The Joy of Giving or Assisted Living?

Using Strategic Surveys to Separate Public Care Aversion from Bequest Motives.

John Ameriks, Andrew Caplin, Steven Laufer, and Stijn Van Nieuwerburgh*

June 8, 2010

Journal of Finance Forthcoming

ABSTRACT

The "annuity puzzle", conveying the apparently low interest of retirees in longevity insurance, is central to household finance. One possible explanation for low annuitization is "public care aversion" (PCA), retiree aversion to simultaneously running out of wealth and being in need of long term care. Another possible explanation is an intentional bequest motive. To disentangle the relative importance of PCA and bequest motive, we estimate a structural model of the retirement phase using a novel survey instrument that includes hypothetical questions. We identify PCA as very significant and bequest motives that spread deep into the middle class. Our results highlight potential interest in annuities that make special allowance for long term care expenses.

*Affiliation by author and contact information: Ameriks, Vanguard; Caplin (andrew.caplin@nyu.edu) and Laufer, New York University Department of Economics; Van Nieuwerburgh, New York University, Stern School of Business, Department of Finance, svnieuwe@stern.nyu.edu. We thank Campbell Harvey and two anonymous referees, George Akerlof, Orazio Attanasio, Daniel Benjamin, Mariacristina De Nardi, Amy Finkelstein, Eric French, Mark Gertler, Greg Kaplan, Miles Kimball, Kathleen McGarry, Costas Meghir, John Phillips, Jim Poterba, Bob Willis, and Motohiro Yogo for helpful guidance. We especially thank Erik Hurst and Jonathan Skinner for insightful discussions at the 2006 and 2007 AEA meetings in Boston and Chicago. We also thank the participants in seminars at New York University, Princeton University, Harvard University, University of California at Berkeley, MIT, the University of Michigan, University College London, the NBER Summer Institute, and the 2010 Midwest Economics Association for comments. The views expressed herein are those of the authors rather than of their institutions.

In a world without bequest motives and with complete markets, a household should fully annuitize and consume all wealth before death (Yaari [1965]). In reality, Dynan, Skinner, and Zeldes [2004] and De Nardi, French, and Jones [2010] show that assets of the old decrease slowly if at all, and many die with significant wealth in the form of housing equity and liquid assets. Similarly, only a small fraction of households annuitize. This "annuity puzzle", whereby retiree demand for annuities is far lower than economic models predict, has generated much work within the academic community. More broadly, there has been a surge of interest in using portfolio theoretic models to address questions of retirement financial security.[1]

This paper develops and estimates a model of retiree choice that answers crucial questions concerning potential interest in annuities. The high observed levels of long term care expenses are a particular focus of our analysis.[2] One possible explanation for the lack of asset run down and under-annuitization may be aversion to the prospect of having insufficient wealth for private long term care, and therefore needing public care. To capture this, we introduce a "public care aversion" (PCA) parameter into a life-cycle model and estimate its importance.[3] Technically, PCA measures retiree aversion to simultaneously running out of wealth and being in need of long term care. In addition to PCA, bequest motives may contribute to the lack of wealth decumulation and under-annuitization in retirement. In order to disentangle the relative importance of the PCA and the bequest motive, we estimate our structural model of the retirement phase using a novel survey instrument.

Our central finding is that PCA is a quantitatively significant driver of precautionary savings. In confirmation of the importance of PCA, subsequent work by Kopecky and Koreshova (2009) shows that saving for late-in-life long-term care expenses impacts aggregate capital accumulation, while Scott, Watson, and Hu (2009) find that the most valuable states of the world to provide insurance to be those that occur late in life, precisely when long term care expenses are usually incurred. Our analysis indicates that there is a powerful interaction between interest in annuities

[1] E.g., Campbell and Viceira [2002], Cocco, Gomes, Maenhout [2005], Gomes and Michaelides [2005], Polkovnichenko [2006], Campbell [2006], Gomes, Kotlikoff, and Viceira [2007], Farhi and Panageas [2007], Lopes and Michaelides [2007], Koijen, Nijman, and Werker [2009], and Yogo [2009].

[2] Brown and Finkelstein [2008] apply the medical transition model of Robinson [2002] to suggest that a 62 year-old man has a 40% chance of entering a nursing home at some future point, while a 62 year-old woman has a 54% chance. The Metlife Market Survey [2006] shows that the national average annual cost of nursing home care in 2006 was $66,800 for a semi-private room. Of that, $57,800 represents out-of-pocket costs, a much higher fraction than in the health sector as a whole (Congressional Budget Office [2004], National Center for Health Statistics [2002]). De Nardi, French and Jones [2010] show that these expenses increase in wealth: a sick 95-year-old woman at the 80th percentile of the permanent income distribution can expect to spend $16,000 per year on out-of-pocket medical costs, while a sick 95-year-old woman at the 20th percentile expects to spend only $2,700.

[3] In the United States, public benefits for long-term care are provided via Medicaid; we use the term public care aversion in this paper rather than "Medicaid aversion" as in our early drafts to emphasize the generality of the phenomenon. It is not about the Medicaid program per se, but more generally the desire to avoid becoming a ward of the state as a consequence of poor health in old age in general and a Medicaid dependent in particular.

and the institutions that provide for long term care, both public and private. Specifically, the high levels of PCA that we identify imply that demand for annuities would be far higher if they included some acceptable form of long term care insurance.[4] We believe that the next wave of annuity design will therefore focus on the interaction with long term care insurance rather than on the equity premium, which was the focus of the last round of innovations.[5,6]

The bulk of our research effort is dedicated to resolving the identification problem between PCA and bequest motives. Dynan, Skinner, and Zeldes [2002] highlight the broad identification problem between bequest and precautionary motives, which is important not only for financial design, but also for those interested in the macro-economic impact of fiscal policies and the intergenerational transmission of wealth inequality:

> "A dollar saved today simultaneously serves both a precautionary life-cycle function (guarding against future contingencies such as health shocks or other emergencies) and a bequest function because, in the likely event that the dollar is not absorbed by these contingencies, it will be available to bequeath to children or other worthy causes." Dynan, Skinner, and Zeldes [2002], p. 274.

We introduce a new survey instrument to resolve this identification problem. We employ a series of hypothetical questions as essential aids in the identification process.[7] These "strategic" survey questions represent natural thought experiments concerning behavior in contingencies selected for their high information content. Survey techniques of this kind may be particularly important in other areas of retirement finance, given the reluctance of many to plan ahead for future aversive events (Brunnermeier and Parker [2007]) and the associated incompleteness of markets.

[4] Consumer Reports [2003] documents major flaws in the existing long term care insurance market. After reviewing 47 policies, the central finding was that, for most, the insurance was too risky and too expensive given that the company may no longer be around when reimbursement is needed, and that continued payment of the premium is needed to keep the policy alive.

[5] Financial engineers designed "flexible" annuities that enabled retirees to take financial risks, and therefore potentially to benefit from the equity premium, while providing a consumption floor should the portfolio fall too low in value. Variable life annuities with guaranteed minimum annual withdrawal benefits were the archetype in this regard. Unfortunately, many mistakes in pricing were made in the initial development of these instruments, which has sent financial engineers back to the drawing board.

[6] As a concrete example, Vanguard's new Managed Payout Funds, which were launched in April 2008, were conceived based on the survey evidence and analysis presented in this paper. Our results were viewed as compelling evidence of the significant demand that would likely exist for a retirement payout product that would provide retired investors regular payments, while emphasizing complete liquidity as well as the potential for growth of invested capital, to meet either precautionary or bequest motives. This family of new funds attracted deposits of close to $200 million in its first three weeks of operation alone.

[7] Similar shortcomings in purely behavioral data motivated earlier survey research aimed explicitly at parameter identification, such as Holland [1969], Ljunqvist [1993], Barsky, Juster, Kimball, and Shapiro [1997], Kimball and Shapiro [2003], Ameriks, Caplin, and Leahy [2003], and Kimball, Sahm, and Shapiro [2007]. Of these, those by Kimball and Shapiro [2003] and Kimball, Sahm, and Shapiro [2007] are closest in spirit to our approach.

While we employ non-standard data, our estimation procedure follows a long tradition in finance of structural estimation of preference parameters.[8] The results of this estimation establish that PCA plays a significant role in explaining the low rate of spending of many middle class retirees. The results are also relevant to ongoing debates concerning the extent of the bequest motive. We find these motives to be more prevalent and to spread deeper into the middle class than is generally believed. Moreover, we find significant evidence for heterogeneity in bequest motives: they are minimal for at least a substantial minority of the population, and are higher on average for those with children than for those without children.

Our findings concerning the prevalence of bequest motives is of independent interest, and further illustrates the value of our strategic survey questions. When these questions are ignored, the likelihood function over bequest parameters is essentially flat and public care aversion cannot be pinned down. Moreover, the actual point estimates implies that almost every marginal dollar of income beyond \$12,000 is saved for the bequest, irrespective of wealth. This contradicts evidence of Hurd and Smith (2002) on realized bequests. In contrast, bequest motives are well identified when we incorporate the strategic survey question, and are broadly consistent with the evidence on realized bequests (see section III).

Section I introduces the model. In section II we introduce the customized survey designed for purposes of model estimation, and to overcome the identification problem as between bequest and precautionary motives.[9] Section III outlines results of the estimation procedure with strategic survey responses included. Section IV pinpoints the implications of our findings for the design of financial instruments for retirees.

I The Model

A Preferences

For simplicity, the unit of analysis is the household consisting of a single individual who has just retired. The first period of observation occurs when the individual is m years old and entering retirement. The model consists of a series of one-year periods, starting at the age of retirement and ending at the year of death, which is restricted to occur by maximum age $M = 100$. The maximum length of the retirement period is $T = M - m$. Periods are indexed by t, the number of years into the retirement period, starting at zero at age m, so that overall $0 \leq t \leq T$. There is a health-dependent death rate δ_t in year t of retirement that evolves in a matter defined below.

[8]Hansen and Singleton [1983], Eichenbaum and Hansen [1990], Gourinchas and Parker [2002], Yogo [2006], Koijen [2008], and many others.

[9]While our survey was drawn from an Internet panel of a commercial supplier, Greenfield Online, we show in an Appendix on the Internet that it is close to representative in terms of household financial characteristics.

The agent maximizes a standard time-separable utility function with exponential discounting. In each period of life, agents receive utility from consumption:

$$u(c_t) = \frac{c_t^{1-\gamma}}{1-\gamma}. \tag{1}$$

Agents also receive end-of-life utility from bequests defined by the function $v(b)$. Hence the agent maximizes,

$$E_0 \sum_{t=0}^{T} \beta^t \left(\prod_{j=0}^{t-1} (1-\delta_j) \right) \{(1-\delta_t)u(c_t) + \delta_t v(b_t)\}. \tag{2}$$

An agent leaving a bequest b receives direct utility:

$$v(b) = \frac{\varpi}{1-\gamma} \left(\phi + \frac{b}{\varpi} \right)^{1-\gamma}. \tag{3}$$

If wealth is negative upon death, the agent is credited with having left a bequest of zero. This method of modeling the utility from the bequest matches the "warm glow" specification of Andreoni [1989], with a risk aversion parameter matching that for consumption. Abel and Warshawsky [1987] show that this warm glow specification is a reduced form for an altruistic bequest motive.[10] With respect to functional form, we follow De Nardi [2004] in parameterizing the bequest utility with two parameters, one to control the strength of the bequest motive (ϖ) and one to measure the prevalence in the population of an operative bequest motive (ϕ). Carroll [2000] labels ϕ as the degree to which bequests are a luxury good.[11]

B *Technology*

Households enter retirement with wealth $X_0 \geq 0$, and wealth at the beginning of time t is denoted X_t. We assume a deterministic stream of annual after-tax income y_t for as long as the retiree lives. There is no income in the year of death. Following the literature, we assume that there is a single riskless asset in which the household can invest and which yields a rate of return $r = \beta^{-1}$. Households are not allowed to take a negative position in assets (no-borrowing

[10] Kopczuk and Lupton [2007] provide reasons for researchers' preference for direct utility of bequest models over altruistic models, such as the finding by Altonji, Hayashi and Kotlikoff [1997] that parents do not offset monetary transfers to their children while alive given an increase in their children's permanent income.

[11] In terms of interpretation of these two bequest parameters, Abel and Warshawsky's derivation shows that ϕ is proportional to the present discounted value of the labor income of all future generations. In Henin and Weitzenblum [2003], ϕ is the expected annual consumption of the heir. Finally, in a simpler model without health risk, spelled out in Appendix A, the optimal policy is to consume c^* per year and to leave a bequest of $(c^* - \phi)$ per year for ϖ years. If wealth is insufficient to cover an annual consumption of at least \$$\phi$, no bequest is left. Hence, ϕ measures the consumption threshold above which the bequest motive becomes operative, and ϖ measures its strength, in years (of annual consumption).

constraint).

C Health Dynamics and Health Costs

Our treatment of health dynamics and death is crucial to the precautionary motive, given the high expenses associated with bad health. There are four health states modeled. State 1 is a state of good health. State 2 is a state in which there are medical problems but no need for long term care. State 3 is a state in which long term care of some form is required, and state 4 is death. In period 0, the individual is in health state $s_0 \in \{1, 2, 3\}$. The health state follows a Markov chain with age-varying one-period state transition matrix $\mathcal{P}(t)$. In each year t, this is a 4×4 matrix. Retirees reaching age $M - 1$ die with probability one the following year.

The initial health state and the Markov transition matrices $\mathcal{P}(t)$ enable us to compute future probabilities attached to all health states, including death. Given the initial health state s_0, the transition matrix is applied repeatedly to derive the probability $\pi_t(s_t)$ that a retiree is in health state $s \in \{1, 2, 3, 4\}$ at time $t \geq 1$. This means that the death probability δ_t can be computed as $\delta_t = \pi_t(4)$. Note that in principle we could have used only one non-LTC health state rather than two. We introduced two states to enable us to capture survey-revealed differences in current health and the corresponding costs.

Note that we have not included the health state directly in the utility function. Rather, we focus on the costs associated with the various health states. Each live state $s \in \{1, 2, 3\}$ has associated with it a necessary and deterministic health cost, $h(s)$. Paying these costs entirely removes any utility penalty that would otherwise be associated with the health state. Death expenses in state 4 are also deterministic, at level $h(4)$, and are subtracted from the bequest. Unlike Yogo [2008], we abstract from investment in health. While some medical expenses are certainly avoidable through investment, many of them are not. Appendix C shows that our calibration presents a realistic characterization of observed medical expense risk.

D Consumption Floor and Public Long Term Care

Given the risk of substantial (non-discretionary) medical expenses which may exceed available wealth, there is need to include a "government welfare" mechanism to guarantee agents a minimal level of consumption. In health states 1 and 2, we model welfare as a "consumption floor" C^f. We assume that an agent who cannot afford her health costs plus this amount of consumption receives government transfers that brings her consumption up to C^f. End of period wealth is set to zero. In state 3, the long term care state, treatment of welfare is related to the institutional reality of *Medicaid*. An individual going on welfare in the long term care state forfeits all wealth to the government (end of period wealth is zero) and accepts care funded by Medicaid. The government covers the cost of health care and the agent receives in that period the public care level of consumption C^{PC}. The public care level of consumption is an important parameter in what follows, since it reflects aversion to publicly provided long term care. If C^{PC} is low, this will produce a strong incentive for households to retain sufficient wealth to retain the private care option. If instead C^{PC} is closer to annual consumption in the pre-long term care period, then the incentive will be to run down wealth and use the public care subsidy in place of savings. The value of C^{PC} therefore has powerful impact on the strength of the precautionary motive.

