing uncertain lifespans still have significant asset holdings after 5 years, even when facing the most pessimistic survival prospects. This comparison shows that at realistic levels of annuitization, the risk of living beyond one's expected lifespan has huge effects on saving.

4.5 Insurance

The life cycle model just described implies very strong demand for insurance products, particularly annuities and Long-Term-Care (LTC) insurance. If priced fairly, these products insure against lifespan or medical expense risk much more efficiently than standard assets. For example, using a very simple version of the life cycle model with only life span uncertainty, Yaari [99] shows that people should immediately annuitize all their wealth. However, it is well-documented that U.S. households hold small amounts of annuities and LTC insurance; see Fang [30] for a recent survey. In this section, we point out that although the low purchase rate of insurance products presents a challenge to the simplest versions of the life cycle model, more realistic versions of the model have the potential to better explain both low insurance holdings and savings behavior.

Many studies of the underannuitization puzzle focus on adverse selection: long-lived people are more likely to purchase annuities, driving annuity prices up and pricing out those who do not expect to live so long. Mitchell et al. [78] show that when they use the mortality tables of those who actually purchase annuities at age 65, annuities pay back 93 cents in expected present discounted value for every dollar purchased. When they instead use the mortality tables for the overall population, the return falls to 81 cents. Comparing the returns of the annuitant and overall populations signals the cost of selection. But even at observed levels of adverse selection, most reasonably calibrated life cycle models with only life span risk still imply that people should completely annuitize. For example, Lockwood [69] shows that people are willing to pay up to 25% of their wealth to gain access to completely fair annuity markets and 16% to access annuity markets with a 10% load.

A number of papers have studied potential reasons for the lack of annuitization. Medical spending risk could increase demand for liquid assets and thus reduce the demand for annuities. Davidoff et al. [17] and Peijnenburg et al. [87] show that high medical risk early in retirement tends to decrease annuity demand, while large medical risks late in retirement tends to increase it. Because medical spending tends to be modest before age 70 and grows rapidly with age (De Nardi et al. [24], Robinson [90]), medical spending is unlikely to significantly decrease the demand for annuities. Medical spending may in fact even increase the demand for annuities, as the mortality credit provided by annuities makes them the most effective way to save for large medical expenditures at very old ages (Pang and Warshawsky, 2010). Pashchenko [85] and Lockwood [69], who study the demand for annuities in a rich framework that includes medical expense risk, stress the importance of bequest motives in reducing annuity demand.

In contrast to annuities, which pay benefits as long as the individual remains alive, LTC insurance pays off only when the individual needs expensive long-term care services. In principle, the demand for LTC insurance should be large, since this insurance often pays off when other financial resources have been exhausted and medical needs are high.

However, access to comprehensive LTC insurance is likely incomplete. Hendren [46] shows that, conditional on observables, the market for an insurance product will collapse if private information problems are sufficiently large. His main finding is that a large fraction of those applying for are rejected by the underwriters because of private information problems. Hendren estimates that 23% of 65-year-olds have health conditions that preclude them from purchasing LTCI. Fang [30] points out that the typical LTC insurance contract caps both the maximum number of days covered over the life of the policy and the maximum daily payment for a nursing home stay, a daily payment that is often fixed in nominal terms.

Moreover, Brown and Finkelstein [13] point out that, by serving as the payor of last resort, Medicaid significantly reduces the return to purchasing LTC insurance for 75% of the U.S. single households. This is because Medicaid generally assists households only with LTC expenses not covered by other forms of insurance. Lockwood [68] finds that bequest motives also reduce the demand for LTC insurance. Davidoff [16] shows that home equity may substitute for long term care insurance. Indeed, it has been shown that health shocks and loss of a spouse are associated with housing wealth decumulation (Venti and Wise [96] and Poterba et al. [89]). This point reinforces a larger theme: assets serve many purposes and can be used for many contingencies.

