Savings After Retirement: A Survey

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Abstracts

The saving patterns of retired US 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 life span risk can explain a significant portion of US saving during retirement. However, more work is needed to distinguish these precautionary saving motives from other motives, such as the desire to leave bequests. Progress toward disentangling these motivations has been made by matching other features of the data, such as public and private insurance choices. An improved understanding of whether intended bequests left to children and spouses are due to altruism, risk sharing, exchange motivations, or a combination of these factors is an important direction for future research.

1. INTRODUCTION

More than one-third of total wealth in the United States is held by households whose heads are over age 65 (Wolff 2004). This wealth is an important determinant of their consumption and welfare. As the US 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 US households, especially those with high income, decumulate their net worth at a slower rate than that implied by a basic life-cycle model in which 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 saving would respond to potential policy reforms. In this review, we present evidence on the potential reasons why so many elderly households hold substantial amounts of assets at very old ages. Most of these explanations fall into two groups.

The first group of explanations emphasizes the risks that the elderly face late in life, particularly uncertain life spans and uncertain medical and long-term-care (LTC) 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 life span risks, can explain a significant portion of US saving 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 expenses than planned.

The second group of explanations emphasizes bequest motives. Individuals may receive utility from leaving bequests to their survivors, most notably their children. Alternatively, they may use bequests to reward their caregivers.

The two motivations, precautionary and bequest, have similar implications for saving in old age, making it difficult to disentangle their relative importance. A number of recent papers attempt to resolve this problem by going beyond saving and considering additional features of the data. For example, without a strong bequest motive, the life-cycle model implies a high demand for annuities and LTC insurance. The observation that these products are purchased infrequently suggests that precautionary motives cannot be the only explanation for high saving in old age, as does the observation that purchasing these products reduces the amount of assets that can be bequeathed. Likewise, because Medicaid eligibility requires low financial resources, qualifying for this insurance program implies lower potential bequests. In contrast, life insurance increases potential bequests while reducing the resources available for precautionary saving. All these forms of insurance, both publicly and privately purchased, generate trade-offs between leaving assets to one's heirs and being insured against medical and longevity risks. The choices made in the face of these trade-offs help differentiate the competing saving motives. Finally, studies using strategic surveys ask individuals to evaluate hypothetical scenarios that contain clear trade-offs between leaving bequests and having consumption when old and sick. Combining the precautionary saving and bequest motives thus promises to explain not only observed saving but also the low purchase rates of annuities and LTC insurance, participation in public insurance programs, purchases of life insurance at older ages, and responses to strategic survey questions.

Section 2 of this review describes the patterns of saving, annuity income, medical spending, health and mortality, and bequests for retired elderly households in the United States. Section 3 sketches a life-cycle model of single retirees that can illustrate many of the saving motivations of elderly savers. Section 4 analyzes the saving implications of medical expenses and differential mortality within this model. In this section, we also discuss possible reasons why households do not buy financial products that address these risks directly, namely annuities and LTC 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 concerning 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 and offers directions for future research.

2. FACTS ABOUT RETIRED HOUSEHOLDS

An important factor determining the welfare of the elderly is their consumption, which is financed by their net worth, Social Security payments, private pensions, and other transfers from government and family. Gustman & Steinmeier (1999) show that, for households near retirement, this measure of total wealth is equal to about one-third of lifetime income. Examining the same age group, Scholz et al. (2006) 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. (2009) compute the trajectories of net worth and annuitized wealth—the expected discounted present value of annuity income—during retirement. They too find that net worth is a significant component of total wealth.

We keep net worth (interchangeably called assets or savings in this review) and annuitized wealth separate in our analysis. As Hurd (1989) emphasized, when households cannot borrow against future annuity income such as Social Security benefits, the distribution of total wealth between net worth and annuitized wealth can 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 US residents who were noninstitutionalized 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 every two years thereafter.

The graphs in this section use data only for singles. Single retirees comprise approximately 50% of people aged 70 or over and 70% of households whose head is aged 70 or over. In Section 7 we present some facts concerning couples.

We break the data into five cohorts consisting of individuals who, in 1996, were aged 72–76, 77–81, 82–86, 87–91, and 92–102. 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 show each cohort's data from 1996 onward.

Because we want to understand the role of income, we further stratify the data by postretirement 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 postretirement PI as the individual's average nonasset, nonmeans-tested social insurance income over all periods during which he or she is observed. Nonasset income includes the value of Social Security benefits, defined benefit pension benefits, veterans' benefits, and annuities. Because nonasset income generally increases with lifetime earnings, it provides a good proxy for PI.

2.1. Asset Profiles

We calculate net worth using the value of housing and real estate, automobiles, liquid assets (e.g., money market accounts, savings accounts, treasury bills), Individual Retirement Accounts, Keogh plans, stocks, any farms or businesses, mutual funds, bonds, other assets, and investment trusts, less mortgages and other debts. Juster et al. (1998) show that the wealth distribution of the AHEAD data set matches well with aggregate values for all but the richest 1% of households.

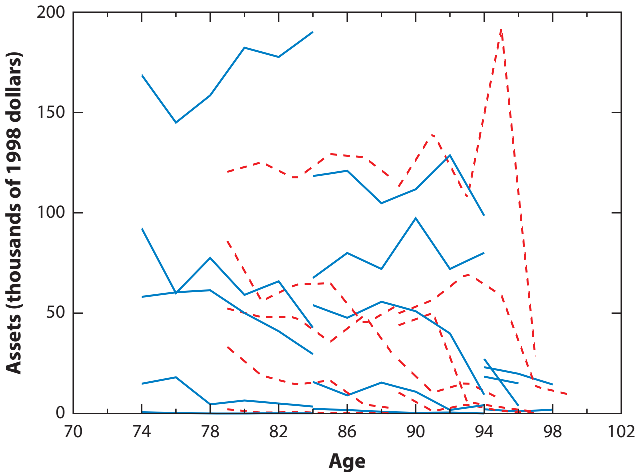

Figure 1

Median assets for singles, by birth cohort and permanent income quintile. Each point represents the median for all the members of a particular cell who are alive at a particular date. Figure adapted from De Nardi et al. (2010) with permission.

Hence, although this data set is representative of the vast majority of the population, it is not representative of the richest 1%, who hold about one-third of aggregate net worth. The amounts below are in 1998 dollars.

Figure 1 displays median assets, conditional on birth cohort and PI quintile, for singles (who tend to have fewer assets than couples). It presents asset profiles for the unbalanced panel; each point represents the median for all the members of a particular cell who are alive at a particular date. Median assets are increasing in PI, with 74-year-olds in the highest PI quintile holding median assets of approximately \$200,000 and those in the lowest PI quintiles holding essentially no assets at all. Over time, those with the highest PIs tend to hold onto significant wealth well into their nineties, those with lower PIs save little, and those in the middle display some asset decumulation as they age. Thus, even at older ages, richer people save more, a finding first documented by Dynan et al. (2004) for the entire life cycle.