E The Optimization Problem

The household enters the period t with health state s_t and wealth X_t. The timing of events is as follows:

1. If $s_t = 4$ so that the individual is deceased, no income is received, health costs $h(4)$ are paid and the bequest b_t equals the remaining net resources, down to a minimum of zero,

$$b_t = \max[X_t - h(4), 0]. \tag{4}$$

2. If $s_t < 4$, period t income of y_t is accrued, and the health costs $h(s_t)$ are incurred. A consumption decision is made. The agent may choose any level of consumption c_t that exceeds the consumption floor C^f and satisfies the budget constraint,

$$X_t + y_t - h(s_t) - c_t > 0 \tag{5}$$

   If no consumption level $c_t > C^f$ satisfies Equation 5, the agent must get help from the government. If $s_t = 1$ or 2, welfare means consuming $c_t = C^f$. If $s_t = 3$, the agent must receive public long term care and $c_t = C^{PC}$.

3. At the end of the period, the agent is left with the unspent portion of assets, which earn a riskless return r. If the agent received government help in the current period, wealth in the next period is zero. Letting I_t^G be the indicator variable for government help in period t, the following period's wealth level obeys:

$$X_{t+1} = \begin{cases} (X_t + y_t - h(s_t) - c_t)r & \text{if } I_t^G = 0; \\ 0 & \text{if } I_t^G = 1. \end{cases} \tag{6}$$

4. Finally, the new health state s_{t+1} is drawn according to the state transition probabilities $\mathcal{P}(s_{t+1}|s_t)$. If $t + 1 = T$, the final period, $s_{t+1} = 4$.

The household maximizes expected utility of the remaining life time consumption (2) subject to the budget constraint (5) and the government-provided consumption floor. The Bellman equation is

$$V_t(s_t, X_t) = \begin{cases} \max_{c_t} \{u(c_t) + \beta E_t V_{t+1}(s_{t+1}, X_{t+1})\} & \text{if } s_t \neq 4 \\ v(b_t) & \text{if } s_t = 4 \end{cases} \tag{7}$$

subject to equations (3), (4), (5), and (6).

To compute optimal policies, we first discretize the state space and the control space. The model is then solved by backwards induction. At time T (age 100), the household dies with probability one. Its value function is the instantaneous utility over bequests, $V_T(s_T, X_T) = v(b_T)$. In every prior period t, the Bellman equation (7) is used to solve for $V_t(s_t, X_t)$. We use a fine grid for X and for consumption, and linear interpolation to compute continuation values for points that are not on the grid. The choice variables ruled out by the budget constraint (5) are given large negative values.

F Health and Longevity Dynamics

The role of health costs is central to our analysis, especially the possibility of high costs associated with long term care. The distribution of these costs in our model is controlled by the medical costs associated with each health state and by the one-period 4×4 state transition matrix $\mathcal{P}(t)$. This matrix is parameterized by twelve parameters, nine that determine the value of $\mathcal{P}(0)$ (of the sixteen elements, four are fixed by the death state being absorbing and there are three further restrictions so that each row sums to one) and three that control the flow of probability from greater health to poorer health as age (t) increases. We select values for these parameters to match four age-dependent mortality rates and eight statistics on long term care utilization from Brown and Finkelstein [2008]. We calibrate this matrix separately for mean and for women. The latter not only live longer, they also face much higher long term care risk. This calibration is described in detail in Appendix B and the longevity and long term care moments that are matched are listed in rows 1-12 in Table I. The table shows that the model replicates the various cross-sectional moments of long term care use and life expectancy during retirement.

Each health state is associated with a (deterministic) medical expense. To calibrate the medical costs associated with non-LTC states, we identify the mean annual out-of-pocket medical costs for non-institutionalized individuals over 62. French and Jones [2004] find mean household medical costs of \$2,800 in the AHEAD survey, whose first wave contains only non-institutionalized individuals. Their numbers therefore exclude most LTC costs. The corresponding number for single households in \$2,000. Using our calibrated health-transition matrix, we find that among the periods our simulated retirees spend out of long term care (health states 1 and 2), they spend

10% in state 2 so that $h(1) = 1$ and $h(2) = 10$ produces an average non-LTC expense of $2,000 in line with the data. For the LTC state 3, we use Metlife's estimate that a semi-private room in a private LTC facility costs $143 per day in 2004. Medicare covered the full cost of LTC for 20 days each year and the daily costs in excess of $109.50 for an additional 80 days. This leaves an annual out-of-pocket expense of $46.7K for a full year of LTC for an individual without LTC insurance. By 2006, this expense had increased to $57.2K. Since our survey data pertain to 2005, we take a value in the middle: $h(3) = 50$. We ignore costs associated with death by setting $h(4) = 0$.

Combining health costs and health and longevity dynamics, Rows 13-17 of Table I report various cross-sectional moments of life-time discounted medical expenses. For each simulation, we calculate the present discounted value of all future medical expenses as of age 62, discounted at a riskless rate of 3% and taking into account mortality. The median value for life-time medical expenses is $32.3K for men ($54.4K for women), while the mean is $64.5K ($96.6K). Long term care costs dominate our model, making up 62% (71%) of all medical expenses. For the 61% of males (47% of females) who do not enter long term care, the mean discounted life-time health cost in retirement is $21K ($25K). In the right tail of the medical expense distribution, men (women) face a 21% (34%) chance of facing health costs greater than $100K and a 4% (9%) chance of costs greater than $250K. These calculations measure all expenses, not just *out-of-pocket* medical expenses. Appendix C discusses the results of a simulation that takes into account government contributions to medical expenses. It compares the model's medical expenses to the data and finds consistency in pattern and magnitude. It also studies two other testable implications of the model: the public care utilization rate and the realized bequest distribution. While the model was not calibrated to explain these data, it matches them reasonably well.

G Non-Linearity in Savings Motives

A key feature of the model is that the incentive to save is particularly high for those with intermediate wealth and income levels. Figure 1 illustrates this for a hypothetical healthy 62-year-old woman. The horizontal axis represents this individual's economic status, as measured by income, and by variations in wealth consistent with the observed joint wealth-income distribution (not shown). The vertical axis illustrates the savings rate out of income. Note that the model-implied saving rate is hump-shaped in income. The saving rate is highest for the "middle class". The reason is that both the precautionary and the bequest motives are operative in full force for this group. Different lines in the figure indicate different degrees of public care aversion. The lower C^{PC}, the stronger the PCA, the stronger the precautionary savings motive, and the larger the saving rate (top line). In sum, disentangling motives for savings therefore is most relevant for the middle class. High wealth individuals are not at risk of needing to resort to public LTC, while poor individuals cannot afford private long term care, no matter how much they save.

II The Survey

A The Sample

Our survey was conducted in September 2006 by Greenfield Online, a major provider of web-based surveys.[12] Any respondent living without a partner was ruled out if: born before 1917 and after 1951; working full-time or looking for work; having total household income from work in 2005 of more than $25,000; being in need of long term care; having children at home. For respondents living with partners, we added the condition that the partner could not be working full time or looking for work, born before 1917 or after 1966, or in long term care. We imposed sampling restrictions on various demographic and wealth groups to obtain a somewhat representative sample. After screening out first-order response errors, we obtained a sample of 938 respondents. With respect to household status, almost 55% comprise single households and 45% are couples. Because our estimation exercise focuses on the sample of singles, we discuss their characteristics here and defer a description of the full sample to the supplementary appendix.

Table II lists summary statistics for our singles sample and compares them to the singles sample in nationally representative surveys. Panel A contains some demographic variables. The mean and median age of respondents was 64, with 90% in the 55-77 range. Nearly three-quarters of single respondents were female. Almost three-quarters were retired. Given that the current state of health is a state variable in our model, we asked questions directly to identify which of the three model-permitted states of health characterized each respondent. 56% of respondents were in good health. There is wide dispersion in the number of children and of grandchildren, with a substantial minority in each case having none, and another substantial group having four or more. Finally, 62% of single respondents were homeowners.

A key premise of the model is that many face high private costs of LTC, and we set the costs of private care at $50K as a fixed parameter in the model. In a sensitivity analysis, we also explore a higher value of $70K. In fitting with the low level of use in the general population, only 10% of singles in our sample have taken out a long term care insurance policy that would provide benefits or reimbursement for LTC expenses. When we explicitly ask respondents to think of the costs of one year of private LTC absent any LTC insurance coverage, the median estimate among singles

[12] A supplementary appendix provides background information on internet survey methodology, on Greenfield Online, on an earlier pilot survey, on sampling restrictions we imposed on various demographics to obtain a somewhat representative sample, and on a preliminary screening for first-order response errors. It also contains more details on the comparison with the Survey of Consumer Finance and the Consumer Expenditure Survey. It concludes with the actual survey questions themselves.

is \$25K, and 10% of respondents think the one-year stay will cost \$100K or more. The claim that private LTC is seen by many as involving high private costs appears warranted.

B Wealth

We asked respondents for measures of assets and debts in 2005, and as with all other numerical dollar values, we asked respondents to first answer questions concerning the range of values in which the corresponding variable lay, and then asked them to make a precise estimate within this range. Panel B of Table II reports various wealth categories. Retirement assets held in tax-favored dedicated retirement accounts (such as 401(k), IRA, 403(b), or other accounts) have an inter-quartile range (IQR) of \$0-\$40K. Financial wealth (bank accounts, money market accounts, stocks and shares, bonds, etc. excluding any assets held in dedicated retirement accounts) has an IQR of \$0-\$52K. The median self-reported home value *among home owners* is \$100K, with IQR \$48K-\$189K. For 53% of single homeowners, the primary mortgage is fully paid off. The IQR for mortgage debt among home owners is \$0-\$35K. The table instead reports home values, mortgage debt, and home equity for the entire population, including renters. The median level of "other assets" (e.g. secondary home, cars, boats, art, private business assets) is \$10K, with an inter-quartile range of \$1K-\$30K, and 10% own more than \$270K. On the debt side (Panel C), more than half of the respondents have no credit card debt and the same is true for "other debt beside primary mortgage and credit card". Among the credit card debt holders, the median debt is \$2K, while among those with other debt, the median debt is \$1K. The median net worth in our sample (Panel D) is \$88K with an IQR of \$5-\$290K. 5% of our singles have a net worth of more than one million dollars.

To estimate our model, we need a total wealth measure for all respondents, taking care to keep the number of state variables to a minimum. While liquid wealth, retirement wealth, and free standing debt categories largely speak for themselves, there are trickier issues associated with housing and durable assets. With respect to housing, the historical real price appreciation (ex-dividend return) is approximately zero per annum (Shiller [2006]). Our model calls for the cum-dividend return on housing, which includes the rent-price ratio. We use a rent-price ratio of 4%.[13] Thus, the cum-dividend return on housing is 4%, somewhat above the 3% average return we assume on the riskless asset. Because of the difference in returns, aggregation at current value would understate the contribution of housing to net worth. To account for its higher return, we increase the contribution of housing wealth to total wealth to the degree appropriate given the

[13]The rent-price ratio in 2005 was equal to 4% nationwide, where rents are measured based on the rental price index of the Bureau of Labor Statistics and house prices based on the repeat-sales index of the Office of Federal Housing Enterprise Oversight. Since we do not have geographic information on our respondents, we use the nationwide number.

longevity of each respondent. Note that implicitly this is treating the house as an asset than will be used late in life, which is empirically accurate. Venti and Wise [1990] show that there is little run down in housing assets except at the very end of life, while Walker [2004] has shown that there is quite often rapid run-down at the end of life often associated with declining health.[14]

C Income, Spending, and Current Health

The survey also gathered data on 2005 and (expected) 2010 income from Social Security, government pensions, and regular employer pensions. The median respondent has $12K in 2005 retirement income and the IQR is $8-$16K. Labor income is set to zero when the respondent indicates not working. The distribution of total income, defined as the sum of labor income and pension income, has a median of $16K and an IQR of $10-24K; see Panel E of Table II. The model calls for a measure of permanent income, for which we use after-tax expected 2010 income. We use the reported tax rate to calculate after-tax income.[15]

Finally, we asked respondents for total spending in 2005, and also for a breakdown into six categories: (a) all mortgage and debt payments except credit card payments; (b) maintenance, improvement and taxes on owned real estate or rent; (c) purchases of major durable goods such as cars, boats, etc; (d) out-of-pocket health care expenses; (e) income or other taxes other than real estate taxes; (f) all other living expenses.[16] Panel F reports the distribution of these expenses in our sample. We are interested in constructing a value for total consumption that excludes health care spending to be consistent with the model, yet includes consumption of housing services. For renters, housing consumption is given by their rent. For home-owners, we set the housing consumption equal to the "imputed rent", the self-reported home value times the 4% rent-price ratio, which we also used in the housing return.[17] Non-durable and services (NDS) consumption is then defined as the sum of all other living expenses and housing services consumption: the median is $11K per year, the average is $14K, and the IQR is $8-$17K. We measure durable consumption as 25% of durable assets, a typical depreciation rate for vehicles and electronics. We define total consumption as the sum of NDS consumption, durable consumption, and housing services from any secondary home. When so defined, consumption has a median of $13K, and average of $17K,

[14]More precisely, we use a simple procedure in which we associate with each individual an expected longevity, and compute the value of the house at that date assuming that it grows at 4% p.a. The increased housing wealth we obtain is such that, when it grows at 3%, it results in the same future value as the observed housing wealth under a 4% growth rate.

[15]We compute the individual-specific tax rate based on 2005 reports on taxes paid and on taxable income, which we define as earnings from labor income plus financial income. Consistent with the model, financial income is measured as 3% of financial wealth.

[16]A check was instituted to ensure that category responses added up to within 10% of total expenses.

[17]We also computed an alternative "user cost" of housing as the sum of the mortgage payment, maintenance and home improvement, and property taxes. The user cost and the imputed rent have a 40% correlation, which is measured precisely.

and an IQR of \$9-\$19K. Since durable consumption and housing services from any secondary home are imputed, we use NDS consumption (which includes housing services from the primary home) as our main measure to be used in the model. Hence, the wealth and consumption measure we use in the model both include the primary home and exclude durables.

The right columns of Table II contain data from the Survey of Consumer Finance (Panels A-E) and from the Consumer Expenditure Survey (Panel F) for singles. A comparison with our survey suggests that our wealth, income, and consumption distributions are quite similar to those in the nationally representative samples. For example, total net worth has an IQR of \$5-\$290K in our sample and \$25-\$306K in the SCF. Likewise, total income has the same IQR of \$10-\$24K in both our sample and the SCF. Finally, total consumption has an IQR of \$9-\$19K in our sample and \$12-\$25K in the CEX. A more detailed comparison between our data and the SCF, CEX, and HRS, including a comparison of wealth and consumption profiles, is relegated to the separate appendix Section D.

Since Table II combines respondents of different ages and since our sample is somewhat younger than the SCF and CEX samples, it is instructive to break down wealth, income, and consumption by age. Table III reports net worth, total income before tax, and total consumption categories for age groups 54-59, 60-64, 65-69, 70-74, and older than 74. Results from other age groupings are similar. Comparing the left panel (our survey) to the right panel (SCF or CEX surveys) shows that, holding constant age, the moments of wealth, income, and consumption are quite similar. For example, wealth (net worth) is typically negative in the fifth percentile in both surveys. As another example, for the age group 60-65, our survey shows wealth of -\$8, \$5, \$70, \$315, and \$979K at the fifth, twenty-fifth, fiftieth, seventy-fifth, and ninety-fifth percentiles of wealth, respectively. The corresponding numbers in the SCF are -\$2, \$5, \$70, \$344, and \$1039K. Also, median income and consumption are similar across surveys, as are the inter-quartile ranges.