5 Bequest motives

As we discussed in section 2.6, many people die with positive assets and thus leave bequests to their children or other heirs. However, it is not clear whether these bequests are intentional or unintentional. For example, De Nardi et al. [24] estimate their model with and without a bequest motive. Figure 10 compares the distributions of bequests implied by both versions of the model against the data. The two specifications fit the data almost equally well. It turns out that in absence of a bequest motive, modest changes in utility function parameters yield larger precautionary savings motives, allowing the model to fit the wealth data almost equally well. Nonetheless, the estimated bequest motive is strong, especially for the rich. This shows the difficulty of separately identifying precautionary savings motives from bequest motives using wealth data alone. Both motivations encourage saving and both motivations are strongest for the rich—bequests are modeled as luxury goods by construction and precautionary savings motives are strongest for rich people who rely less heavily on means-tested government insurance. As Dynan et al. [27] note, many people are likely driven by both motivations.

More recent papers have attempted to attempt to distinguish between precautionary savings and bequest motives by matching additional features of the data. For example, Lockwood [68] matches additional data on purchases of LTC insurance. His key idea is that in the absence of bequest motives all savings is due to precautionary purposes, which implies that demand for LTC insurance is very large. In the absence of insurance market frictions, the only way to simultaneously match savings and low purchases of LTC insurance is to

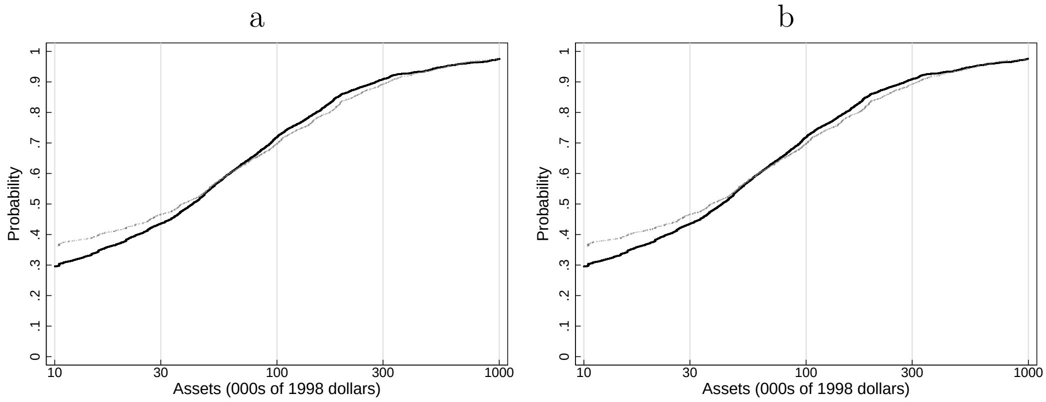

Figure 10: Cumulative distribution function of assets held 1 period before death: data (solid line) and model (lighter line). Panels a and b show results for models with and without bequest motives, respectively.

have modest precautionary savings motives and a significant bequest motive. Using a complementary argument, Inkmann and Michaelides [55] conclude that the life insurance holdings of UK households are consistent with bequest motives.

Ameriks et al. [5] and Ameriks et al. [4] match the responses to 'Strategic Survey Questions' that involve hypothetical trade-offs between consuming long term care and leaving bequests. The hypothetical wealth splits chosen by survey respondents help identify the relative strength of bequest motives. Their results, based on samples of wealthy retirees, suggest that precautionary motives are at least as important as bequest motives. De Nardi et al. [26] match Medicaid recipiency rates and transfer amounts. Matching the Medicaid data bounds the medical expense risk and the strength of the associated precautionary saving motives generated by their model. To match observed assets holdings in this environment, the model attributes part of savings to bequest motives. More generally, papers that bring more aspects of the data to bear tend to find more evidence in favor of a bequest motive, at least for richer families.

There is also uncertainty about how bequest motives are best modeled. Altonji et al. [3] empirically reject important implications of the purely altruistic, dynastic model. Hurd [51] and Kopczuck and Lupton [60] find that the presence or absence of children is not important to determining either the existence or the strength of bequest motives. In contrast, Ameriks et al. [5] find that households with children answer 'Strategic Survey Questions' in a way consistent with stronger bequest motives. Laitner and Juster [64] find large heterogeneity both in bequest motives and strength.