2.2. Asset Profiles and Mortality Bias

It is well documented that health and wealth are positively correlated (see, for instance, Smith 1999, Adams et al. 2003, Poterba et al. 2010). 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 1975, Mirer 1979, Hurd 1987). **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 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,

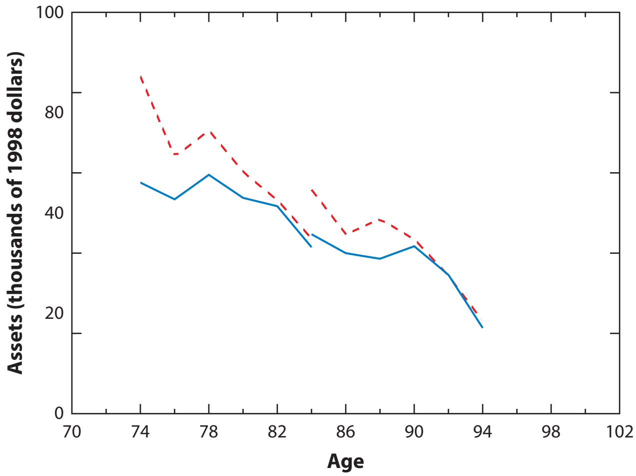

Figure 2

Median assets by birth cohort. 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 adapted from De Nardi et al. (2010) with permission.

the median assets of the 74-year-olds who survived to 2006 were $84,000. In contrast, in 1996, the median assets for all 74-year-olds were $60,000. The 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. (2009). Sorting the data by PI 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, for the AHEAD birth-year cohort whose members were ages 72–76 (with an average age of 74) in 1996. For ease of interpretation, we display profiles with no attrition, so that the composition of the simulated sample is fixed over the entire simulation period. This allows us to track the income of the same people over time. Average annual income ranges from approximately $5,000 per year in the bottom PI quintile to approximately $23,000 in the top quintile; median wealth holdings for the two groups are zero and just under $200,000, respectively.

2.4. Medical Spending Profiles

Although Kotlikoff (1988) pointed out nearly 30 years ago that medical expense risk could be an important driver of saving, it was not until the late 1990s that high-quality panel data on the medical spending of older households became available in the AHEAD/HRS.[1] Medical expenses

[1]Data from the Medicare Current Beneficiary Survey (MCBS) became available at about the same time. De Nardi et al. (2015) review the MCBS medical spending data in some detail.

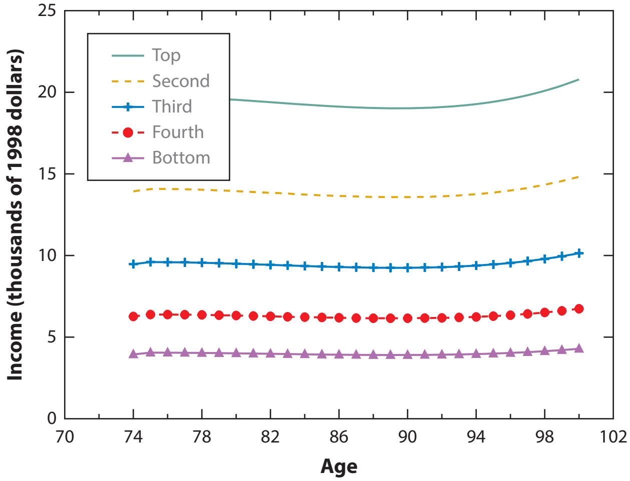

Figure 3

Average income, by permanent income quintile, for the AHEAD birth-year cohort whose members were ages 72–76 (with an average age of 74) in 1996. Figure adapted from De Nardi et al. (2010) with permission.

are the sum of what the individual spends out of pocket on insurance premia; drug costs; and costs for hospital care, nursing home care, doctor visits, dental visits, and outpatient care.

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 PI quintile. PI has a large effect on average medical expenses, especially at older ages. Average medical expenses are less than \$1,000 per 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

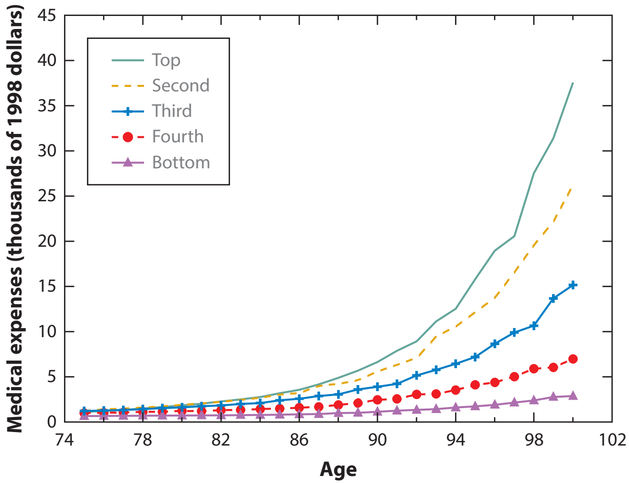

Figure 4

Average out-of-pocket medical expenses, by age and permanent income quintile, for the AHEAD birth-year cohort whose members were ages 72–76 (with an average age of 74) in 1996. Figure adapted from De Nardi et al. (2010) with permission.

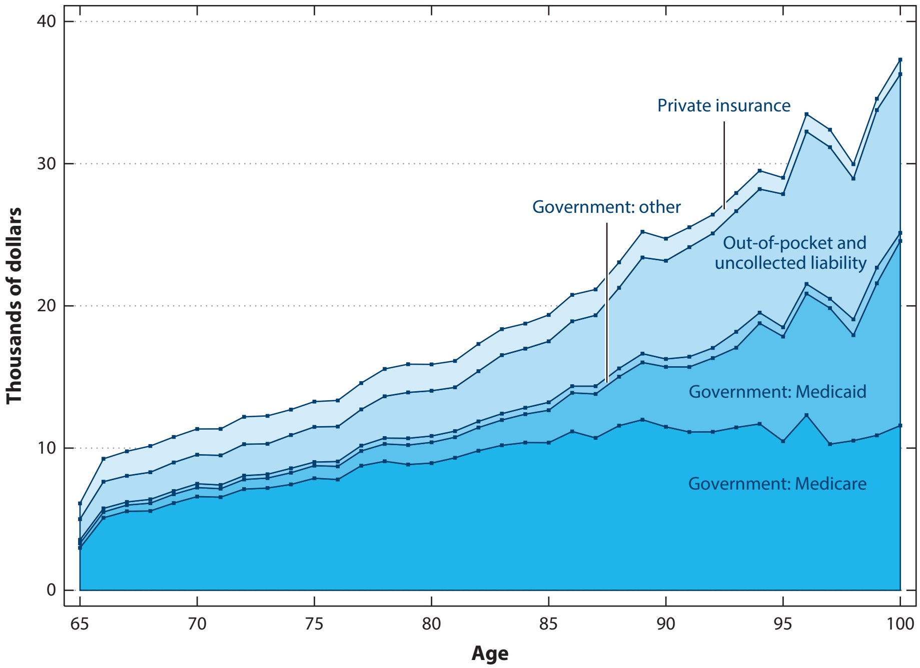

Figure 5

Average total medical expenditure, by age and payer type, in 2014, according to the Medicare Current Beneficiary Survey. Figure adapted from De Nardi et al. (2015) with permission.

those at the top of the income distribution. Mean medical expenses at age 100 are $17,700, which is greater than the average income of that age group.