We now turn to the strategic survey questions which the following section will show are instrumental in separating bequest and precautionary motives.

D Strategic Survey Questions

We posed two distinct types of strategic survey questions, differing in when the proposed contingency would play out. Our first question was to play out "immediately following survey completion", as in Barsky, Juster, Kimball, and Shapiro [1997] and Kimball and Shapiro [2003]. The interpretation of the response to this question depends on wealth, income, health status, age, and gender. A fixed survey response will have entirely different interpretation in terms of model parameters depending on the other data that describe this respondent. Our second question placed respondents close to the end of life when the motives come into play. The interpretation of these answers in terms of model parameters is the same for all respondents, since they were placed in the same hypothetical situation. The differences between the questions allow each question to generate information of independent value in the final estimation.

D.1 The Immediate Prize

Our immediate prize scenario involved the respondent winning a prize (either \$100K or \$250K) that had to be divided up between a bequest locked box and a long term care locked box, where the idea of using the locked box was precisely to provide an appropriate commitment device. More precisely, we specified that money placed in the bequest box could not be accessed during the lifetime, but would be passed on in whole to beneficiaries (who could not be told of this) upon death. Money in the long term care box could be accessed only to pay for private long term care (stated as costing \$50K a year) for the respondent (and partner if applicable), and would not be available to bequeath. The point of this question was to overcome the identification problem associated with wealth that is fungible between these uses.

Figure 2 shows that the single largest group of respondents would split the money 50-50. If the prize is \$100K (two years of LTC), then 33% would split it evenly; if the prize is \$250K (five years of LTC) only 17% percent would split it evenly. The second most common answer is a polar answer of 0 or 100%, but there is non-trivial probability mass on all other answers. This is the first evidence suggestive of our basic finding, which is that both public care aversion and bequest motives are important for a significant set of retirees. The second question with a \$250K prize has a more even distribution across answers than the first; it is more discriminating. There is a large positive correlation between the two questions: the correlation between the \$100K answer and the \$250K answer is 0.8. Forty-five single respondents answer 0 to both questions (9% of sample), 65 answer 50% to both (13%), and 70 answer 100% to both questions (14%).[18]

D.2 The End of Life

In posing the end of life question, we asked all respondents to place themselves in a hypothetical situation in which they were: of age 85 and the sole surviving member of their household; in need of long term care yet had absolutely no LTC insurance; knew that they had exactly one year left to live and would need to spend it in a long term care facility; and had sold their home and had total available wealth that is worth \$200K at today's prices and final year income net of taxes worth \$25K in terms of current prices. They were then offered the choice between LTC that was privately financed and government provided LTC that is financed through the government

[18] We experimented with randomizing the order of the answers to the survey questions to detect anchoring effects. We found that the answers from the group that was presented the "100% in LTC" answer first were no different from the answers given by the group that was presented the "0% in LTC" answer first.

(Medicaid). This choice was described as impacting their LTC options and the bequest that they would leave as follows:

1. Option A: Use Medicaid funded LTC. The government will pay for your LTC, allowing you to leave all $200,000 as a bequest. However, using Medicaid restricts your choice of facility, on average results in inferior care, and requires you to surrender all income to the government.

2. Option B: Use private LTC. Pay $50,000 for private LTC. You would only leave $150,000 as a bequest but would have your choice of facility and would have your income available for spending as you wish during that year (unspent income would be forfeited).

Note that our question asserts directly that Medicaid on average results in inferior care, which we see as uncontroversial "folk wisdom" designed to frame the question appropriately. There is no evidence suggesting that this framing had any effect. First, respondents had all answered the locked box question (which made no comments on Medicaid quality) before seeing this second question. Second, the answers to this question suggests a *lower* public care aversion than do the responses to the earlier locked-box questions.[19]

The response to the qualitative question was clear-cut. An overwhelming majority (85%) of single respondents preferred to go to a private facility if the cost is a reduction in bequest of $50K. This is strong evidence for public care aversion, the key driver of the precautionary savings motive in our model. Yet there is also evidence that many attach great importance to bequests. Following the above yes/no question, we followed up with a quantitative question designed to pin down how much of the $200,000 that would be willingly foregone to stay in a private LTC facility rather than use government-funded LTC. The median response was $50K, with an IQR of $20-100K. As an indication of coherence in responses, the median willingness to pay was only $3K for the 15% respondents who chose government funding in the first part of the question, while it was $50K for the other remaining respondents. Figure 3 plots the distribution of willingness to pay for a private facility for the 421 singles who prefer to avoid Medicaid.

Section E of the Internet Appendix investigates the plausibility of the answers we obtained to the strategic survey questions. The analysis suggests that the questions were taken seriously and answered in a fashion that is internally consistent with other parts of the survey as well as consistent with intuition. Section C of the Internet Appendix details the quality controls we implemented to obtain meaningful answers. Despite our best efforts, the usual caveats to survey work apply. There may be a difference in what respondents do and what they say they will do, when put in a hypothetical scenario which does not necessarily describe their current state.

[19]An estimation that uses consumption data and the end-of-life survey question data, but without the locked-box question data, results in lower PCA estimate. The results are discussed in section III D.

Ultimately, we think of our strategic survey questions as another potentially useful tool (as the next section will show) with its own shortcomings.

III Estimation

The central issue faced in estimation is how separately to identify the C^f and C^{PC} parameters which control precautionary savings, and the bequest motive, governed by ϖ and ϕ. This section estimates these four parameters using a maximum likelihood estimation procedure. Section A uses only consumption data to estimate parameters. This data turns out to be insufficient to separately identify the precautionary savings and bequest motives. In response, Section B adds the end-of-life and lock-box survey questions from the previous section, and shows that the identification problem disappears. For parsimony, both estimation exercises assume that the parameters $\theta \equiv \{C^{PC}, \phi, \varpi, C^f\}$ are common across the population. Finally, Section C adds a limited amount of parameter heterogeneity by introducing two types that differ in the strength of their bequest motive ϖ. Evidence from the survey supports such heterogeneity. In our estimation, we follow De Nardi, French and Jones [2010] and focus on single respondents due to the many additional intricacies involved in simulating end of life spending of those with partners. Our sample includes all $N = 498$ single respondents.

A Consumption Only

For a given set of parameter values $\Theta \equiv (\theta, \beta, \gamma)$, the model of Section I predicts an optimal current consumption choice $c(\Gamma_i; \Theta)$ for each demographic type $\Gamma_i = \{m, sex, s_0, X_0, y_0\}$ which lists age, sex, health, wealth, and income of respondent i at the time of the survey. We postulate the following data-generating process for each respondent:

$$\log c_i = \log c\,(\Gamma_i, \Theta) + \varepsilon_{ci}, \text{ where } \varepsilon_{ci} \sim i.i.d.N(0, \sigma_c^2),$$

where ε_{ci} is an idiosyncratic shock that represents classical measurement error in consumption levels. Our survey provides data on the demographics Γ_i and on consumption c_i. We are interested in estimating the parameters of the model, θ, alongside the measurement error standard deviation σ_c. Under regularity conditions, the maximum likelihood estimator $\hat{\theta}$ is consistent and asymptotically efficient. The likelihood of an individual consumption response given demographics and parameters is given by:

$$\mathcal{L}\left(c_i | \Gamma_i, \Theta, \sigma_c\right) = \frac{1}{\sigma_c} \Phi\left(\frac{\log c_i - \log c(\Gamma_i, \Theta)}{\sigma_c}\right),$$

where $\Phi(\cdot)$ denotes the standard normal pdf (to avoid confusion with the bequest parameter ϕ). The log-likelihood for the entire sample is the sum of the logs of the individual likelihoods. We use a Nelder-Mead simplex algorithm to find the maximum likelihood estimate $\hat{\theta}$:

$$(\hat{\theta}, \hat{\sigma}_c) = \arg\max_{\theta,\sigma_c} \sum_{i=1}^{N} \log \mathcal{L}\left(c_i | \Gamma_i, \Theta, \sigma_c\right).$$

This approach addresses one further complication. The parameters β and γ are not identified separately from the parameters in θ. Intuitively, changes in the subjective time discount factor induce saving behavior that is difficult to distinguish from that arising from other savings motives in the model. This leads us to fix $\beta = r^{-1} = .97$, corresponding to a conventional choice of 3% for the riskless rate.[20] A similar logic leads us to fix the risk aversion coefficient γ at a conventional choice of 3.[21] The precautionary savings motives are driven by $u'(C^f)$ and $u'(C^{PC})$, which are not only functions of C^f and C^{PC} but also of risk aversion γ, and the desire to avoid a zero bequest leads to a marginal value $v'(0) = \phi^{-\gamma}$, which depends on both ϕ and γ. Changing γ and shifting C^f, C^{PC} and ϕ in response delivers an equally good fit.

The model predicts that the poorest retirees should consume at the consumption floor. In the data, we see a number of such respondents and their observed consumption helps identify a value of $C^f = 5.75(.29)$; asymptotic standard errors are in parentheses. This value of \$5,750 for the consumption floor is consistent with average Social Security payments. The estimate for our public care aversion coefficient, the consumption equivalent of Medicaid, is $C^{PC} = 2.20(.12)$, less than half the consumption floor in the first two health states. This parameter is largely identified from the savings rate of (less wealthy) respondents who consume too little to be affected by the bequest motive. It suggests strong public care aversion. Our estimate for the luxury bequest parameter ϕ is 12.06 (.65); this means that the intentional bequest motive only kicks in when consumption is above \$12,060 per year. This value indicates that 60% of our respondents consume too little to be affected by the bequest motive. Among the (wealthy) respondents consuming above this threshold, we estimate a very high value for $\varpi = 93.7(7.4)$. This value implies little sensitivity of consumption to wealth, consistent with an explanation that additional wealth is being saved for

[20] As a robustness check, we also solved the model for a stochastic return with mean 3% and volatility 6.8%, the historical mean and volatility of the return on a portfolio of 30% stocks and 70% bonds. The 70-30 mix approximates the average share of equity in the portfolios of retirees in the SCF and agrees with common recommendations of financial planners. The findings are similar and are omitted for brevity. We also confirmed the robustness of our results to choices of r of 1.02 and 1.04, but omit them in the interest of brevity.

[21] Gourinchas and Parker [2002] estimate values around 1.5 from pre-retirement consumption and income data of various educational groups. Some research has argued that older investors are more risk averse (Morin and Suarez [1983]), but there is debate about their findings (Wang and Hanna [1997] and Bajtelsmit and Bernasek [2001]). Asset pricing studies routinely use much higher values than 3. The choice of 3 is a compromise between these two strands of the literature. We investigate the robustness of our results to choices of γ of 2, 5, and 10 below.

a bequest. In the limit as $\varpi \to \infty$, the marginal value of additional assets bequeathed becomes constant at value $u'(\phi)$, i.e. the bequest function $v(b)$ becomes linear. All additional consumption above ϕ is forgone in favor of saving the additional funds as a bequest. Our estimation shows that the data approach this limiting case. As we show below, the estimates imply an implausible realized bequest distribution. Finally, the log consumption measurement error standard deviation is estimated to be $\sigma_c = 0.526$, or 52.6%. Taken together, these estimates suggest that bequests are not that prevalent, but that for the wealthy they are a very strong motive. Public care aversion is a significant saving motive for the rest of the population.

The estimation results with only consumption data suffer from an important identification problem. While the likelihood function exhibits a maximum at the above parameter values, there is a ridge in the parameter space along which the likelihood changes very little. Figure 4 illustrates the identification problem in the estimation with only consumption data. Each panel shows the log-likelihood contours for all combinations of the parameters ϖ and C^{PC}, and for a given value for the parameter ϕ. The latter is listed in the caption of the panel alongside the maximum likelihood value for that panel. As we move across panels in the direction of increasing ϕ and C^{PC} and decreasing ϖ all the way to parameter values ($\phi = 8.2, \varpi = 68.0, C^{PC} = 4.5$), the log likelihood is essentially flat. Not only does this imply that we cannot identify the prevalence of the bequest motive, governed by ϕ, from the strength of the bequest motive, governed by ϖ, but also that we cannot identify the strength of public care aversion C^{PC}. Likelihood ratio tests confirm that we cannot distinguish a PCA of 4.5 (with $\phi = 8.2$ and $\varpi = 68.0$) from our point estimate of 2.2 at the 95% level and a PCA value of 9.0 (with $\phi = 7.4$ and $\varpi = 60.3$) from 2.2 at the 99% level. Values of 4.5 and 9 imply no particular aversion to public long-term care, in the sense that they are close to the regular subsistence level of consumption of 5.75. All savings beyond normal precautionary savings is explained by bequests. Our point estimate of 2.2, on the other hand, does imply strong aversion to public long-term care and no bequest motive for a substantial fraction of the population. Hence, there is no identification from an economic point of view. From a statistical point of view, the standard errors with only consumption are larger than those for our benchmark results reported below, in particular for the bequest parameters ϕ and ϖ. Yet, because they are calculated as second-order approximations near the maximum, the standard errors understate the actual degree of estimation uncertainty when the likelihood function is steep locally but much flatter globally. Figure 4 suggests that this is indeed the case. Thus, the main conclusion is that identification is poor with consumption data alone, even when all respondents are assumed to have common parameters.

We have used model simulations to investigate whether other variables, such as the expected consumption over the next five years or realized bequests, are helpful in recovering the true preference parameter θ. These alternatives did not solve the identification problem either. This is what led us to turn to the survey questions of Section II.D as an additional source of data that is particularly well-suited to identify motives.

B With Strategic Survey Questions

The model not only predicts an optimal consumption policy, conditional on parameters Θ and demographics Γ_i, it also predicts an optimal answer to the two survey questions spelled out in Section II.D. With the optimal policies in hand, we can formally incorporate data from these questions in the estimation.

For given parameters, the end-of-life survey question has a simple closed form answer inside the model. Its answer Z^*_{EOL} satisfies:

$$u(25) + \beta v(200 - Z^*_{EOL}) = u(C^{PC}) + \beta v(200),$$

where the left-hand side describes Scenario A, consuming \$25K and paying Z^*_{EOL} dollars from the \$200K estate for private long term care (LTC), and the right hand side describes Scenario B, leaving all \$200K as a bequest and receiving care in a government-funded facility, which gives utility $u(C^{PC})$. The value $Z^*_{EOL}(\Theta)$ makes the respondent indifferent between the two scenarios, given model parameters Θ. The optimal answer to the end-of-life question does not depend on Γ_i, because the question controls for demographics. As we did for consumption data, we model individual response data to this question as a true answer $Z^*_{EOL}(\Theta)$ plus an idiosyncratic measurement error $\varepsilon_{EOL,i} \sim iidN(0, \sigma^2_{EOL})$, as in Kimball, Sahm, and Shapiro [2007].