An alternative to altruism is the strategic bequest motive introduced by Bernheim et al. [10], where potential bequests are used as rewards. Brown [14] finds that among AHEAD respondents and aged 69 and older, 14% (including spouses) receive regular care from their children, while only 1% pay a child for informal care. However, Brown [14] finds that while caregivers receive more end-of-life transfers, the transfers are modest. Furthermore, McGarry and Schoeni [76] show that in the AHEAD data, financial transfers from living parents to their children do not favor caregivers.

6 Housing, portfolio choice, and rate of return risk

6.1 Housing

Our model contains a single risk free asset which can be bought or sold without cost and which affects the consumer only as a financial resource. However, the most important asset for most US households is their primary home, which provides consumption services as well as financial returns.

In most countries, people run down their non-housing wealth more quickly than their housing wealth (Nakajima and Telyukova [81], Blundell et al. [11]). For example, Blundell et al. [11] show that between 2002 and 2012 the median non-housing wealth of elderly US households declined by close to 50% (Figure 11, panel a, circle-dash line), whereas median housing wealth declined by about 30% (Figure 11, panel b, circle-dash line). During the same period in England, the elderly ran down their non-housing wealth by 25% (Figure 11, panel a, solid line), but increased their housing wealth by 40% (panel b).

Changes in housing wealth are driven by life-cycle changes in homeownership and home size, and time-specific changes in house prices. In the US, the homeownership rate falls from 80% to 60% between ages 70 and 90, a fact that cannot be explained by cohort effects or differential mortality. In England, Blundell et al. [11] show that the homeowership rate falls from 75% to 60% between ages 70 and 90. Regarding downsizing, Banks et al. [9] show that many retired Americans sell their home and use the proceeds to purchase a smaller home, although this is much less common in England. Finally, during a b

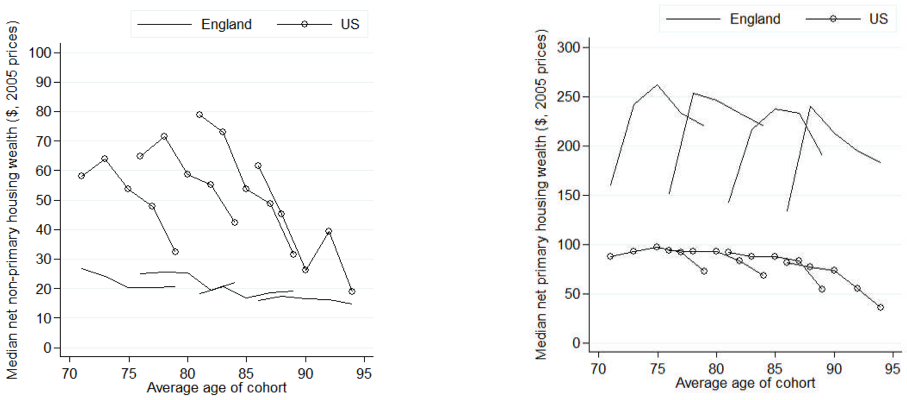

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Figure 11: Median net non-primary housing wealth (panel a) and net primary housing wealth (panel b) in the US and England by age and cohort, 2002-2012. *Notes*: Sample consists of households where at least 1 member responds in both the first and last waves.

the period 2002-12, the sample period behind Figure 11, both countries experienced run ups and run downs in housing prices. By 2012, US housing prices had returned to their 2002 values, while prices in England had risen 20%.

There are several potential reasons why the elderly may liquidate their financial wealth before their housing wealth (e.g., Engen et al. [29]). First, liquidating a house entails substantial transaction costs. For example, most buyers and sellers use real estate agents and these agents typically charge 5-6% of the selling price of the house. This is in addition to taxes and other fees associated with selling a house and the time and effort spent moving. Using a quantitative structural model, Yang [100] shows that observed housing transaction costs can explain why older US households decrease their consumption of housing more slowly than their consumption of other goods and services.

Second, housing is typically tax-advantaged relative to other assets, in several ways. For example, in the US housing can often be bequeathed to one's heirs tax-free, whereas liquidating the housing wealth will often force the seller to pay capital gains taxes. Furthermore, housing assets are often exempt from the asset tests associated with the Medicaid and Supplemental Security Income programs (De Nardi et al. [25]). Households that sell their home and use the proceeds to purchase financial assets become ineligible for these government transfers until the financial assets are depleted. Finally, income from financial assets is usually taxable. The 'rent' a homeowner pays herself is untaxed.