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. On average, people with low wealth pay a smaller share of their total medical care costs, because they receive more assistance from means-tested social insurance programs such as Medicaid. These programs are more important for the observed income gradient of out-of-pocket expenditures than any differences in underlying medical spending (De Nardi et al. 2015).

Much of the medical care received by older individuals in the United States is paid for by the government through either Medicare, a program available to almost everyone aged 65 and older, or Medicaid. **Figure 5** uses data from the Medicare Current Beneficiary Survey (MCBS) to summarize total medical expenditure for individuals aged 65 and over. Medical spending in the MCBS data falls into the same spending categories as in the AHEAD/HRS data, and De Nardi et al. (2013) show that the distribution of out-of-pocket medical spending is very similar in both surveys. **Figure 5** shows that most of the medical expenses of the elderly are paid by Medicare, by Medicaid, or out of pocket; private insurance plays a small role. Medicare is the dominant payer at younger ages, whereas Medicaid and out-of-pocket spending are significant at older ages when nursing home expenses become larger. Medicare's coverage of nursing home expenses is limited, and only a small fraction of households have LTC insurance.

Table 1 shows the distributions of out-of-pocket and total medical spending. Both are concentrated, with out-of-pocket medical spending being more concentrated than total medical spending. For example, the top 5% of total medical spenders aged 65 and over account for 34.6% of total

Table 1 Spending percentiles for total and out-of-pocket medical expenditures, ages 65 and over

Spending	Total		Out-of-pocket	
Percentile	Average spending	Percentage of total	Average spending	Percentage of total
All	14,120	100.0%	2,740	100.0%
95–100%	97,880	34.6%	26,930	49.1%
90–95%	48,890	17.3%	6,700	12.2%
70–90%	20,540	29.1%	2,920	21.3%
50–70%	7,750	11.0%	1,360	9.9%
0–50%	2,250	8.0%	420	7.6%

Calculations use data from the Medicare Current Beneficiary Survey. Total and out-of-pocket spending are sorted independently. Spending is adjusted to 2014 dollars. Table adapted from De Nardi et al. (2015) with permission.

medical spending, whereas the top 5% of out-of-pocket medical spenders account for 49.1% of out-of-pocket medical spending. Although a large share of medical spending is paid for by the government, the risk of high out-of-pocket spending is significant.

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 be flexible functions of PI, age, previous health status, and gender. **Table 2** 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 70-year-old male in the bottom quintile of the PI distribution expects to live only 6 more years, that is, to age 76. In contrast, a healthy woman of the same age in the top quintile of the PI distribution expects to live 17 more years, to age 87.[2] Our estimated income gradient is similar to that of Waldron (2007), who finds that those at the top of the US income distribution live 3 years longer than those at the bottom, conditional on being 65. Attanasio & Emmerson (2003) document similar findings for the United Kingdom, and Hurd et al. (1999) and Gan et al. (2003) do so for the United States.

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

2.6. Bequests

The importance of bequests has been recognized since at least the 1980s, when Kotlikoff & Summers (1981) and Modigliani (1988) debated the fraction of wealth that is transmitted across generations rather than earned during one's lifetime. Gale & Scholz (1994) suggest that the amount is at least 50%. However, although many people die with positive assets and leave bequests to their heirs, most of these bequests are very modest. For example, De Nardi et al. (2010) show that, 1 year

[2]Our predicted life expectancy at age 70 is about 3 years less than what 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.

Table 2 Life expectancy in years, conditional on reaching age 70

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	

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.

before 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 & Smith (1999) report that the average bequest amounts left by decedents are even lower. French et al. (2006) 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. The decline might also be caused by reporting errors, as children of decedents tend to underreport the value of estates (Gale & Scholz 1994, Laitner & Sonnega 2010), or by end-of-life transfers aimed at reducing estate taxes (Kopczuk 2007).

3. A LIFE-CYCLE MODEL

We can analyze many potential saving motives by studying a fairly simple version of the life-cycle saving model. In this model a single person faces life span 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.

Although we focus on singles for now, to keep the model simple, in Section 7 we discuss how being part of a couple can either increase or decrease the risks faced by each person. These changes in risk can occur because couples combine risks across two people and because members of a household can care for each other, partly substituting for more formal care.

Consider a retired single person seeking to maximize his expected lifetime utility by choosing consumption, c_t, at age t, $t = t_{r+1}, \ldots, T$, where t_r is the retirement age. During 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 and health 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 (2004), the utility the individual derives from leaving assets, a, 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 and k determines the curvature of the bequest function and hence the extent to which bequests are luxury goods.

We assume that nonasset income, y_t, is a deterministic function of sex, g; PI, I; and age, t:

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

The individual faces several sources of exogenous risk:

1. Health status uncertainty. The transition probabilities for health status (current, j, and future, k) depend on previous health, sex, PI, 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 health status h, and enjoying PI 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 on sex, health status, PI, and age. The stochastic, idiosyncratic component of m_t is modeled as the sum of a persistent first-order autoregressive [AR(1)] process and a white noise process. Feenberg & Skinner (1994) and French & Jones (2004) show that having both persistent and transitory medical expense shocks is essential to replicating observed medical expense dynamics.

Assets evolve according to

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

$$a_t \geq 0, \tag{7}$$

where $y_n(ra_t + y_t, \tau)$ denotes posttax income; r denotes the risk-free, pretax 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 $\underline{c}$:

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

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, such that

$$x_t = a_t + y_n(ra_t + y_t, \tau) + b_t - m_t. \tag{9}$$

Letting β denote the discount factor and ζ_t the persistent medical expenditure shock, we can write the dynamic problem recursively as

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

[3] De Nardi et al. (2011) provide a discussion of the Medicaid rules and Hubbard et al. (1994) for other means-tested social insurance programs.

subject to

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

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

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

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

De Nardi et al. (2006, 2009, 2010) estimate versions of this model using the Method of Simulated Moments (as in Gourinchas & Parker 2002, Cagetti 2003, French 2005) and find that the model matches well with median assets by age, PI, and cohort for the population aged 70 and over. In the following sections, we use this model to analyze how retirement saving responds to different saving motives by showing the simulation results (using sets of estimated preference parameters that match the data well) that arise as we shut down different combinations of the model's features.