The solution to the lock-box question is slightly more difficult. To accommodate the scenario described, the model is modified to include funds in a bequest box (Z_B) and a LTC box (Z_{LTC}). When an agent in period t reaches the LTC health state $s = 3$ with $Z_{LTC,t} > 0$, she uses funds from the lock box to reduce her medical costs to $\max(h(3) - Z_{LTC,t}, 0)$, leaving her with $Z_{LTC,t+1} = \max(Z_{LTC,t} - h(3), 0)$ in the LTC lock-box. In other health states, the box is not used and $Z_{LTC,t+1} = Z_{LTC,t}$. The value of Z_B does not change over time and therefore does not need a time index. An agent who dies with Z_B in the bequest box and other assets b simply receives value $v(b + Z_B)$ from the total bequest. In this augmented version of the model, an agent in state X_t with money in the lock-boxes has a value function $V_t(X_t, Z_B, Z_{LTC,t})$. The respondent in the model optimally chooses the controls $(Z_B, Z_{LTC,t})$ to maximize $V_t(X_t, Z_B, Z_{LTC,t})$ subject to $Z_B + Z_{LTC} = 250$ and $Z_B, Z_{LTC,t} > 0$.[22] Again, we model the individual response data as a true answer $Z^*_{BOX}(X_{it}, \theta)$ plus an idiosyncratic measurement error $\varepsilon_{BOX,i} \sim iidN(0, \sigma^2_{BOX})$. For

[22]The lock-box question adds substantial computational burden because it has two additional state variables. We solve for the augmented value function for each X_t state on a discrete grid of (Z_B, Z_{LTC}) combinations and find the maximum value.

simplicity, we assume that the error terms on the two survey questions are uncorrelated with each other and with ε_{ci}.

Our estimation asks which parameter vector (θ, Σ), where $\Sigma = \{\sigma_c, \sigma_{EOL}, \sigma_{BOX}\}$ collects the measurement error standard deviations, most likely generated the respondents' consumption and survey answers. The likelihood function for a given respondent with demographics Γ_i is:

$$\begin{aligned}\mathcal{L}(c_i, Z_i^{EOL}, Z_i^{BOX} | \Gamma_i, \Theta, \Sigma) \quad = \quad & \frac{1}{\sigma_c}\Phi\left(\frac{\log c_i - \log c(\Gamma_i, \Theta)}{\sigma_c}\right) \times \\ & \frac{1}{\sigma_{EOL}}\Phi\left(\frac{Z_i^{EOL} - Z^{EOL}(\Theta)}{\sigma_{EOL}}\right) \times \frac{1}{\sigma_{BOX}}\Phi\left(\frac{Z_i^{BOX} - Z^{BOX}(\Gamma_i, \Theta)}{\sigma_{BOX}}\right).\end{aligned}$$

We find the maximum likelihood estimates $\hat{\theta}$ and $\hat{\Sigma}$ by maximizing

$$\sum_{i=1}^{N} \log \mathcal{L}(c_i, Z_i^{EOL}, Z_i^{BOX} | \Gamma_i, \Theta, \Sigma).$$

As before, we hold $\beta = .97$ and $\gamma = 3$ fixed, and we conduct sensitivity analysis below.

Our estimates of the key parameters of interest, using both survey questions in addition to the consumption data, are (with standard errors in parentheses): $C^f = 5.77$ (0.28), $C^{PC} = 2.80$ (0.14), $\phi = 7.28$ (0.36), and $\varpi = 47.6$ (1.5). Also, we estimate $\sigma_c = .532$ (0.017), $\sigma_{EOL} = 31.2$ (1.0), and $\sigma_{BOX} = 49.4$ (1.6). The point estimates and standard errors are summarized in the second row of Table IV. Several remarks are in order. First, the value of ϕ is considerably lower than in the estimation without survey questions (7 versus 12). This value for ϕ corresponds to the 23^{rd} percentile of our consumption distribution. Thus, we estimate that bequests are less of a luxury good once the survey data are included. The reason is that respondents throughout the consumption (and wealth) distribution indicate the importance of leaving a bequest through their survey responses. Figure 5 shows that there is little difference across wealth groups in the fraction of the \$250K locked box dedicated to long term care (*pctltc*) and the fraction of \$200K dedicated to avoid public care at the end of life (*pctpca*). Hence, our estimation suggests that the folk wisdom that bequest motives are minimal for the vast majority of households holds up only when consumption data are used in estimation. Our survey results provide no support for this view.

Second, we now estimate a smaller value for ϖ of 48. To interpret the meaning of this estimate, consider a simple special case with no discounting, no returns on assets, and no uncertainty. In such a world, consider a single retiree of age 65 with \$200K in wealth and \$30K in annual income, who will live a known 18 years, and face \$100K in long term care expenses at the end of life. With $\varpi = 40$, the optimal bequest is around \$350K or 22 years of optimal retirement consumption. This is a strong bequest motive. Third, with a more prevalent bequest motive, savings of the relatively less wealthy are partially explained through their bequest motive and we estimate a smaller desire to save in order to avoid public care, i.e., a larger value for C^{PC}. Nevertheless, its value of 2.8 suggests that publicly provided LTC has a consumption equivalent of only \$2,800 per year, which is only half the value of the estimated non-LTC consumption floor of \$5,770. It indicates strong public care aversion, consistent with the fact that 83% of our survey respondents preferred to go to a private LTC facility if the cost is a reduction in bequest of \$50K. Fourth, the measurement error standard deviation on the survey questions is relatively high because of the concentration of answers at 0% and 100% allocations (recall Figures 2 and 3). We come back to this below. Fifth, and most importantly, all parameters in θ are well identified. Figure 6 shows that the likelihood function is now much steeper in all directions. For a given ϕ, which is held fixed at a different value in each panel, we obtain a well-identified maximum in the (ϖ, C^{PC}) space. As we move across panels and consider different values of ϕ, the maximum first increases as we approach the global maximum at $\phi = 7.3$ and then decreases again. The standard error for ϕ has decreased by a factor of two compared to the estimation with consumption only and the standard error for ϖ by a factor of five. Likelihood ratio tests also confirm that the parameters are well identified. Hence, adding the strategic survey questions enables us to separately identify the bequest and public care aversion parameters of interest.

C Adding Heterogeneity

So far, we have assumed that all respondents share the same parameters θ. However, responses to the strategic survey questions display heterogeneity not captured by the model thus far. Comparing the top and bottom panels of Figure 5 shows that respondents with children dedicate a much smaller fraction of their extra resources to long term care and to the avoidance of public care than those without children, consistent with a stronger bequest motive. In this section, we estimate a version of the model that accommodates limited heterogeneity in the bequest motive along this dimension.

Specifically, we postulate that the population is made of two types that differ only in the strength of their bequest motive: $\varpi_1 > \varpi_2$. We denote the parameter vectors Θ_1 and Θ_2, in the understanding that only the value for ϖ differs. The probability that a respondent is of a particular type is modeled to depend on whether she has children through the following logit:

$$Pr(\Theta = \theta_2 | kids_i) = \frac{\exp\{\lambda_0 + \lambda_1(kids_i - \overline{kids})\}}{1 + \exp\{\lambda_0 + \lambda_1(kids_i - \overline{kids})\}}$$

Of course $Pr(\Theta = \Theta_1 | kids_i) = 1 - Pr(\Theta = \Theta_2 | kids_i)$. The parameter λ_0 controls the total fraction of people of each bequest type and λ_1 governs the change in likelihood of being in one group or the other because of having kids. We define the vector of logit coefficients $\Lambda = (\lambda_0, \lambda_1)$. In our sample of 498 singles, 70% have children. We add the $kids_i$ dummy to the list of characteristics Γ_i.

With only the consumption data, the likelihood function of a given individual respondent is:

$$\mathcal{L}(c_i|\Gamma_i, \Theta, \sigma_c, \Lambda) = \sum_{j=1,2} Pr(\theta = \Theta_j|kids_i, \Lambda)\frac{1}{\sigma_c}\Phi\left(\frac{\log c_i - \log c(\Gamma_i, \theta_j)}{\sigma_c}\right).$$

When we add the survey data, the likelihood becomes:

$$\mathcal{L}(c_i, Z_i^{EOL}, Z_i^{BOX}|\Gamma_i, \Theta, \Sigma, \Lambda) = \sum_{j=1,2} Pr(\Theta = \Theta_j|kids_i, \Lambda) \times \mathcal{L}(c_i, Z_i^{EOL}, Z_i^{BOX}|\Gamma_i, \Theta_j, \Sigma).$$

We estimate parameters by maximizing the sum of log likelihood values across all 498 single respondents.

Using only the consumption data, introducing heterogeneity does not improve the model fit in any significant way. The estimation allowing for heterogeneity continues to support a single high value for the bequest motive parameter ϖ. It simply puts all the weight on the one high value ϖ_1 and ignores the other value ϖ_2. As a result, there is no difference with the common parameter case, and there is no improvement in the likelihood function value. In other words, not only does the identification problem remain, consumption data alone provide no evidence for preference heterogeneity.

In contrast, when we add heterogeneity to the estimation with the survey questions, we obtain a large improvement in model fit. The likelihood increases by 84.3% compared to the common parameter model. A different way of quantifying the improvement is as a decline in the measurement error standard deviation. The parameter σ_{EOL} goes down by half: from 31.2 to 16.9; the other two measurement error standard deviation estimates remain about the same as in the common parameter model. A final way to quantify the improvement is to ask at what statistical significance level we can reject the null hypothesis of common parameters. We use a likelihood ratio test of the null hypothesis that $\varpi_1 = \varpi_2$ by comparing the log likelihood of the restricted and unrestricted models. Two times the change in log likelihood has a χ^2 distribution with one degree of freedom. The test statistic is 168, which has a p-value of 0.000. Hence, there is strong evidence against the null of one common bequest parameter.

The improvement in fit arises because the model is now able to better match the heterogeneity in the survey responses and in particular the differential responses of those with and without children. Of our two estimated values for the bequest motive, one is close to the previous estimate ($\varpi_1 = 47.5$) and one is substantially lower ($\varpi_2 = 8.33$). For respondents with children, we estimate a 86% probability of being the high type. For respondents without children, the probability is only 72%. The logit parameters Λ, as well as the θ parameters, are well-identified. The point estimates and standard errors are reported in the last row of Table IV. A stronger bequest motive for those with children is consistent both with intuition and with our survey response analysis of the lock-box questions (recall Figure 5). Figure 7 illustrates the improvement in the model's fit to the end-of-life survey question, which is responsible for the overall improvement in fit. The dashed line plots the model's prediction for the answer to the end-of-life question under preference heterogeneity; the solid line is for the model with homogenous bequest motive. The histogram plots the actual survey responses in our sample. The model with heterogeneity is a closer fit to the empirical distribution of the survey answers thanks to its two mass points at low and at high responses. Unlike the analysis using only the consumption data, the survey data provides strong evidence of heterogeneity in the bequest motive and, in particular, suggest differences between those with and without children.

Hurd [1987] identified similar spending patterns of otherwise similar retired households with and without children. This finding has generally been interpreted as evidence against bequest motives. While we find a similar pattern of spending in our respondents, our final estimates suggest possible differences in motivation. Those without children appear more motivated to save for precautionary reasons than for bequest reasons, relative to those with children.[23]

D Sensitivity Analysis

As a first robustness check, we repeat the estimation of the model with common preference parameters based on both consumption and survey data, but holding the risk aversion fixed at different values from their benchmark. In the model, the risk aversion coefficient γ controls both risk aversion over consumption and over bequests. We consider $\gamma = 2, 5, 10$. Rows three through five of Table IV contain the results. As risk aversion goes up, the standard precautionary savings motive goes up, ceteris paribus. As a result, the consumption floor C^f, which also affects precautionary savings, does not have to be as low. Our point estimate goes up from $C^f = 5.70$ (.37) for $\gamma = 2$ to 6.62 (.18) for $\gamma = 10$. The luxury bequest parameter ϕ remains largely unchanged, but the strength of bequest parameter ϖ decreases from 51.2 (2.5) for $\gamma = 2$ to 27.1 (1.5) for $\gamma = 10$. The marginal value of a bequest depends not only on the parameters ϖ and ϕ, but also on the risk aversion γ. When risk aversion is higher, a lower ϖ is necessary to make the same bequest strategy optimal. As risk aversion increases, C^{PC} increases from 1.43 (.05) for $\gamma = 2$ to 8.94 (.22) for $\gamma = 10$. Despite the increases in the point estimate of C^{PC}, the strength of public care aversion is about the same as for our benchmark case. As with bequests, a given PCA corresponds

[23]Stronger precautionary savings motives for those without children possibly reflects the lack of a safety net (implicit insurance) from the family. The broader question of how family relations interact with the power of bequest and precautionary motives is an interesting avenue for future research.

to a higher consumption equivalent of public long term care if the curvature parameter γ of the utility function is higher. The following equivalence calculation illustrates. Consider an agent with consumption of \$17K (the 75th percentile of our distribution) and ask how much consumption she would forgo to avoid a lottery which grants her consumption \$17K with probability 0.95 and consumption C^{PC} with probability 0.05. At our baseline estimates of risk aversion and C^{PC}, we find she would sacrifice \$6.8K. At our estimates with $\gamma = 2$, the answer is \$6.0K, at $\gamma = 5$ it is \$5.7K, and at $\gamma = 10$ it is \$8.9K. The latter number is, if anything, higher than in the benchmark, suggesting a somewhat stronger PCA motive. In conclusion, the strength of public care aversion (precautionary savings) is driven by both C^{PC} and risk aversion and is estimated to be similar for different values of risk aversion.

As a second check, we estimated the model with a lower and higher interest rate ($r = 1.02$ and 1.04) and found estimates similar to the baseline results. The results are omitted for brevity.

As a third check, we increase the out-of-pocket costs of long-term care from \$50K per year to \$70K per year to consider an expensive scenario. We recall that some of our respondents (10%) indeed estimated the cost of a private long-term care facility to be high (above \$100K per year). The sixth row of Table IV shows that our measure of public care aversion remains virtually unchanged, the bequest motive becomes slightly more prevalent, but weaker for those for whom it is operative (lower ϖ). With higher long-term care costs, the likelihood of leaving a (smaller) bequest is smaller (higher). Therefore, for the same consumption and savings data to be optimal, the bequest motive must be weaker, and this is indeed what we find.

As a final robustness check, we estimate the model using the two survey questions individually, as opposed to jointly. The results are in row seven for the lock box question and in row eight for the end-of-life question. The end-of-life question pushes our estimate for ϕ, ϖ and C^{PC} up, while the lock-box question suggests lower estimates for these parameters. This is a direct consequence of the fact that many survey respondents set aside a substantial amount of the lock box towards long-term care, more so than for the end-of-life question (See Section II D). Hence, the estimation with the lock-box question suggests stronger public care aversion than the one with the end-of-life question.

E The Distribution of Bequests

While the introduction and estimation of PCA is our main focus, our work also sheds light on the strength and prevalence of the bequest motive. In this section, we investigate whether our model implies a plausible distribution of realized bequests.

Specifically, we compare simulated bequests using our model and our 2005 sample with realized bequests from Hurd and Smith [2002], based on the AHEAD sample. In so doing, we make two adjustments necessary to make the two data samples comparable. First, we multiply the AHEAD data by 1.32 to account for inflation between 1993 and 2005. Second, we make adjustments related to cohort effects.[24] Following the research of Bosworth and Smart [2009], we conclude that because of cohort differences, our sample is 2.16 times wealthier than the AHEAD sample.[25,26]

Table V compares the simulated bequest distribution for singles in our model with the Hurd and Smith (H&S) data. The first column reports the moments of the realized bequest distribution we are studying. The second column reports the raw H&S data for singles from the AHEAD cohort. The third column adjust the H&S numbers for inflation and for cohort effects in wealth, effectively making the data comparable to the predictions from our model. The fourth column reports the model predictions for realized bequests (of singles), as implied by the benchmark parameter estimates, listed in the second row of Table IV. The fifth column reports the percentage distance between the benchmark model and the (adjusted) data.