Third, people may enjoy prefer living in owner-occupied housing to living in rental properties, perhaps because they can more easily modify their own property to fit their needs. Estimating a structural model of saving and housing decisions, Nakajima and Telyukova [80] find that homeowners dissave slowly because they prefer to stay in their homes as long as possible.

Documenting that homeowners decumulate their wealth more slowly, Nakajima and Telyukova [80] argue that homeownership is an important driver of retiree saving. In principle older homeowners should be able to access their housing wealth without moving, through the use of reverse mortgages. Nakajima and Telyukova [82] report that in 2011 only 2.1% of eligible homeowners had reverse mortgage loans. They find that bequest motives, nursing-home-move risk, house price risk, and loan costs all contribute to the low take-up of reverse mortgages, but do not completely explain it. It is not clear whether the observed slow decumulation of housing wealth can be explained unless reverse mortgages are assumed to be unavailable.

The results in De Nardi et al. [24] suggest that appropriately modeling medical expenses is important to appropriately modeling slow wealth decumulation in old age, even when running down one's assets is costless and frictionless. Looking across countries, Nakajima and Telyukova [81] argue that medical expenses have important effects, but primarily on non-housing assets. Because home equity can substitute for LTC insurance (Davidoff [16]) and can be bequeathed, the home ownership motivation cannot be measured independently of the other savings motives.

6.2 Portfolio choice, and rate of return risks

Surprisingly little work has been done in terms of the link between health, medical expenses, and portfolio choices. Yogo [101] allows for portfolio choice in addition to health investment. Koijen et al. [58] propose a framework for summarizing the risk exposure of complex portfolios in presence of mortality and medical expense risks. These models are rich but do not account for the fact that people cannot borrow against future annuitized income, for example. Gomes and Michaelides [41] develop a rich model of portfolio choice where people face borrowing constraints and earnings risks but not health and medical expense risks later in life.

French et al. [35] document large differences in portfolio holdings across the elderly population and present information on the rates of return of different asset types. These asset price shocks are an important source of risk to the elderly population. However, Love and Smith [71] show that there is little evidence of a link between these portfolio shares and health status, once other factors (such as the level of wealth) are taken into account.

Arguably the most important return shocks facing most households are changes in house prices. Li and Yao [67] use a quantitative general equilibrium model to study the lifecycle effects of house price changes. They point out that increases in home prices likely reflect increases in expected future rents and thus higher expected future expenses. This effect mutes the non-housing consumption and saving responses to house price changes. Older homeowners face a shorter horizon, however; they will likely have to pay higher rents for only a limited period of time. Thus the non-housing consumption response of old homeowners is more sensitive to house price changes than that of middle-aged homeowners. Attanasio et al. [6] use a structural model with housing transaction costs and home-owning utility to study the effects of house price shocks on consumption growth in the aggregate. They find that their model matches the data quite well. Whether these models generate empirically plausible asset trajectories in old age remains an open question.

7 Couples

Building on Hurd [51], Hurd [52] was among the first to develop a model of the savings of couples. Moving from singles to couples introduces several new considerations. Even if one assumes that couples behave as a unit, rather than strategically,[4] couples are subject to a different set of risks and, potentially,

[4]Mazzocco [74] shows that under full commitment, the behavior of a couple can be characterized by a unique utility function if the husband and wife share identical discount factors, identical beliefs and Harmonic Absolute Risk Aversion utility functions with identical curvature parameters.

bequest motives. Couples face two sets of health and medical expense risks, but they can pool both their risks and their assets. They may also be able to partially self-insure by using the time of the healthier partner to provide care for the other one. On the other hand, two-person households are exposed to the risk of having one person die. Couples may thus want to leave bequests not only to children, but also to surviving partners. While single households likely have lower needs, Braun et al. [12] show that the death of the husband often leads to a large reduction in the wife's income: widows are much more likely to be impoverished than wives. Moreover, altruism toward a surviving spouse may differ greatly from altruism toward other potential heirs.