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 found in the data are an important driver of old-age saving. To answer this question, we zero out both expected and realized out-of-pocket medical expenditures and examine the resulting changes in assets. **Figure 6** shows median assets with and without medical expenses for individuals aged 72–76 in 1996. The simulations begin with the distribution of assets, PI, health status, medical expenses, and sex found in the 1996 AHEAD

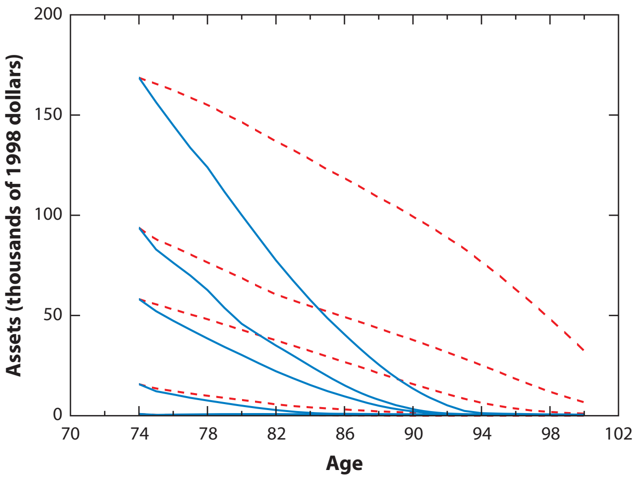

Figure 6

Median assets by cohort and permanent income quintile for individuals aged 72–76 in 1996. The dashed red lines represent asset profiles resulting from a baseline model with medical expenses; the solid blue lines represent the asset profiles without medical expenses. The assets of those in the bottom quintile are not visible because they are close to zero. Figure adapted from De Nardi et al. (2010) with permission.

data. Although the individual's decision rules reflect mortality risk, as before there is no attrition in the simulations.

The dashed lines in **Figure 6** represent the net worth profiles for each PI quintile generated by the baseline model with medical expenses. As in the data, the assets of those in the bottom quintile are not visible because they are close to zero. Households in this PI group rely on their annuity 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; those in the top PI quintile start off with $170,000 in median net worth at age 74 and retain 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 major determinant of retiree saving. Medical expenses are especially important for those with high PI, who face the highest expenses and are relatively less insured by the government-provided consumption floor. These retirees reduce their current consumption 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 PI 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 saving by the elderly.

Our results indicate that modeling uncertain life spans and out-of-pocket medical expenses is important in evaluating policy proposals that affect the elderly. A natural test of this conclusion is to compare saving across countries with different levels of publicly provided LTC. Consistent with the implications of the model, Nakajima & Telyukova (2013) find that in Sweden, where the government provides universal LTC insurance, households decumulate assets more quickly than in the United States, where publicly provided LTC insurance is available only to the impoverished.

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 straits. Several papers address the issue of endogenous medical expenditure. McClellan & Skinner (2006), De Nardi et al. (2010), and Ameriks et al. (2015) allow increased medical expenditures to increase current period utility, reflecting channels such as improved nursing care. Davis (2006), Halliday et al. (2009), Fonseca et al. (2009), Khwaja (2010), Hugonnier et al. (2012), Scholz & Seshadri (2013), Ozkan (2014), and Yogo (2016) build on the Grossman (1972) model of investment in health.

The results of De Nardi et al. (2010) suggest, first, that whether exogenous or endogenous, medical expenses need to match the data, and thus they have a similar impact on observed saving. If individuals expect to purchase expensive medical services at the end 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 saving response. Yogo (2016) also finds that allowing for endogenous medical spending reduces the precautionary saving motive.

Laitner et al. (2014) 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. Laitner et al. (2014) 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 shift the marginal utility of medical spending, either directly, as in De Nardi et al.

(2010), or by changing the marginal productivity of medical spending in building and preserving health.

A related question is whether the marginal utility of nonmedical 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. In De Nardi et al. (2010), this parameter is negative—the marginal utility of consumption is higher in bad health—but estimated imprecisely. Palumbo (1999) and Low & Pistaferri (2010) take similar approaches. Hong et al. (2015) 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 consumption rises at older ages because of declining health, retirees would have an additional reason to hold on to 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 magnitude of the effect (Finkelstein et al. 2009).

4.3. Heterogeneous Mortality

Figure 7 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 in three other cases, in which 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 orange dashed line, everyone is assumed to be in perpetual bad health

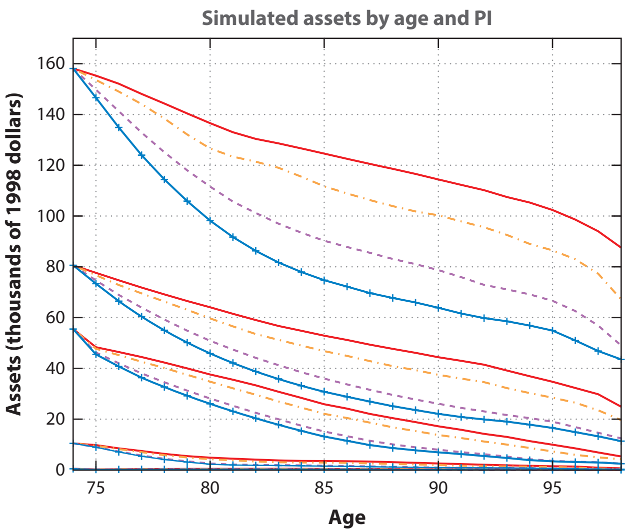

Figure 7

Median assets by permanent income (PI) quintile under different mortality assumptions. The solid red line represents the baseline. The orange dashed line indicates that all individuals are in bad health; the purple dashed line, that all individuals are male and in bad health; the blue line with crosses, that all individuals have low permanent income, are male, and are in bad health. Assets for the bottom PI quintile are not visible. Figure adapted from De Nardi et al. (2009) with permission.