As in the data, the model delivers a sizeable fraction of zero bequests, and a very skewed and fat-tailed distribution because of sizeable bequests by the wealthy. Thus, it captures the salient features of the observed bequest distribution. More precisely, simulations indicate that 29% of realized bequests are zero in the model, similar to the 25% in the AHEAD data. Second, the mean and median of the realized bequest distribution are about 10% higher than that in the data. Third, the model generates the right amount of skewness, as measured by the ratio of the mean to the median, which is 2.01 in the model and 2.05 in the data. Fourth, the model generates a fat right tail of the actual bequest distribution, over-predicting the 70th, 90th, and 95th percentiles by about 30%, and under-predicting bequests at the 98th percentile by about 30%. We conclude that our benchmark parameter estimates imply a reasonable description of the observed bequest distribution. They corroborate our claim that bequest motives may be more prevalent than usually thought.[27]

[24] The Hurd and Smith sample uses respondents born before 1924 and who died between 1993 and 1995. The inter-quartile range for age in our 2006 sample is age 58-68, corresponding to birth years 1938-1948. Most of our respondents are from the HRS cohort (born between 1931 and 1941) and from the two subsequent cohorts ("War Babies" 1942-1947 and 1948-1953): 35%, 29%, and 30% of the sample, respectively. Our sample has only 9 respondents (2%) from that cohort ($\geq$ 83 years old at the time of our survey in 2006).

[25] They calculate an average wealth among respondents age 60-69 in the 2003-2005 PSID (roughly the same cohort as our sample) of approximately $410,000. In the 1984 PSID, households with heads ages 60-69 (birth year 1915-1924, roughly corresponding to the AHEAD sample) had slightly less than half this amount of wealth, with mean approximately $190,000. The PSID wealth adjustment factor for the AHEAD cohort is 410/190 = 2.16.

[26] Related to this, Hurd and Smith [2002] also document that subjective bequest probabilities are much higher for the later cohorts than for the earlier ones. The increase between the 1942-1947 and the pre-1923 cohort in the subjective probability of leaving a bequest that is greater than either $10,000 or $100,000 is more than 8 percentage points: 74.6% versus 66.2% and 46.4% versus 38.3%, respectively (see their Table 4).

[27] Based on the same AHEAD data, Fink and Redaelli [2005] reach as similar conclusion: "As to the data, the overall picture is quite clear: about 50% of the population in the sample indicate to be certain to leave some bequests, which does not only show that intentional bequest motives are operative, but also that bequests matter for a significantly large part of the population." Their and our findings are also in line with McGarry [1999] and

In contrast, the model estimated from consumption data alone (using the estimates listed in the first row of Table IV) implies a realized bequest distribution that is a worse match to the observed bequest distribution than the benchmark model that adds the survey questions in estimation. Columns 6 and 7 of Table V indicate an average bequest of $382K and a median bequest of $143K, 64% and 26% higher than in the data, respectively. Furthermore, the model without survey questions implies a bequest distribution that is too skewed. It has a ratio of mean to median of 2.67 compared to 2.05 in the data. Finally, the right tail of the bequest distribution becomes too thick. The 70^{th}-95^{th} percentiles are 72-137% above the numbers observed in the data, with the 98^{th} percentile still 38% too high.

As a related check on the plausibility of the model predictions, we compare model-implied and the observed consumption and wealth profiles by cohort (see Section D.4 of the Internet Appendix). As in the data, the consumption profiles in the model simulations do not display the downward trend in consumption that would be expected in a standard life-cycle model. As in the data, we see little evidence of a run-down in wealth late in life. The model's main drawback is too much consumption and too little wealth accumulation for healthy and wealth elderly households. Several extensions of our model may be able to improve on this dimension. First, one could allow for different mortality rates at different wealth levels, as in Denardi, French, and Jones (2010). Second, one could generalize the bequest function, for example by allowing for a different curvature parameter over bequests than over consumption while alive. A lower curvature parameter over bequests would imply a stronger bequest motive for the wealthy.

IV Product Innovation in Retirement Finance

We conclude with a brief illustration of the value of our estimation exercise for product design in the market for retirement finance. As discussed in the introduction, actual take-up rates for existing annuity products are low. Both public care aversion and bequest motives may explain such low take-up. Our previous estimation quantified the importance of both motives, and hence enables a precise evaluation of the willingness to pay for new products. Given the strong public care aversion we estimated, we explore an annuity product that has additional pay-outs in the long term care (LTC) state.

The idea of an LTC-annuity combination first emerged in Pauly [1990].[28] The mechanics of the

Laitner and Ohlsson [2001].

[28]The most detailed suggestions to date for a life-annuity long term care combination product are provided in Murtaugh, Spillman and Warshawsky [2001, 2003]. The product idea is a straightforward combination of a life annuity with a disability type "pop up" benefit triggered by LTC needs. The particular product that they outline combines a lifetime immediate annuity of $1,000 (nominal) per month, with an additional payment of $2,000 monthly for annuitants with 2 activities of daily living (ADL) impairments or severe cognitive impairment, plus another $1,000 monthly if the annuitant had 4 ADL impairments. Ameriks, Caplin, Laufer, and Van Nieuwerburgh

policy are straightforward. Assuming actuarial fairness and complete information, suppose that a LTC policy paying X dollars per month in the LTC state costs Y dollars per month. Assume also a standard life annuity paying A dollars per month costs B dollars under the same assumptions. Purchasing the combination policy consists of paying B dollars to obtain a life annuity, then using Y dollars of the annuity payments to obtain LTC benefits X. Hence the combination product pays a monthly benefit of (A-Y) in non-LTC, non-death states, and (A+X) dollars in the LTC state (assuming premiums cease once the individual claims LTC benefits), and nothing at death. Furthermore, the combination product may be cheaper because it alleviates potential adverse selection problems in both the LTC and the standard annuity component: people who enter in LTC typically live less long.[29]

Figure 8 plots the willingness to pay (WTP), as a fraction of fair market value, for two annuity products. The WTP is calculated for a healthy, 62-year-old woman with annual income of \$22K and wealth of \$300K. This person roughly corresponds to the 75^{th} percentile of our respondent distribution. The first product is a standard life annuity which makes an annual (real) payment of \$5,000 (left panel). The second product is a combination policy that pays \$5,000 every year in which the buyer is alive and not in long term care (health states 1 or 2) and \$15,000 when the buyer is in the LTC state (right panel). The fair value of the combination policy is \$98.7K, while the fair value of the standard annuity is \$85.7K. All parameters are at the baseline estimates of Section B. At this baseline, we obtain a WTP of .94 for the standard annuity, recovering the lack of interest in standard annuities, but a WTP of 1.10 for the combination product. That is, this person would be willing to pay a 10% premium over the zero-load cost for the combination product. The figure further investigates how the WTP varies with the strength of public care aversion (the parameter C^{PC} is on the vertical axis) and the strength of the bequest motive (the parameter ϖ is on the horizontal axis). For the standard annuity, the WTP decreases with the bequest motive and increases with PCA (decreases with C^{PC}). It never exceeds the zero-load value of 1 over the range of parameters plotted. For the combination product, the WTP also decreases with the bequest motive and increases with PCA. In the same range of parameters, the WTP reaches 50% above the zero-load cost. Intuitively, for the retiree with no PCA, LTC insurance is undesirable because it consumes resources and delivers benefits in states that are not of great concern. However, in the neighborhood of our parameter estimates, we predict that there should be a substantial demand for LTC insurance, even if offered at loads as high as 50%. For those who dislike public long term care (or fear the depletion of their bequest), the LTC insurance component of the policy provides insurance against the risk that most strongly threatens their

[2008] calculate the value of several other products, using the estimation results of (a previous version of) this paper.

[29]Murtaugh, Spillman and Warshawsky [2001] estimate that their combination product would be roughly 3% cheaper than if the two products were purchased separately.

financial security.[30]

The clear conclusion of this exercise is that both PCA and bequest motives contribute to the lack of demand for standard annuities. Our estimation suggests that PCA is significant, resulting in considerable demand for LTC insurance products. Any attempt to bring a credible LTC insurance product to the market, either alone or coupled with an annuity, would be tremendously valuable and should receive great interest in the market.

V Conclusion

Lack of wealth decumulation and under-annuitization in retirement are two pervasive puzzles in household finance. Two potential explanations for these puzzles are bequest motives and public care aversion (PCA), the desire to avoid simultaneously running out of wealth and being in need of long term care, hence having to rely on publicly-provided long term care at the end of life. This paper develops a life-cycle model of retiree choice and identifies the importance of PCA. In order to disentangle the relative importance of the PCA and the bequest motive, we estimate our structural model of the retirement phase using a novel survey instrument. We find that PCA is a crucial driver of precautionary savings. We also find that bequest motives are more prevalent than previously thought. By formulating and estimating the structural parameters of a retirement savings model, we provide important ingredients for the design of new financial products. Our estimation results suggest a strong demand for annuity products with long term care insurance features. On the normative side, further progress in the design of new products is of high practical interest, given that 75 million baby boomers are about to retire in the US alone. On the positive side, future work could enrich the model's bequest function and mortality risk dynamics with a view towards improving the fit of consumption and wealth profiles.

[30]Such combination product should be even more valuable for couples than for the singles we considered in the estimation. Modeling the intricacies of household dynamics in the context of retirement planning is a task we leave for future research.

References

[1] Abel, Andrew B. and Warshawsky, Mark .J., 1988, "Specification of the Joy of Giving: Insights from Altruism." *The Review of Economics and Statistics*, 70(1), pp. 145-149.

[2] Altonji, Joseph G., Hayashi, Fumio and Kotlikoff, Laurence J, 1997, "Parental Altruism and Inter Vivos Transfers: Theory and Evidence." *Journal of Political Economy*, 105(6), pp. 1121-1166.

[3] Ameriks, J., A. Caplin, S. Laufer, and S. Van Niewerburgh, 2008, "Annuity Valuation Given Long-term Care Concerns and Bequest Motives."*Pension Research Council Conference Volume*, eds. Olivia Mitchell and John Ameriks, pp. 251-267.

[4] Andreoni, James, 1989, "Giving with Impure Altruism: Applications to Charity and Ricardian Equivalence." *Journal of Political Economy*, Vol. 97, pp. 1447-1458.

[5] Bajtelsmit, Vickie L., and Bernasek, Alexandra, 2001, "Risk Preferences and the Investment Decisions of Older Americans." AARP Working Paper 2001-11.

[6] Barsky, Robert, Juster, Thomas, Kimball, Miles, and Shapiro, Matthew, 1997, "Preference Parameters and Behavioral Heterogeneity: An Experimental Approach Using the Health and Retirement Survey." *Quarterly Journal of Economics*, 112, pp. 537-579.

[7] Bosworth, Barry P. and Rosana Smart, 2009, "Evaluating Micro-Survey Estimates of Wealth and Saving." Center for Retirement Research at Boston College, CRR WP 2009-4.

[8] Brown, Jeffrey and Finkelstein, Amy, 2008, "The Interaction of Public and Private Insurance: Medicaid and the Long-Term Care Insurance Market." *American Economic Review*, 98(3), pp. 1083-1102.

[9] Brunnermeier, Markus K., Papakonstantinou, Filippos and Jonathan A. Parker, 2007, "An Economic Model of The Planning Fallacy."Mimeo, Princeton University.

[10] Campbell, John, 2006 "Household Finance." *Journal of Finance*, 61(4), pp. 1553-1604.

[11] Campbell, John and Viceira, Luis, 2002, "Strategic Asset Allocation: Portfolio Choice for Long-Term Investors." Oxford University Press.

[12] Christopher D. Carroll, 2000, "Why Do the Rich Save So Much?."In Joel B. Slemrod, ed., Does Atlas Shrug? The Economic Consequences of Taxing the Rich. Harvard University Press.

[13] Cocco, Joao, Gomes, Francisco, and Maenhout, Pascal, 2005, "Consumption and Portfolio Choice over the Life-Cycle." *Review of Financial Studies*, 18(2), pp. 491-533.

[14] Congressional Budget Office, 2004, "Financing Long Term Care for the Elderly." Washington, D.C.

[15] Consumer Reports, 2003, "Do You Need Long Term Care Insurance?" Yonkers, New York.

[16] De Nardi, Mariacristina, 2004, "Wealth Distribution, Intergenerational Links, and Estate Taxation." *Review of Economic Studies*, 71(3), pp. 743-68.

[17] De Nardi, Mariacristina, French, E., and J. Jones, 2010, "Differential Mortality, Uncertain Medical Expenses, and the Saving of Elderly Singles." *Journal of Political Economy*, 118(1), pp. 39-75.

[18] Dynan, Karen; Skinner, Jonathan and Zeldes, Stephen P., 2002, "The Importance of Bequests and Life-Cycle Saving in Capital Accumulation: A New Answer." *American Economic Review, Papers and Proceedings*, pp. 274-278.

[19] Dynan, Karen; Skinner, Jonathan and Zeldes, Stephen P., 2004, "Do The Rich Save More?" *Journal of Political Economy*, vol. 112(2), pp. 397-444.

[20] Eichenbaum, Martin and Hansen, Lars P., 1990, "Estimating Models with Intertemporal Substitution Using Aggregate Time Series Data." *Journal of Business and Economic Statistics*, 8, pp. 53-69.

[21] Farhi, Emmanuel and Panageas, Stavros, 2007, "Saving and Investing for Early Retirement." *Journal of Financial Economics*, 83, pp. 87-122.

[22] Fink, Gunter and Redaelli, Silvia 2005, "Understanding Bequest Motives An Empirical Analysis of Intergenerational Transfers." *DNB Working Paper*, No 42.

[23] French, E., and J. Jones, 2004, "On the Distribution and Dynamics of Health Care Costs." *Journal of Applied Econometrics*, vol. 19, 705-721.

[24] Gomes, Francisco, Kotlikoff, Lawrence, and Viceira, Luis, 2007 ,"Optimal Life-Cycle Investing with Flexible Labor Supply: A Welfare Analysis of Default Investment Choices in Defined-Contribution Pension Plans." Working Paper Harvard Business School.

[25] Gomes, Francisco, and Michaelides, Alex, 2005, "Optimal Life-Cycle Asset Allocation: Understanding the Empirical Evidence." *Journal of Finance*, 60(2), pp. 869-904.

[26] Gourinchas Pierre-Olivier and Parker, Jonathan A., 2002, "Consumption Over the Life Cycle." *Econometrica*, 70(1), pp. 47-89.

[27] Hansen, Lars P. and Singleton, Kenneth, 1983, "Stochastic Consumption, Risk Aversion, and the Temporal Behavior of Asset Returns." *Journal of Political Economy*, 91, pp. 249-265.

[28] Hénin, Pierre-Yves and Thomas Weitzenblum, 2003, "Redistribution through alternative pension reforms : A life-cycle analysis on French occupational groups." CEPREMAP Working Paper 307.

[29] Holland, Daniel, 1969, "The Effect of Taxation on Effort: Some Results for Business Executives." In Proceedings of the 62nd Annual Conference of the National Tax Association, Boston, MA: pp. 428-517.

[30] Hurd, Michael D., 1987, "Savings of the Elderly and Desired Bequests." *American Economic Review*, 77 (3), pp. 298-312.