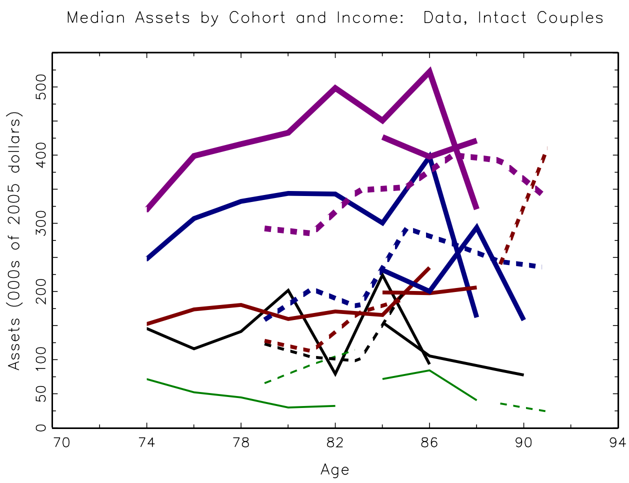

Figure 12: Median assets for intact couples, PI percentiles computed using couples only.

Figure 12 displays median assets for households who are couples during our entire sample period. The first thing to notice is that these couples are richer than singles. The younger couples in the highest PI quintile for couples hold over \$300,000, compared to \$200,000 (in 2005 dollars) for singles, and even the couples in the lowest PI quintile hold over \$60,000 in the earlier years of their retirement, compared to zero for the singles. As for the singles, the couples in the highest PI quintile hold on to large amount of assets well into their nineties, while those in the lowest income PIs display more asset decumulation. Interestingly, these graphs display flat to increasing asset profiles, going from low to high permanent income.

Poterba et al. [89] and French et al. [36] document large falls in assets at the death of a spouse. To quantify this observation, we perform fixed

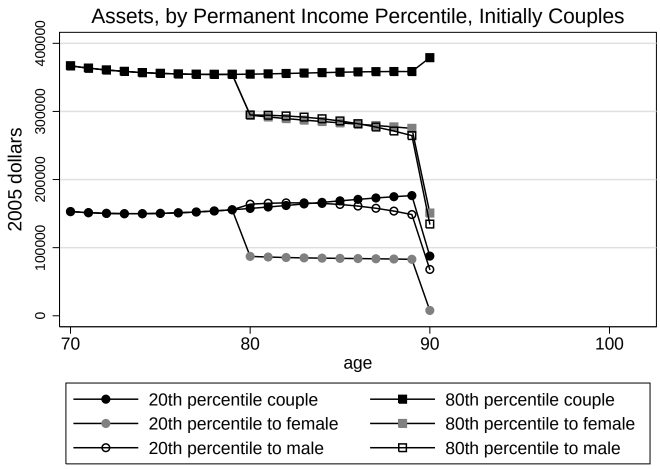

Figure 13: Net Worth, conditional on permanent income and family structure. *Notes*: Figure assumes all households begin as couples, then potentially change to a single male or single female at age 80, then exit at age 90.

effects regression analysis, where wealth is regressed on a polynomial in age, age interacted with permanent income and household composition (i.e., single male, single female, couple). Figure 13 reports the predicted assets of a couple starting out, respectively, in the top PI income quintile and in the bottom one, and display the assets under three scenarios. Under the first one, the couple remains intact until age 90. Under the second one, the male dies at age 80, while under the third one, the female dies at age 80. For both PI levels, assets stay roughly constant if both partners are alive. In contrast, assets for the top-PI couples display a significant drop if either spouse dies. Interestingly, at the lower PI quintile assets experience a large drop when the male dies, but much less of a drop when the female dies first.

8 Medical expenses, government insurance, and policy reform

In the previous sections we have identified medical expenses as an important factor generating large savings in old age and government insurance as an important factor mitigating this risk and thus reducing savings. Kopecky and Koreshkova [61] develop a general equilibrium model with uncertain lifetimes and old age medical expense risk. They show that savings for out-of-pocket medical expenses in old age account for a significant fraction, 13.5%, of aggregate wealth.