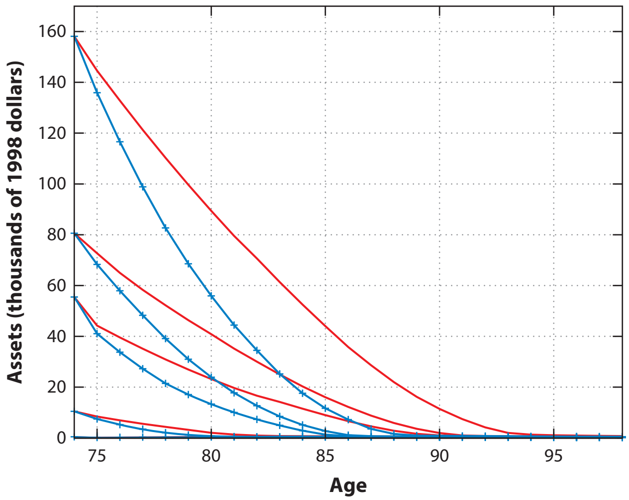

Figure 8

Median assets by permanent income quintile under different mortality assumptions when there are no medical expenses. The solid red line represents the baseline. The blue line with crosses indicates that all individuals have low permanent income, are male, and are in bad health. Assets for the bottom PI quintile are not visible. Figure adapted from De Nardi et al. (2009) with permission.

and have the associated mortality of those in bad health. The resulting drop in life expectancy is two to four years, depending on gender and PI. This lower life expectancy generates a noticeable drop in net worth, especially for the highest PI households. The purple dashed line corresponds to the mortality expectations of males who are always sick, who on average live five years less than a woman of the same health and PI. The blue 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 PI are important to understanding saving patterns across these groups, and the effect of each factor is of a similar order of magnitude.

Figure 8 shows the median asset profiles that arise when there is life span uncertainty but no medical costs. Here, too, there is a cluster of lines for each PI quintile, with the cluster for the bottom PI quintile not visible. The solid red line displays asset profiles for the baseline life expectancy case, whereas the blue crossed line refers to the case in which everyone has the life expectancy of a sick, poor male. 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 the 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 PI provide a significant incentive for the old-age savings of the richest households. When their life expectancy is decreased, rich retirees are less likely to survive to extreme old age and face large medical expenses. This has a major effect on their level of saving and the sensitivity of their saving 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. French et al. (2006), Marshall et al. (2011), De Nardi et al. (2015), and Braun et al. (2016) 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

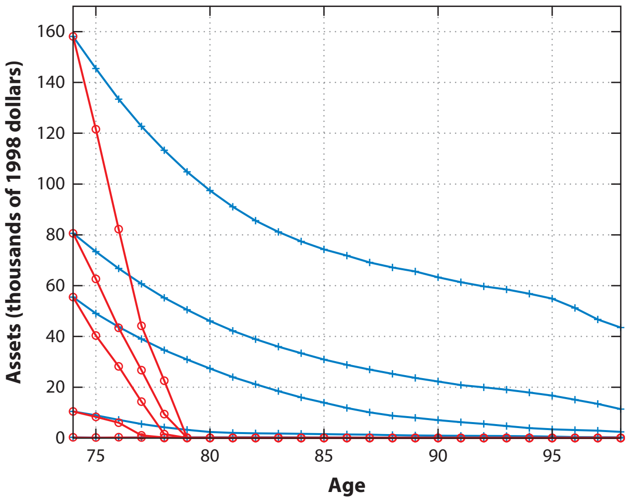

Figure 9

Median net worth by permanent income quintile under different mortality assumptions. The blue line with crosses represents a case in which all individuals have a low permanent income, are male, are in bad health, and have an expected life span of five years. The red line with circles represents a case in which all individuals have a low permanent income, are male, are in bad health, and have a fixed life span of exactly five years. Figure adapted from De Nardi et al. (2009) with permission.

expenses and mortality both increase when health switches from good to bad. Moreover, Spillman & Lubitz (2000) and Braun et al. (2016) show that end-of-life costs rise with age, probably because of increased LTC costs.

4.4. The Role of Life Span Risk

In this section, we consider the effects of longevity risk—the risk of outliving one's expected life span—on saving, an issue first considered by Davies (1981). **Figure 9** shows two sets of simulations. In the first, individuals have an expected life span of five years but face the risk of living much longer. In the second, all individuals expect to live exactly five years, to age 79. In such a case, there is no value in holding assets after five 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 life spans still have significant asset holdings after five years, even when facing the most pessimistic survival prospects. This comparison shows that, at realistically low levels of annuitization, the risk of living beyond one's expected life span has huge effects on saving.

4.5. Insurance

The life-cycle model just described implies a very strong demand for insurance products, particularly annuities and LTC insurance. If priced fairly, these products insure against life span or medical expense risk much more efficiently than standard assets. For example, using a very simple version of the life-cycle model with uncertainty in life span only, Yaari (1965) shows that people should immediately annuitize all their wealth. However, it is well documented that US households hold small amounts of annuities and LTC insurance (see Fang 2014 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 explain both low insurance holdings and saving 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 & Poterba (1999) 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 annuitized and overall populations reveals 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 (2012) 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. One is that medical spending risk could increase the demand for liquid assets and thus reduce the demand for annuities. Reichling & Smetters (2015) show that introducing health-dependent mortality risk reduces annuity demand. This is because a bad health shock simultaneously raises a person's expected (current) medical expenses and lowers her expected life span. A bad health shock thus simultaneously lowers an annuity's actuarial value and raises the need for liquid wealth.

Davidoff et al. (2005) and Peijnenburg et al. (2016) find that high medical risk early in retirement tends to decrease annuity demand, whereas high medical risk late in retirement tends to increase it. Because medical spending tends to be modest before age 70 and then grows rapidly (Robinson 1996, De Nardi et al. 2010), 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 in old age (Pang & Warshawsky 2010). In addition, Lockwood (2012) and Pashchenko (2013), 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 LTC services. In principle, the demand for LTC insurance should be high, because this insurance often pays off when other financial resources have been exhausted and medical needs are extensive.

However, access to comprehensive LTC insurance is likely incomplete. Hendren (2013) shows that, conditional on observables, the market for an insurance product will collapse if private information problems are sufficiently widespread. His main finding is that a large fraction of those applying for insurance 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 LTC insurance. Fang (2014) 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; the daily payment is often fixed in nominal terms.

Moreover, Brown & Finkelstein (2008) point out that, by serving as the payer of last resort, Medicaid significantly reduces the return on the purchase of LTC insurance for 75% of US single households. This is because Medicaid generally assists households only with LTC expenses not covered by other forms of insurance. Lockwood (2014) finds that bequest motives also reduce the demand for LTC insurance. Davidoff (2010) shows that home equity may substitute for LTC insurance. Indeed, it has been shown that health shocks and loss of a spouse are associated with housing wealth decumulation (Venti & Wise 2004, Poterba et al. 2011). This point reinforces a larger theme: Assets can simultaneously serve many purposes and can be used for many contingencies.