[31] Hurd, Michael and Smith, James , 2002, "Expected Bequests and Their Distribution." RAND Working Paper, July.

[32] Kimball, Miles S. and Shapiro, Matthew D., 2003, "Labor Supply: Are Income and Substitution Effects Both Large or Both Small?" mimeo., University of Michigan.

[33] Kimball, Miles S., Sahm C. and Shapiro, Matthew D., 2007, "Imputing Risk Tolerance from Survey Responses."NBER Working Paper 13337, Cambridge, MA.

[34] Koijen, Ralph, 2008, "The Cross-section of Managerial Ability and Risk Preferences." Working Paper New York University Stern School of Business.

[35] Koijen, Ralph, Nijman, Theo, and Werker, Bas, 2009, "Optimal Annuity Risk Management." , *The Review of Finance*, forthcoming.

[36] Kopczuk, Wojciech and Lupton, Joseph P., 2007, "To Leave or Not To Leave: The Distribution of Bequest Motives.", *The Review of Economic Studies*, 74(1), 207-235.

[37] Krueger D. and Perri, F., 2005, "Does Income Inequality Lead to Consumption Inequality? Evidence and Theory" *Review of Economic Studies*, vol. 73, pp. 163-193.

[38] Laitner, J., and Ohlsson, H., 2001, "Bequest Motives: A Comparison of Sweden and the United States." *Journal of Public Finance*, 79, pp. 205-236.

[39] Ljungqvist, Lars, 1993, "A Unified Approach to Measures of Privacy in Randomized Response Models: A Utilitarian Perspective", *Journal of the American Statistical Association*, Vol. 88, No. 421, pp. 97-103.

[40] Lopes, Paula and Michaelides, Alex, 2007, "Rare Events and Annuity Market Participation." *Finance Research Letters*, 4(2), pp. 82-91.

[41] McGarry, Kathleen, 1999, "Inter Vivos Transfers and Intended Bequests." *Journal of Public Economics*, 73(3), 321-51.

[42] MetLife Mature Market Institute, 2006, "MetLife Market Survey of Nursing Home and Home Care Costs 2006." Westport, CT.

[43] Morin, R.A. and Suarez A.F, 1983, "Risk Aversion Revisited." *Journal of Finance*, 38(4), pp. 1201-1216.

[44] Murtaugh, C., Spillman, B., and Warshawsky, M, 2001, "In sickness and in health: An annuity approach to financing long-term care and retirement income." *The Journal of Risk and Insurance*, 68(2), pp. 225-253.

[45] Murtaugh, C.M. Spillman, B.C., Warshawsky, M.J., 2003, "Policy Implications of an Annuity Approach to Integrating Long-Term Care Financing and Retirement Income." *Journal of Aging and Health*, 15(1), pp. 45-73.

[46] National Center for Health Statistics, 2002. Health, United States, 2002 with Chartbook on Trends in the Health of Americans. Hyattsville, Maryland.

[47] National Center for Health Statistics, 2006. Health, United States, 2004 with Chartbook on Trends in the Health of Americans. Hyattsville, Maryland.

[48] Pauly, Mark, 1990, "The Rational Nonpurchase of Long-Term-Care Insurance. " *Journal of Political Economy*, 98(1), pp. 153-168.

[49] Polkovnichenko, Valery, 2006, "Life Cycle Portfolio Choice with Additive Habit Formation Preferences and Uninsurable Labor Income Risk." *Review of Financial Studies*, Forthcoming.

[50] Robinson, James, 2002, "A Long Term Care Status Transition Model." Mimeo., University of Wisconsin, Madison.

[51] Shiller, Robert, 2006, "Irrational Exuberance." Princeton University Press.

[52] Stewart, Susan T. , 2004, "Do Out-of-Pocket Health Expenditures Rise With Age Among Older Americans?" The Gerontologist, Vol. 44, pp. 48-57.

[53] Venti, Steven, and Wise, David, 1990, "But They Don't Want to Reduce Housing Equity, *Issues in the Economics of Aging*, University of Chicago Press

[54] Walker, Lina , 2004, "Elderly Households and Housing Wealth: Do They Use It or Lose It?" Working Paper 070, Michigan Retirement Research Center , University of Michigan.

[55] Wang, Hui and Sherman, Hanna, 1997, "Does Risk Tolerance Decrease With Age?" Association for Financial Counseling and Planning Education, Vol. 8, No. 2.

[56] Yaari, Menahem E., 1965, "Uncertain Lifetime, Life Insurance, and the Theory of the Consumer." *Review of Economic Studies*, 32(2), pp. 137-150.

[57] Yogo, Motohiro, 2006, "A Consumption-Based Explanation of Expected Stock Returns." *Journal of Finance*, 61(2), pp. 539-580.

[58] Yogo, Motohiro, 2009, "Portfolio Choice in Retirement: Health Risk and the Demand for Annuities, Housing, and Risky Assets." Working Paper Wharton School of Business.

A Bequest Motive

To understand the motivation for our choice of $v(b)$, consider a simple model in which an agent starts with wealth X dollars at retirement. there is no uncertainty with respect to health nor mortality: the agent is in good health with zero medical expenses for exactly n years and then dies. The real rate of return on wealth is zero and labor income is zero. In each year of life, the agent consumes c dollars, deriving annual utility $u(c) = c^{1-\gamma}/(1-\gamma)$. Upon death, the agent bequeaths the remaining $b = X - nc$, receiving the utility specified by equation (3). The agent's problem is to choose the optimal annual consumption level c that maximizes total utility. The first-order condition shows that the solution is to choose an annual consumption c^* such that bequest satisfies $b^* \equiv X - nc^* = \varpi(c^* - \phi)$. In other words, the agent leaves an inheritance to cover ϖ years of spending at an annual expenditure level $(c^* - \phi)$, the amount by which his own optimal annual consumption exceeds the threshold ϕ. If X is insufficient to allow the agent to consume more than ϕ dollars each year, no bequest is left.

B Health Transition Calibration

The distribution of medical costs in our model is controlled by the medical costs associated to each health state and by the one-period 4×4 state transition matrix $\mathcal{P}(a)$, where a denotes age in excess of 62. This matrix is parameterized by twelve parameters, nine that determine the value of $\mathcal{P}(0)$ (of the sixteen elements, four are fixed by the death state being absorbing and there are three further restrictions so that each row sums to one) and three that control the flow of probability from greater health to poorer health as age increases. We calibrate these 12 parameters to match 8 moments related to long term care utilization and 4 moments related to longevity. Table I in the main text shows the moments we match, their target value, and our best fit. The last 4 rows show some features of the distribution of medical costs. More precisely, the 1-period ahead transition matrix at age $62 + a$ is given by $\mathcal{P}(a) =$

$$\begin{bmatrix} p_{11} & p_{12} & p_{13} & 1-p_{11}-p_{12}-p_{13} \\ p_{21} & p_{22} & p_{23} & 1-p_{21}-p_{22}-p_{23} \\ p_{31} & p_{32} & p_{33} & 1-p_{31}-p_{32}-p_{33} \\ 0 & 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} 1-c_1a^e & c_1a^e\left(\frac{c_2c_3}{1+c_2+c_3c_2}\right) & c_1a^e\left(\frac{c_3}{1+c_2+c_3c_2}\right) & c_1a^e\left(\frac{1}{1+c_2+c_3c_2}\right) \\ 0 & 1-c_1a^e & c_1a^e\left(\frac{c_2}{1+c_2}\right) & c_1a^e\left(\frac{1}{1+c_2}\right) \\ 0 & 0 & 1-c_1a^e & c_1a^e \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

The second matrix is the age-adjustment. It shifts probability mass from the left (better health states) towards the right (worse health states and death), relative to the transition matrix at age 62, $\mathcal{P}(0)$. The 3 parameters c_1, c_2, and c_3 control how fast this shifting occurs. Loosely speaking, the parameter c_1 controls the transition from LTC to death as age increases; c_2 determines how much more likely death is relative to LTC when in health state 1 or 2, and c_3 determines how much likely state 2 is when in good health. The exponent e allows for faster than linear probability shifting as the agent becomes older. It is held fixed at $e = 1.5$. We note that there is no unique solution to the system of 12 equation and 12 parameters because the system is highly non-linear. We use a non-linear least-squares procedure to obtain the best fit. For males, we find the following transition probabilities (multiplied by 100): $p_{11} = 96.3945$, $p_{12} = 3.3547$, $p_{13} = .0020$, $p_{14} = 0.2489$, $p_{21} = 33.6005$, $p_{22} = 56.0655$, $p_{23} = 6.5959$, $p_{24} = 3.7381$, $p_{31} = 2.4812$, $p_{32} = 13.6231$, $p_{33} = 74.6274$, $p_{34} = 9.2683$, and scale parameters $c_1 = .001441$, $c_2 = .8966$, and $c_3 = .5643$. For females, we use the following transition probabilities (multiplied by 100): $p_{11} = 97.219$, $p_{12} = 2.778$, $p_{13} = 0.003$, $p_{14} = 0.000$, $p_{21} = 34.0$, $p_{22} = 56.0$, $p_{23} = 6.0$, $p_{24} = 4.0$, $p_{31} = 0.5$, $p_{32} = 12.0$, $p_{33} = 85.0$, $p_{34} = 2.5$, and scale parameters $c_1 = .001347$, $c_2 = 1.3$, and $c_3 = 1.1$. To scale the moments to the same units, and to attach more importance to matching some moments than others, we use the following weights on the 12 moments: 100, 5, 10, 100, 100, 100, 100, 1, 4, 5, 6, and 7. Finally, since the data on LTC usage pertain to individuals 62 or older, we assume that the health status stays constant for individuals aged 55-62.

C Additional Testable Implications

In this appendix, we compare several other quantitative predictions of our model to the data: average and extreme medical expenditures and public long term care usage. A related discussion on realized bequests is located in Section E. To compute these statistics in the model, we take all the single respondents in our survey who are younger than 62, and record their reported health state, income, and wealth. We then simulate 250 sample paths for each one, where sample paths differ by the realized health shocks (including mortality). The simulation uses the parameter estimates of the model with common parameters where consumption and survey data are used; see Section III.B.

A Medical Expenditures

Average Spending First, we compute out-of-pocket (OOP) medical expenditures in the model simulation, averaged by age and income groups among those that are alive. These are actually incurred health costs, i.e., OOP medical expenditures of those not declaring bankruptcy and not going on public long term care (Medicaid). Panel A of Table VI tabulates this average OOP spending. The model predicts medical expenses that rise with age, and much more so in the higher income percentiles. The difference in medical spending between the high- and low-income groups is a result of the poor being more likely to go bankrupt when hit by a health shock. They then rely on publicly-provided medical care rather than paying expenses out-of-pocket. Most of the increase in out-of-pocket medical spending by age arises from the increased likelihood of long term care (LTC, health state 3). But there is also a slight increase in the likelihood of being in the poor health state (state 2) by age. This is consistent with the conclusion of Stewart [2004], who shows that out-of-pocket medical expenses increase only slightly in age when LTC expenditures are excluded, but increase dramatically once LTC is included.

In more detail, we find that average medical expenses start around \$3.7K at age 65, climb to \$4.4K by age 75, to \$8.0K at 85, and to \$11.8K at 95. If we exclude all LTC expenses, the corresponding numbers at age 65,75,85, and 95 are \$2.6K, \$1.9K, \$2.5K and \$3.2K. Overall, for the entire population over 65, the mean annual cost is \$5.5K with LTC expenses and \$2.1K without them. The out-of-pocket expenses conditional on age are similar for men and women (not reported), consistent with the findings of French and Jones [2004].

Based on data from waves 2 through 5 of the Health and Retirement Survey (HRS), French and Jones [2004] report average annual expenses of \$2.8K for those over 65 in 2000. Since these surveys start out with a sample of the non-institutionalized population in wave 1, their waves 2 through 5 contain some but far from all LTC expenses. Even wave 5 has an average number of nights per year in nursing homes that is still 22% below the nationwide average. Hence, the \$2.8K average expense they find is slightly above the actual non-LTC average expense. In fact, our health costs in states 1 and 2 were calibrated to match a \$2K average non-LTC cost, which is the HRS average for single households. Our health costs in the LTC state 3 were calibrated to match the observed out-of-pocket costs of a semi-private room in a nursing home in 2005. To further compare model to data, we collected data from the 2004 HRS (wave 5) ourselves. We sorted the 10,039 respondents into six income groups and four age groups (5-year buckets centered around ages 65, 75, 85, and 95) and calculated average OOP medical expenses for each cell. They are reported in the right columns of Panel A in Table VI. The income group cutoffs in the model are set equal to those in the data. The magnitudes and age/income patterns are broadly consistent between model and data. The model has slightly higher expenditures because we have a smaller fraction of respondents below age 65 that report being in good health than in the population at large. We also have slightly higher expenditures at age 85, presumably because the HRS misses a fair share of LTC costs especially for this age group. Finally, we generate about the right medical expenditures at age 95. We conclude that our (simple) model does a good job matching observed average out-of-pocket medical expenses.

Catastrophic Expenditures An interesting question is whether the model generates the right amount of out-of-pocket medical expense *risk*. One important feature of that risk is the probability of a disastrous health outcome. Underestimating such tail risk may lead the model to underestimate the strength of the precautionary savings motive (and overestimate the strength of the bequest motive). We show that this is not the case for our calibration. To quantify the tail risk, we calculate the present discounted value of future out-of-pocket medical expenses at age 62, based on the same simulation used to compute average expenditures. Following French and Jones [2004], we use a 3% discount rate and take into account survival when discounting. For men, our model generates a median out-of-pocket cost of $36.3K and a mean cost of $58.2K. In the right tail, 43% of men incur expenses over $43.5K, 12% over $125K, and 2% over $250K. For women, our model generates a median out-of-pocket cost of $46.2K and a mean cost of $74.8K. In the right tail, 53% of women incur a lifetime discounted health shock over $43.5K, 18% over $125K, and 4% over $250K. These numbers make clear that agents in our model face enormous OOP medical expense tail risk. Our estimates are so high because the tail events typically involve long spells of LTC.

B Medicaid Utilization Rates

Consistent with the rules on Medicaid utilization in the US, the model assumes that only households who have run out of resources can use Medicaid to pay for long term care. Using the same model simulation as for the calculation of average medical expenses, Panel B of Table VI reports public care utilization rates implied by our benchmark model. The model generates a concentration of utilization in the lowest income groups and an increasing pattern with age.

To compare model to data, we again use the HRS to study Medicaid utilization rates for LTC. In particular, we calculate the fraction of respondents that have Medicaid and received either nursing home care or home care in the previous two years. The fraction of those in the overall sample is 3.2%. The right columns of that same Panel B show the Medicaid utilization rates in the HRS data. In the lowest income group, where the bulk of the Medicaid-paid long term care use is concentrated, we find utilization rates of 11% at age 65, 14% at age 75, 23% at age 85, and 32% at age 95.

Medicaid utilization rates for this group in the model are several percentage points lower than the data at each age but rise with age at the same rate. The model's utilization rates in this lowest group are: 4% at age 65, 7% at age 75, 15% at age 85, and 25% at age 95. The model's predictions for utilization in the next lowest income group are in good agreement with the data. At higher incomes, the decreasing rate of Medicaid utilization with income is somewhat slower in the model than in the data.

Finally, the 2003 Medicare Current Beneficiary Survey shows that 44.7% of the $86 billion in aggregate LTC expenses in 2003 were paid for by Medicaid. In our model simulation, Medicaid covers 41% of all LTC costs. We conclude that the model implies public long term care usage that fits the data well.