In a period of large and ever increasing pressure on budget deficits, the question of how and to what extent the government should insure medical expenses risk becomes even more pressing. De Nardi et al. [25] estimate a rich structural model of endogenous medical expenses and savings and find that most individuals value the insurance provided by Medicaid at more than their actuarial cost. Braun et al. [12] find that, in presence of medical expenses and lifespan risk, the gains from means-tested social insurance such as Medicaid and food stamps are large. In fact, increasing size of the insurance by a third benefits both the poor and the affluent, assuming the increase is financed by a payroll tax. Pashchenko and Porapakkarm [86] study the effects of Obamacare (and increasing Medicaid provision) in a general equilibrium model with exogenous medical expenses and find that the welfare gains stemming from the reform mostly come from redistribution, rather than reductions in adverse selection. Jeske and Kitao [56] also study the financing of health insurance and medical spending in a general equilibrium framework.

Thus, the literature to date suggests that means-tested programs such as Medicaid are welfare enhancing. However, in presence of population aging programs that benefit the elderly, such as Medicaid and Medicare, will become more broad-based and expensive. For example, Attanasio et al. [8] study the financing of Medicare in presence of population aging and medical expense risk. They find that the labor income tax will have to increase from 23% in 2005 to 36% in 2080, with over two thirds of the tax increase due to Medicare. This result helps understand the size and growing importance of Medicare costs in presence of population aging and the fiscal adjustments that will be needed to finance it.

How medical spending should be distributed across people is also an important question. Ales et al. [2] assume that health care increases the survival probability and consider an environment where individuals have different life cycle profiles of productivity. In the socially efficient allocation for their environment, health care spending increases with labor productivity during the working years, but is equal for everyone after retirement[5]. They find that in the U.S., those in the top of the income distribution should spend 1.5 times what those at the bottom spend on health care, conditional on health status, for most of the life cycle. This ratio should decline from about 2 (at age 25) to 1 at retirement. According to their analysis, the largest inefficiencies lie in the lower part of the income distribution and in post retirement ages, a finding that is consistent with the idea that health insurance programs targeted to the elderly poor after retirement are welfare enhancing (Braun et al. [12]).

Some, although not all, of the aforementioned papers allow for a bequest motive. In the aggregate, the importance of bequests has been recognized at least since the debate between Kotlikoff and Summers [63] and Modigliani [79] about what fraction of wealth that is transmitted across generations rather than earned during one's lifetime. Gale and Scholz [39] suggest that the amount is at least 50%. De Nardi [20] finds that bequests play an important role in explaining the observed distribution of wealth.

As we have pointed out above, the relative importance of bequest and precautionary savings motives has not been resolved. Moreover, how the bequest motive is modeled remains an important and open question. However, it is likely that the consequences of different policies depend critically on how these two motives are modeled and quantified. For example, Fuster et al. [38] find that the welfare gains of privatizing Social Security are increasing in the degree of altruism.

[5] Interestingly, Ozkan [83] finds that early in life the rich spend significantly more on health care, whereas starting from middle age, the medical spending of the poor dramatically exceeds that of the rich.

9 Conclusion

As we have shown, the elderly run down their savings much more slowly than implied by a basic life cycle model with a known date of death. The literature suggests that uncertainty and heterogeneity in the length of life and medical spending, along with bequest motives, are important to understanding the slow decumulation of retirement wealth. In contrast, public insurance may reduce the need to save to insure against longevity and medical spending risk, although it is a realistic feature of the economies that we study.

Some of the risks affecting savings can be estimated directly from the data. For instance, we can measure total medical expenditures, private insurance premia and benefits, and government transfers to gauge the degree of total and out-of-pocket medical spending risk. Also, we can estimate longevity risk and its heterogeneity both from observed outcomes and from self-reported expectations. Thus, we have good measures of the kind of medical expense and longevity risks that people face. However, the relative importance of the bequest and precautionary saving motives depend crucially on preference parameters that cannot be identified directly. More specifically, we need to infer risk aversion, patience, the strength of the bequest motive, and the extent to which bequests are a luxury good.

Identifying these parameters, for both singles and couples, and the relative importance of the bequest and precautionary saving motives that they imply is important, because the consequences of policy reforms hinges on the relative strength of these saving motives. Looking at additional features of the data, especially those not matched in the calibration or estimation of the model, is a key assessment tool. Recent studies have brought additional information to bear in promising ways.

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