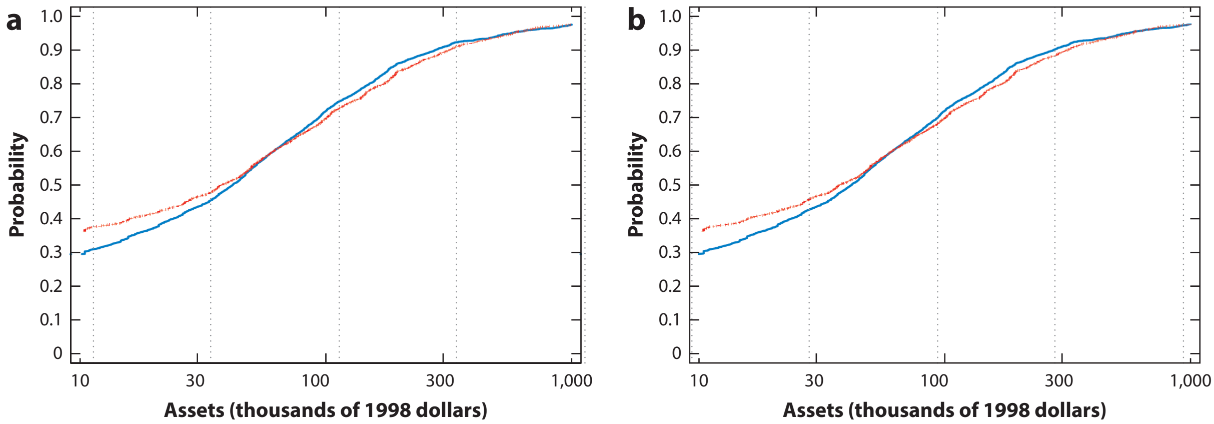

Figure 10

Cumulative distribution function of assets held one period before death. The data is represented by the blue line and the model by the red line. Results are shown for models (*a*) with and (*b*) without bequest motives. Figure adapted from De Nardi et al. (2010) with permission.

5. BEQUEST MOTIVES

As discussed in Section 2.6, many people leave bequests to their children or other heirs. However, whether these bequests are intentional or unintentional is not clear. For example, De Nardi et al. (2010) 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 the absence of a bequest motive, modest changes in utility function parameters yield larger precautionary saving motives, allowing the model to continue fitting the wealth distribution. Nonetheless, the estimated bequest motive is strong, especially for the extremely rich. This shows the difficulty of separating precautionary saving 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 saving motives are strongest for wealthy people who rely less heavily on means-tested government insurance. As Dynan et al. (2002) note, many people are likely driven by both motivations.

More recent papers have attempted to distinguish between precautionary saving and bequest motives by matching additional features of the data. For example, Lockwood (2014) matches additional data on purchases of LTC insurance. His key idea is that in the absence of bequest motives all saving is for precautionary purposes, which implies that the demand for LTC insurance is very high. In the absence of insurance market frictions, the only way to simultaneously match saving with low purchases of LTC insurance is to have modest precautionary saving motives and significant bequest motives. Using a complementary argument, Inkmann & Michaelides (2012) and Hong & Rios-Rull (2012) conclude that the life insurance holdings of UK and US households are consistent with bequest motives.

De Nardi et al. (2013) match Medicaid recipiency rates, which in their framework implies that Medicaid is relatively generous. Matching the Medicaid data thus bounds medical expense risk and the strength of the associated precautionary saving motives. To match observed asset holdings in this environment, the model attributes a significant proportion of saving to bequest motives.

Ameriks et al. (2011, 2015) reach a somewhat different conclusion by considering the responses to strategic survey questions that present the respondents with hypothetical trade-offs between consuming LTC and leaving bequests. Matching the hypothetical wealth splits chosen by their survey respondents helps 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.

There is also uncertainty about how bequest motives are best modeled. Altonji et al. (1992) empirically reject important implications of the purely altruistic, dynastic model. Hurd (1989) and Kopczuk & Lupton (2007) 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. (2011) find that households with children answer the strategic survey questions in a way consistent with stronger bequest motives. Laitner & Juster (1996) find large heterogeneity in both the presence and strength of bequest motives.

An alternative to altruism is the strategic bequest motive introduced by Bernheim et al. (1985), in which potential bequests are used as rewards. Brown (2006) finds that among AHEAD respondents aged 69 and older, 14% (including spouses) receive regular care from their children, whereas only 1% pay a child for informal care. However, Brown (2006) finds that although caregivers receive more end-of-life transfers, the additional transfers are modest. Furthermore, McGarry & Schoeni (1997) show that in the AHEAD data, financial transfers from living parents to their children do not favor caregivers. Barczyk & Kredler (2016) argue that the degree of informal care observed in the data implies altruism as well as strategic concerns.

6. HOUSING, PORTFOLIO CHOICE, AND RATE-OF-RETURN RISK

6.1. Housing

Our model contains a single risk-free asset that can be bought or sold without cost and that 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 nonhousing wealth more quickly than their housing wealth (Nakajima & Telyukova 2013, Blundell et al. 2016a). For example, Blundell et al. (2016a) show that between 2002 and 2012 the median nonhousing wealth of elderly US households declined by close to 50% (**Figure 11*a***), whereas median housing wealth declined by approximately 30% (**Figure 11*b***). During the same period in England, the elderly ran down their nonhousing wealth by 25% (**Figure 11*a***), but increased their housing wealth by 40% (**Figure 11*b***).

Changes in housing wealth are driven by life-cycle changes in homeownership and home size and time-specific changes in house prices. Blundell et al. (2016a) show that, in the United States, the homeownership rate falls from 80% to 60% between ages 70 and 90, whereas in England the homeownership rate falls from 75% to 60% between ages 70 and 90. These declines cannot be explained by cohort effects or differential mortality. Regarding downsizing, Banks et al. (2012) 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 the period 2002–2012, the sample period behind **Figure 11**, both countries experienced run-ups and subsequent run-downs in housing prices. By 2012, US housing prices had returned to their 2002 values, whereas 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. 1999). First, liquidating a house entails substantial