Table I: Calibration of Health Transition Probability Matrix

The first column shows the moment, the second column the target from the data, and the last column shows our calibrated value at the chosen parameters. The first 8 moments capture aspects related to long term care (LTC); the data are from Brown and Finkelstein [2008] Table 1 for males and females. The next 4 moments relate to longevity; the data are from the National Center for Health Statistics, Vital Statistics (2006), Table 2 for males and table 3 for females (2003 Life Tables). The last 5 moments show features of the distribution of medical costs in thousands of dollars ($\$K$). They are cross-sectional moments of the life-time present discounted medical expenses, calculated using a 3% discount rate which takes into account the mortality dynamics. These are total medical expenses, regardless of whether they are paid out-of-pocket by the household or by the government. These moments of medical expenses are not used in the calibration. All moments for the model are obtained from simulating 100,000 men and 100,000 women, in good health, from age 62 onward, for a maximum number of 39 years. Details of the calibration exercise are in Appendix B.

	Moment	Males		Females	
	long term care	Data	Calibration	Data	Calibration
1	Probability ever use LTC (%)	40.0	38.9	54.0	52.3
2	Average age of first use (among users)	80.0	78.2	82.0	80.1
3	Cond. Avg. years spent in care	2.9	3.4	4.2	4.6
4	Cond. Prob. use more than 1 year (%)	77.0	72.5	85.0	80.3
5	Cond. Prob. use more than 3 year (%)	37.0	36.6	53.0	50.3
6	Cond. Prob. use more than 5 year (%)	17.0	18.0	31.0	30.8
7	Cond. Prob. ever exit to non-death state (%)	33.0	35.4	35.0	34.8
8	Cond. Avg. number of spells	1.2	1.2	1.3	1.2
	Longevity				
9	Life expectancy at age 62	18.9	18.3	22.1	22.0
10	Life expectancy at age 75	10.5	9.9	12.6	12.4
11	Life expectancy at age 85	6.0	6.0	7.2	7.4
12	Life expectancy at age 95	3.2	3.2	3.7	3.7
	Present Discounted Medical Expenses				
13	mean lifetime medical expenses ($K)		64.5		96.6
14	Median lifetime medical expenses ($K)		32.3		54.4
15	Prob lifetime medical expenses > $50K (%)		38.1		52.2
16	Prob lifetime medical expenses > $100K (%)		21.2		33.5
17	Prob lifetime medical expenses > $250K (%)		3.8		9.2

Table II: Summary Statistics

The left panel contains summary statistics for the 498 single retirees from our 2006 survey. The right panel contains statistics from the 2004 Survey of Consumer Finance. In the SCF we selected a sample of singles that satisfies the same pre-screening criteria as our own sample: we exclude respondents below the age of 54, those who work full-time or expect to work full-time, with income from work above $25K, and with children at home. This guarantees we are comparing mostly retirees to a sample of mostly retirees. The resulting SCF sample consists of 887 individuals. The summary statistics are computed using the SCF weighting scheme. In Panel F, starred items are computed from 4107 observations of 1943 single respondents from the Consumer Expenditure Survey (CEX) who meet the same selection criteria as described above. We use the 2003-04 data from Krueger and Perri [2005].

	Moment	**Our 2006 Survey**					**SCF/CEX 2004**				
	Percentile:	5	25	50	75	95	5	25	50	75	95
A: Demographics											
	Age	55	58	63	68	76	58	66	75	81	89
	Number of children	0	0	2	4	5+	0	1	2	3	7
	Number of grandchildren	0	0	2	6	10+					
B: Wealth	(× $1000)										
	Retirement assets	0	0	0	44	300	0	0	0	4	100
	Liquid financial assets	0	0	3	52	301	0	1	12	89	531
	Primary home	0	0	60	155	379	0	0	76	150	450
	Other assets	0	1	10	30	275	0	2	4	14	233
	Total assets	0	10	109	323	1,035	0	29	125	335	1,171
C: Debt	(× $1000)										
	Primary mortgage	0	0	0	2	82	0	0	0	0	69
	Credit card	0	0	0	2	13	0	0	0	0	6
	Other debt	0	0	0	1	11	0	0	0	0	16
	Total liabilities	0	0	2	20	97	0	0	0	5	87
D: Net Worth	(× $1000)										
	Home equity	0	0	39	125	364	0	0	62	150	400
	Total net worth	-6	5	88	290	1,005	0	25	116	306	1,154
E: Income	(× $1000)										
	Labor income	0	0	7	14	22	0	0	0	0	8
	Retirement income	0	8	12	16	39	0	9	13	23	42
	Total income	3	10	16	24	41	5	10	14	24	44
	After-tax income	2	10	16	24	39					
F: Spending	(× $1000)										
	Total spending *	5	10	14	20	45	5	9	13	20	46
	Mortgage Debt	0	0	0	3	11	0	0	0	0	7
	Maintenance and Rent *	0	1	3	5	10	0	1	2	4	9
	Durables *	0	0	0	1	5	0	0	0	0	5
	Health	0	0	0	1	6					
	Income Taxes	0	0	0	1	5					
	Living expenses	1	3	6	10	20					
	Housing consumption *	1	3	5	7	15	2	5	8	10	15
	NDS consumption *	4	8	11	17	38	3	5	8	12	23
	Total consumption *	5	9	13	19	42	6	12	18	25	46

Table III: Wealth, Income, and Consumption By Age Group

This column reports wealth, income, and consumption for singles in five age groups, which are listed in the first column. Wealth is measured as net worth, income is measured as total before-tax income, and consumption is measured as total expenditures. See the mein text for definitions. The second column reports the number of observations in each age group for our 2006 survey. Columns 3-7 report the fifth, twenty-fifth, fiftieth, seventy-fifth, and ninety-fifth percentile of the wealth, income, or consumption distribution in our sample. Columns 8-12 report the corresponding moments in the 2004 Survey of Consumer Finance (SCF) or 2003-04 Consumption Expenditure Survey (CEX). Selection criteria for the SCF and CEX samples are described in Table II in the main text.

Age	[observ.]	5	25	50	75	95	5	25	50	75	95
	Panel A1: Wealth in our survey						**Panel A2: Wealth in SCF**				
54-59	[177]	-9	2	55	266	1,092	-1	1	8	182	971
60-64	[116]	-5	3	104	327	825	-1	9	125	320	1,880
65-69	[108]	-8	5	70	315	979	-2	5	70	344	1,039
70-74	[58]	-6	41	126	333	1,315	2	50	115	381	1,325
>74	[39]	-3	10	226	360	1,405	0	36	135	281	1,083
	Panel B1: Income in our survey						**Panel B2: Income in SCF**				
54-59	[177]	0	8	14	21	35	5	7	10	16	73
60-64	[116]	5	12	18	25	50	0	8	14	24	42
65-69	[108]	5	11	16	24	39	7	9	14	25	50
70-74	[58]	10	14	19	29	62	7	11	18	30	60
>74	[39]	10	13	16	24	50	6	11	15	22	40
	Panel C1: Consumption in our survey						**Panel C2: Consumption in CEX**				
54-59	[177]	5	9	13	18	38	5	9	15	24	48
60-64	[116]	4	9	14	22	42	6	9	14	21	53
65-69	[108]	5	9	13	21	48	5	9	14	21	59
70-74	[58]	6	10	16	25	60	5	10	14	22	50
>74	[39]	10	13	17	24	50	5	8	12	18	40

Table IV: Summary Table of Estimates

The table reports maximum likelihood estimates of the structural parameters of the model under different specifications. Asymptotic standard errors are in parentheses, next to the point estimate. The first row uses only consumption data in the estimation. All other rows use both consumption and survey data in estimation. The second row is our benchmark estimation. Rows three through eight report sensitivity analysis. The last row reports the heterogeneity case, where the bequest motive takes on one of two values.

	C^f	ϕ	ϖ	C^{PC}	σ_c	σ_{BOX}	σ_{EOL}
Cons. only	5.75 (.29)	12.06 (.65)	93.7 (7.4)	2.20 (.12)	.526 (.017)		
Benchmark	**5.77 (.28)**	**7.28 (.36)**	**47.6 (1.5)**	**2.80 (.14)**	**.532 (.017)**	**49.4 (1.6)**	**31.2 (1.0)**
$\gamma = 2$	5.70 (.37)	7.34 (.21)	51.2 (2.5)	1.43 (.05)	.535 (.017)	51.4 (1.6)	31.2 (1.0)
$\gamma = 5$	4.63 (.15)	7.55 (.30)	32.3 (1.8)	5.64 (.29)	.553 (.018)	44.7 (1.4)	31.2 (1.0)
$\gamma = 10$	6.62 (.18)	7.69 (.32)	27.1 (1.5)	8.94 (.22)	.542 (.017)	41.3 (1.3)	31.1 (1.0)
LTC=70k	5.41 (.38)	5.87 (.42)	28.2 (1.7)	3.06 (.15)	.547 (.018)	46.7 (1.6)	31.4 (1.0)
Lock-Box only	5.81 (.30)	5.10 (.20)	19.7 (0.8)	2.32 (.08)	.568 (.018)	43.1 (1.4)	
EOL only	5.70 (.30)	8.67 (.27)	69.4 (3.3)	3.16 (.11)	.528 (.017)		31.2 (1.0)
	C^f	ϕ	ϖ_1	C^{PC}	σ_c	σ_{BOX}	σ_{EOL}
Heterogeneity	5.75 (.28)	6.69 (.28)	47.5 (2.7)	3.46 (.12)	.554 (.018)	48.9 (1.5)	16.9 (.59)
			ϖ_2		λ_0	λ_1	
			8.33 (.31)		1.53 (.13)	.86 (.25)	

Table V: Implications for the Realized Bequest Distribution

The first column reports the moments of the realized bequest distribution we are studying. The second column reports the raw Hurd and Smith (2002) data for singles from the AHEAD cohort (H&S). The third column adjust the H&S numbers for inflation and for cohort effects in wealth, effectively making the data comparable to our model. The inflation adjustment factor is 1.32 and the cohort adjustment factor for wealth is 410/190=2.16. The fourth column reports the model predictions for realized bequests for singles (our model is only for singles), as implied by the benchmark parameter estimates listed in the second row of Table III. The fifth column reports the percentage distance between the benchmark model and the (adjusted) data. The sixth column report the realized bequests from the model estimated on consumption data only; the estimates are listed in the first row of Table III. The seventh column reports the percentage distance between the consumption-only model and (adjusted) data.

moment	Data Raw	Data Adjusted	Model Benchmark	Model - Data %error	Model Cons only	Model - Data %error
mean	82	234	257	10%	382	64%
median	40	114	128	12%	143	26%
70	80	228	310	36%	391	72%
90	188	536	688	28%	1166	118%
95	250	712	955	34%	1686	137%
98	600	1709	1238	-28%	2350	38%

Table VI: Additional Testable Implications

Panel A reports average out-of-pocket (OOP) medical expenses in thousands of dollars and Panel B reports public long term care (Medicaid) utilization rates. The left columns report the values that arise from simulating the model under the benchmark parametrization. In particular, for each respondent under age 62 in our sample, we simulate 250 sample paths with randomly drawn health shocks. We start of each respondent with his or her reported income, wealth, and health status. For each sample path, we keep track of OOP medical expenses and Medicaid usage, defined as being in the LTC state and unable to afford private LTC. The right columns report the values for the data. The data are from wave 5 (2004) of the Health and Retirement Survey. The population of respondents include those who answered either Yes or No for having Medicaid Insurance with non-missing household income in 2000. Using LTC is defined as having used nursing home care or home care in the previous two years. The income cutoffs that define the income percentiles are the same in model and data.

	Panel A: Average OOP Medical Expenses ($1000)											
	Model						*Data*					
Income %	<10	10-30	30-50	50-70	70-90	>90	<10	10-30	30-50	50-70	70-90	>90
Age 65	2.7	3.5	4.2	5.0	3.5	1.5	1.6	2.1	2.2	2.2	2.1	2.7
Age 75	2.2	3.9	5.1	6.3	6.6	5.6	1.2	2.8	2.4	2.5	3.1	3.1
Age 85	3.1	7.1	10.4	11.0	10.6	13.9	2.7	3.9	3.4	4.7	5.0	7.3
Age 95	3.7	10.3	15.9	17.8	16.9	14.6	4.7	11.3	13.0	29.9	18.7	3.0
	Panel B: Medicaid Usage											
	Model						*Data*					
Age 65	4.3	3.5	1.6	.1	.0	.0	11.0	2.9	.4	.2	.1	.2
Age 75	7.1	5.3	2.0	.5	.0	.0	13.9	5.0	.4	.5	.5	.0
Age 85	14.7	9.0	2.6	.4	.0	.0	22.9	5.6	2.1	.0	.0	.0
Age 95	25.3	14.8	3.9	.3	.0	.0	32.1	15.2	1.1	.0	.0	.0

Figure 1: Middle Class Precautionary Savings

The figure plots the savings rate, defined as consumption over income (on the vertical axis) against income (on the horizontal axis). The figure is for a hypothetical single female, age 62, in good health. As we vary income, we simultaneously vary wealth, to capture the positive cross-sectional correlation between income and wealth. The various lines are for different public care aversion parameters, C^{PC}, with the strongest precautionary motive being the highest line.

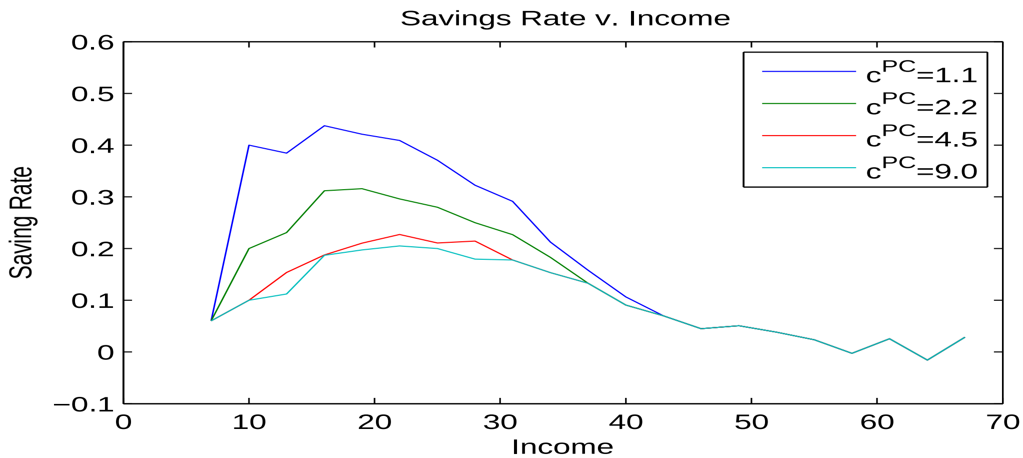

Figure 2: Trading off Long-Term Care and Bequests at the Current Moment

The figure shows a histogram of responses to survey question 18b. The question asks what fraction of $250K prize the respondent would devote to a lock LTC box. The complementary fraction would go to the bequest box. The sample consists of all 498 single respondents.