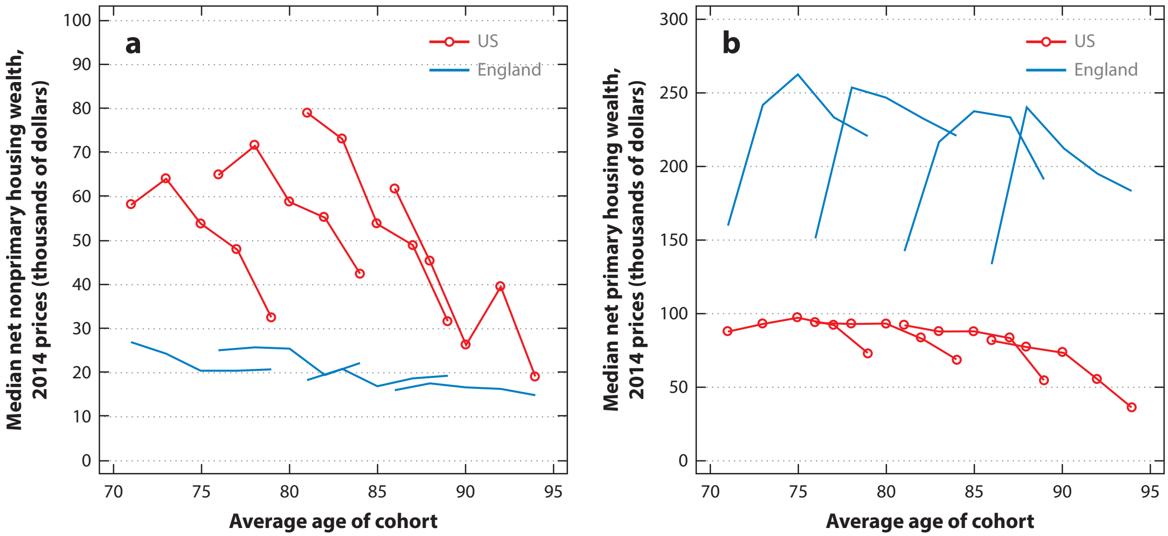

Figure 11

(*a*) Median net nonprimary housing wealth and (*b*) net primary housing wealth in the United States and England by age and cohort, 2002–2012, in thousands of 2014 dollars. Lines refer to cohorts born in the spans 1929–1933, 1924–1928, 1919–1923, and 1914–1918. The sample consists of households in which at least one member responds in both the first and last waves. Figure adapted from Blundell et al. (2016a) with permission.

transaction costs. For example, most buyers and sellers use real estate agents who 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 (2009) 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 United States housing can often be bequeathed to one's heirs tax free, whereas liquidating one's housing wealth often forces 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 (SSI) programs (De Nardi et al. 2011). Households that sell their home and convert the proceeds to 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 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 & Telyukova (2012) find that homeowners dissave slowly because they prefer to stay in their homes as long as possible.

Because homeowners decumulate their wealth more slowly, Nakajima & Telyukova (2012) 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. However, Nakajima & Telyukova (2014) report that in 2011 only 2.1% of eligible homeowners had reverse mortgage loans. They find that bequest motives, nursing-home 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.

As the low use of reverse mortgages suggests, homeownership almost surely interacts with other saving motives. The results in De Nardi et al. (2010) suggest that appropriate modeling of medical expenses is important to appropriate modeling of slow wealth decumulation in old age, even when decumulation is frictionless. Looking across countries, Nakajima & Telyukova (2013) also find that medical expenses have important effects, but these are primarily on nonhousing assets. Moreover, home equity can substitute for LTC insurance (Davidoff 2010) and can be bequeathed. Isolating the homeownership motivation from other saving motives is difficult. Once again, considering additional features of the data should help.

6.2. Portfolio Choice and Rate-of-Return Risks

Surprisingly little work has been done on the links among health, medical expenses, and portfolio choices. Yogo (2016) allows for portfolio choice in addition to health investment. Koijen et al. (2016) propose a framework for summarizing the risk exposure of complex portfolios in the 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 & Michaelides (2005) develop a rich model of portfolio choice in which people face borrowing constraints and earnings risks later in life, but not health and medical expense risks.

French et al. (2007) 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 & Smith (2010) 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 & Yao (2007) use a quantitative general equilibrium model to study the life-cycle 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 nonhousing consumption and saving responses to house price changes. Older homeowners face a shorter horizon and will likely have to pay higher rents for only a limited period of time. Thus, the nonhousing consumption response of older homeowners is more sensitive to house price changes than that of middle-aged homeowners. Attanasio et al. (2011) use a structural model with housing transaction costs and home owning utility to study the effects of house price shocks on aggregate consumption growth. 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

Hurd (1999) 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, bequest motives.

[4]Mazzocco (2007) 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.

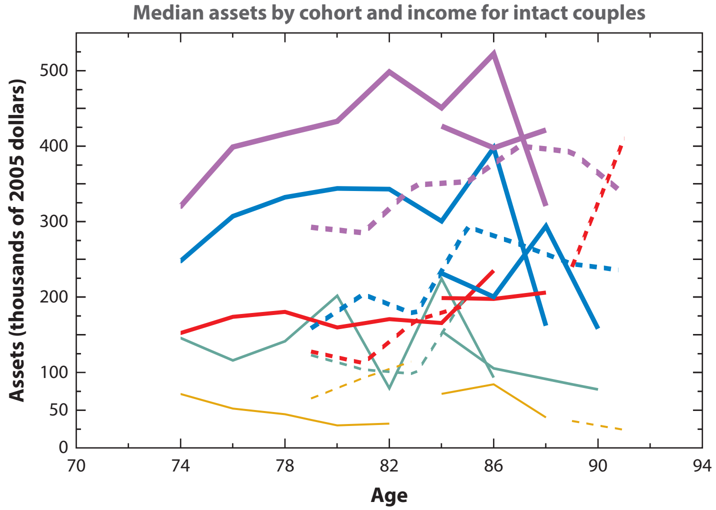

Figure 12

Median assets, by birth cohort and permanent income quintile, for intact couples. Thicker lines denote higher permanent income quintiles. Solid lines denote cohorts aged, respectively, 74 and 84 in 1996, whereas dashed lines denote cohorts aged 79 and 89. Figure adapted from De Nardi et al. (2016) with permission.

Recent work by Blundell et al. (2016b) shows that, among working-age households, risk sharing within the household is very important. Risk sharing among the elderly has been less studied. 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 partner. However, 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. Although single households likely have lower needs, Braun et al. (2016) 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 displays median assets for households that are couples during our entire sample period. The first thing to notice is that couples are richer than singles. The younger couples in the highest PI quintile hold over $300,000, compared with $200,000 (in 2005 dollars) for singles. Even the couples in the lowest PI quintile hold over $60,000 in the earlier years of their retirement, compared with zero for the singles. As with the singles, couples in the highest PI quintile hold large amounts of assets well into their nineties, whereas those in the lowest income PI quintiles display more asset decumulation.

French et al. (2006) and Poterba et al. (2011) document large decreases in assets at the death of a spouse. To quantify this observation, De Nardi et al. (2016) perform a fixed effects regression, allowing wealth to depend on household composition (i.e., single male, single female, couple), polynomials in age and PI, and interactions between these variables. **Figure 13** presents the predicted assets of a couple starting out in the top and bottom PI quintiles and displays asset profiles under three scenarios. In the first scenario, the couple remains intact until age 90. In the second scenario, the male dies at age 80, and in the third scenario, the female dies at age 80. For both PI levels, assets stay roughly constant while both partners are alive. In contrast, assets for couples in the top PI quintile display a significant drop if either spouse dies. Interestingly, the

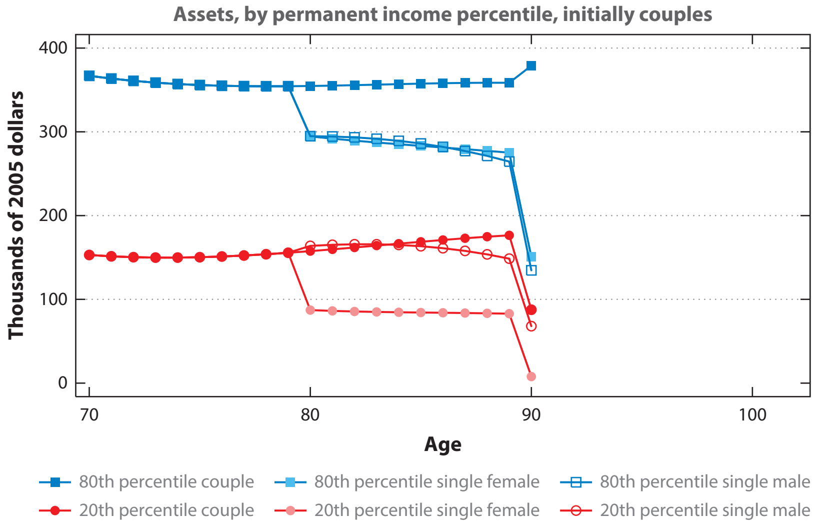

Figure 13

Net worth, conditional on permanent income and family structure. The graph assumes all households begin as couples, potentially change to a single male or single female at age 80, and exit at age 90. Figure adapted from De Nardi et al. (2016) with permission.

lower PI couples experience a large drop in assets when the male dies but much less of a drop when the female dies first.

8. MEDICAL EXPENSES, GOVERNMENT INSURANCE, AND POLICY REFORM

As the population ages, public health insurance programs for the elderly, such as Medicaid and Medicare, will become increasingly broad based and expensive. For example, Attanasio et al. (2010) study the financing of Medicare in the presence of population aging and medical expense risk. They find that the labor income tax rate will have to increase from 23% in 2005 to 36% in 2080, with over two-thirds of the increase due to Medicare. The question of how and to what extent the government should insure the medical expense risk of the elderly is pressing. In answering this question, it is essential to keep in mind the evidence from Section 4 that uninsured medical expenses are important in generating large savings in old age. Kopecky & Koreshkova (2014) assess this motivation at the aggregate level, using a general equilibrium model with uncertain lifetimes and uncertain old-age medical expenses. They find that saving for medical expenses in old age generates a significant fraction, 13.5%, of aggregate US wealth.

Unregulated private markets cannot perfectly insure medical expense risk. Although Cochrane (1995) shows that the best outcome would be the enrollment of every newborn individual into a long-term health insurance contract, in practice these contracts are not feasible because consumers cannot commit to participate continuously: People who turn out to be healthier over time will drop out. As a result, privately insured individuals must buy short-term contracts that become more expensive when their health deteriorates (Pashchenko & Porapakkarm 2015b). This problem can be alleviated by community rating, in which insurers must charge healthy and sick people the same price. Although community rating has long been of a feature of US employer-based insurance [Jeske & Kitao (2009) show that this is welfare enhancing], community rating in the US private nongroup insurance market was rare before the Affordable Care Act (ACA). Pashchenko & Porapakkarm (2013a) show that the ACA reforms are welfare enhancing but that the gains come mostly from income redistribution rather than the restructuring of the individual insurance market.

Figure 5 shows that in the United States many of the medical expenses of the elderly are covered by Medicare, which is provided to almost everyone 65 and older, but also that a significant fraction are covered by Medicaid, which is means tested. In principle, means-tested health insurance, which is more targeted than universal coverage, can be very valuable. However, it also distorts incentives to work, save, and consume medical care. Pashchenko & Porapakkarm (2013b, 2015a) find that the work disincentives of Medicaid are significant and costly. Focusing on the elderly, De Nardi et al. (2013) estimate a rich structural model of saving and endogenous medical spending. They find that most individuals value the insurance provided by Medicaid at more than its actuarial cost. Braun et al. (2016) find that, in the presence of medical expense and life span risk, the benefits retirees receive from means-tested programs such as Medicaid and SSI are large. In fact, increasing the size of this insurance by one-third benefits both the poor and the affluent, assuming the increase is financed by a payroll tax.

How medical care should be distributed among people is also an important question. Ales et al. (2012) assume that health care increases survival probabilities 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 it is equal for everyone after retirement.[5] According to their analysis, the largest inefficiencies lie in the lower part of the income distribution and in postretirement ages, a finding consistent with the idea that health insurance programs targeted to poor retirees are welfare enhancing (Braun et al. 2016).

Some of the aforementioned papers allow for a bequest motive. As we have discussed at length, the relative importance of bequest and precautionary saving motives has not been resolved. Moreover, the modeling of the bequest motive 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. (2007) find that the welfare gains of privatizing Social Security are increasing in the degree of altruism.

9. CONCLUSIONS AND DIRECTIONS FOR FUTURE WORK

A large body of work has shown that 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 the amount of medical spending, along with bequest motives, are important to understanding the slow decumulation of retirement wealth.

Some of the risks affecting saving 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. We can also 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

[5]Interestingly, Ozkan (2014) 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.

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 hinge on the relative strengths of these saving motives. Savings data alone do not appear to be sufficient to disentangle precautionary saving motives from bequest motives. To measure their relative importance, recent work also matches purchases of LTC insurance and annuity products, patterns of participation in means-tested social insurance programs such as Medicaid, and survey questions that directly elicit preferences concerning bequests and the consumption of LTC and other goods. These studies have found that both precautionary saving and bequest motives play an important role in determining saving patterns in old age, although the relative importance of these factors remains an open question. Papers matching demand for annuities and LTC insurance tend to find stronger bequest motives.

Progress has also been made by modeling richer heterogeneity along observable dimensions, including health, gender, and income. Importantly, it has been found that allowing mortality and medical expenditure risk to depend on observables is important to reconciling the observed data and understanding the heterogeneity in saving along these dimensions. However, most models allow for very little heterogeneity in other dimensions, such as the desire to leave bequests (Laitner & Juster 1996, Kopczuk & Lupton 2007) and beliefs about life expectancy and medical expenses (Gan et al. 2003).

Although bequest motives likely play an important role, it is still not clear why people desire to leave bequests and how we should model these desires. Most papers assume an altruistic bequest motive for tractability. However, from a policy analysis standpoint this is a restrictive assumption, because the altruistic bequest motive does not depend on the heirs' characteristics, estate taxes, and other important features of the environment. Moving beyond bequests, the family is an important potential source of both insurance and risks. For instance, each member of a couple is exposed to the risks of the other but might also benefit from shared resources and the other's help. In addition, parents and children might respond to each other's needs with transfers of both time and money. An important avenue for future research is better documentation of these interactions and better modeling of the motivations behind them.

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