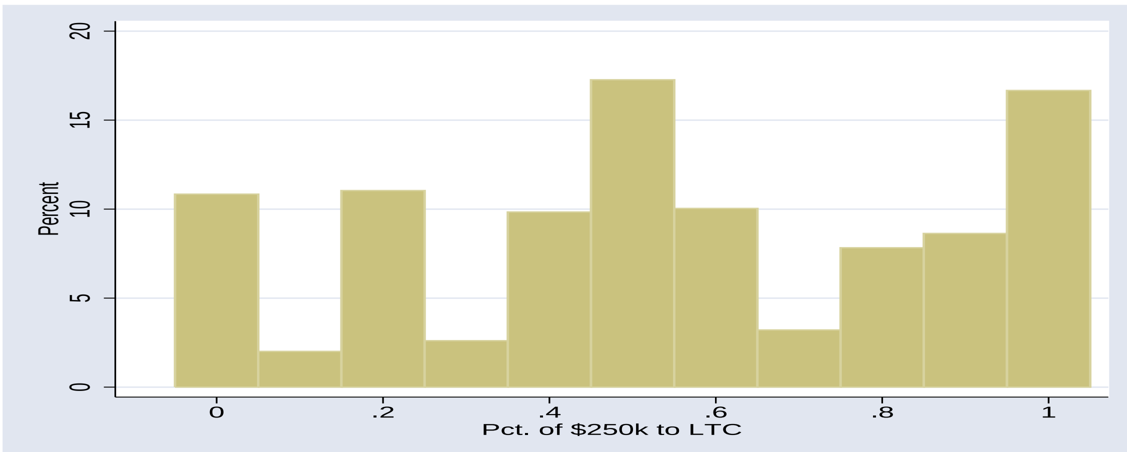

Figure 3: Trading off Long-Term Care and Bequests at the End-of-Life

This graph shows a histogram of responses to survey question 20b. The question asks what fraction of $200K in remaining wealth the respondent would forgo to avoid government-funded long term care (LTC) when LTC in his/her last year of life were unavoidable. The figure plots the answers for the 421 single respondents (out of a total of 498) who indicate that they prefer private LTC to Medicaid in a preliminary qualitative question.

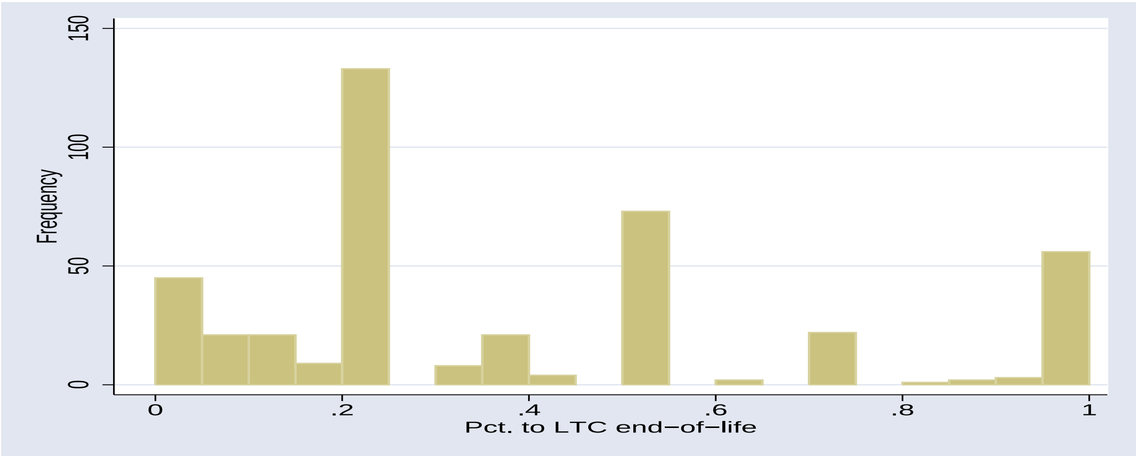

Figure 4: Likelihood Function with Consumption Data Alone

This figure plots likelihood function contours in (ϖ, C^{PC}) space. Each panel is drawn for a different value of ϕ, mentioned in the caption of each panel. That same caption also states the maximum likelihood value and the point estimates for which that maximum value is achieved. Only consumption data are used in the estimation. The sample is all 498 single respondents.

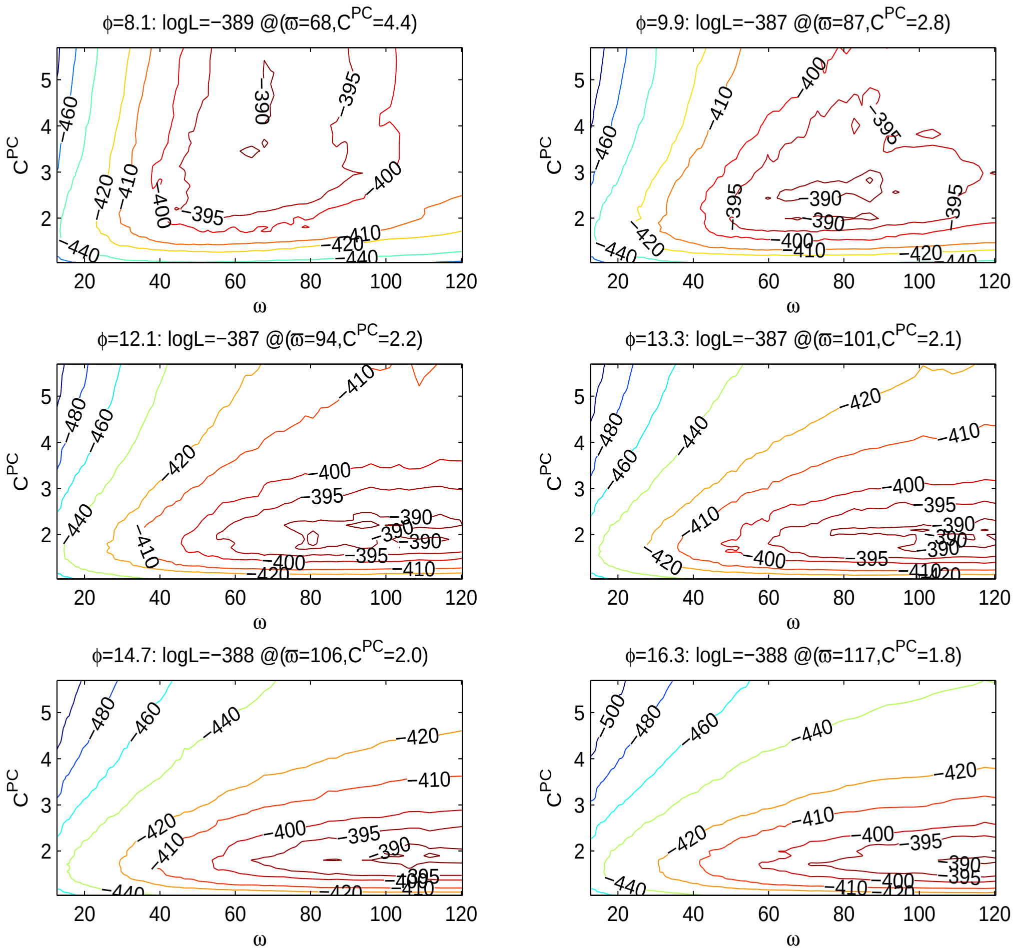

Figure 5: Survey Questions for Single Respondents

This figure plots the survey answers to the locked-box question (pctltc) and the end-of-life question (pcpca) by net worth decile (from low wealth on the left to high wealth on the right). The variable *pctltc* measures the fraction of the $250K locked box dedicated to long term care and the variable *pctpca* the fraction of $200K dedicated to avoid public care at the end of life. The net worth deciles are the same in both panels and the decile cutoffs are based on all 498 singles. The first panel is for those with children (347), the second panel for those without children (151). The singles without children tend to be wealthier on average, so that relatively more of them are present in the higher wealth deciles.

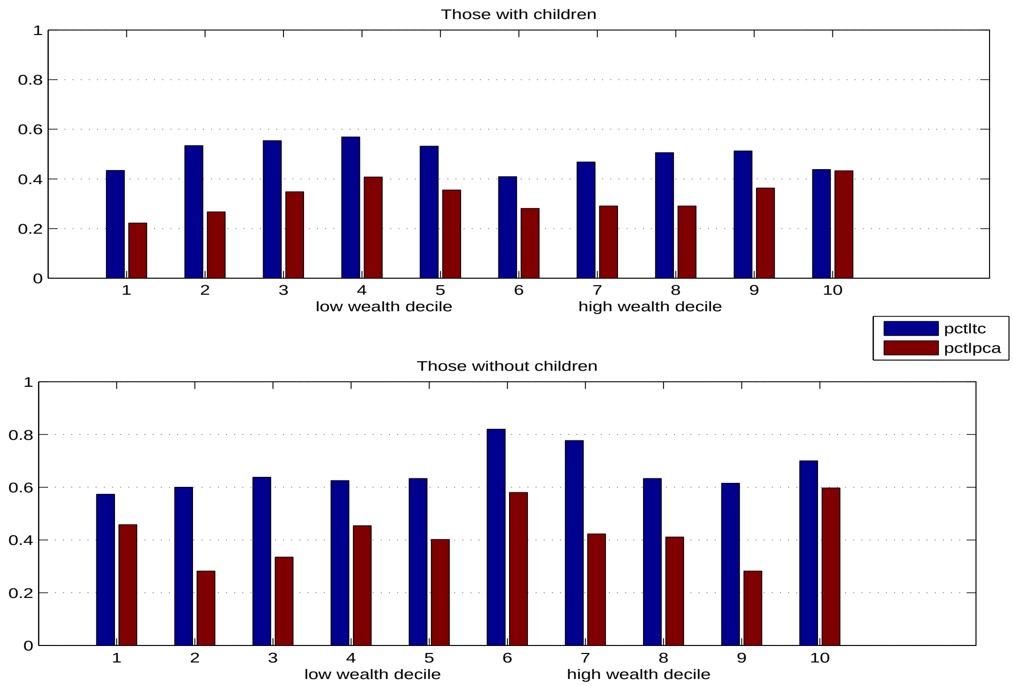

Figure 6: No more Identification Problem with Strategic Survey Questions

This figure plots likelihood function contours in (ϖ, C^{PC}) space. Each panel is drawn for a different value of ϕ, mentioned in the caption of each panel. That same caption also states the maximum likelihood value and the point estimates for which that maximum value is achieved. Both consumption and survey response data are used.

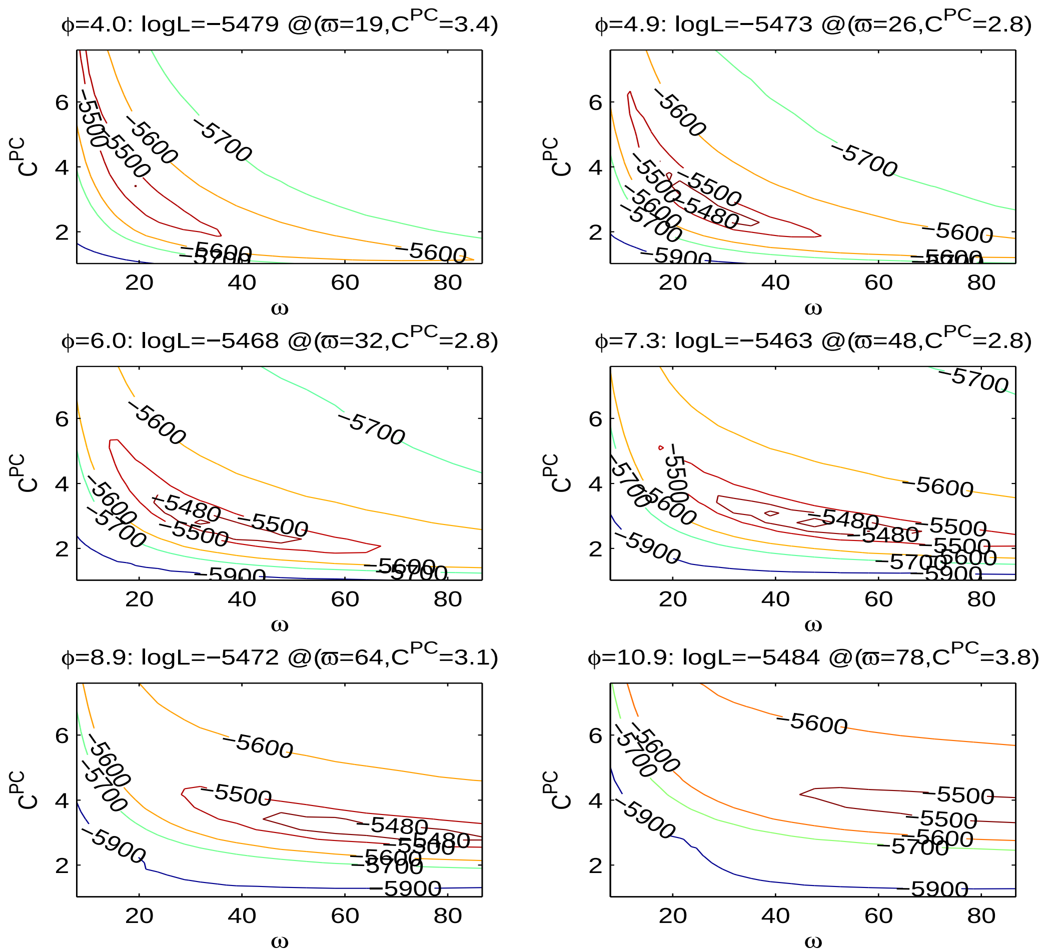

Figure 7: Improvement in Fit for Heterogeneous Bequest Model

This figure plots the model's fit to the end-of-life strategic survey question under the assumption of homogeneity in the bequest motive and heterogeneity.

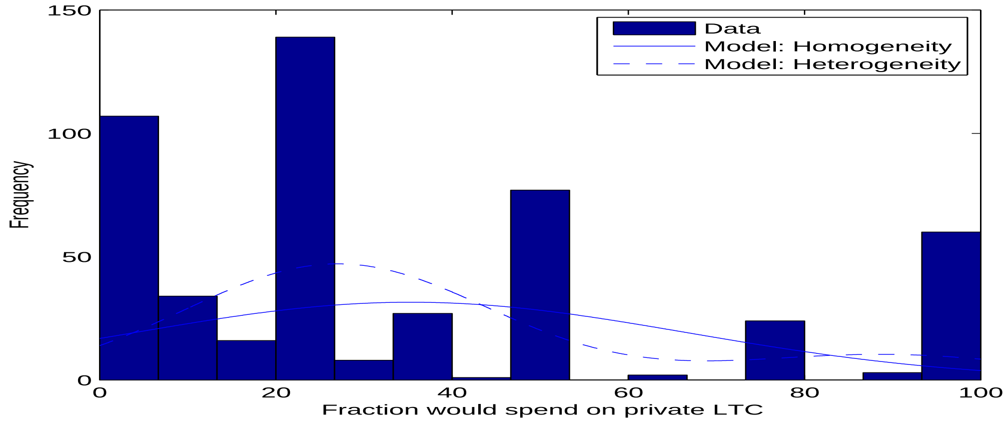

Figure 8: Product Innovation: Willingness To Pay for Annuity with LTC Pop-Up

This figure plots the willingness to pay (WTP), as a fraction of fair market value, for two annuity products. The first product is a standard life annuity which makes an annual (real) payment of \$5,000 (left panel). The second product is a combination policy that pays \$5,000 every year in which the buyer is alive and not in long term care (health states 1 or 2) and \$15,000 when the buyer is in the LTC state (right panel). The horizontal axis displays the strength of the bequest motive, while the vertical axis displays public care aversion, as captured by the consumption equivalent of public long-term care. All other parameters are held fixed at our benchmark estimates.