The Importance of Bequest Motives: Evidence from Long-term Care Insurance and the Pattern of Saving*

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January 6, 2010

Abstract

There is a long-running controversy about why people spend down their wealth slowly during retirement, which pits precautionary motives against bequest motives. Disagreement persists largely because of a fundamental identification problem: the same non-contingent wealth gets consumed in some states and bequeathed in others. In this paper, I exploit people's decisions about whether to buy long-term care insurance and the pattern of saving across the wealth distribution to separately identify precautionary and bequest motives. Estimations based on the Method of Simulated Moments identify modest precautionary motives and widespread, important bequest motives. The estimates indicate that shutting down the bequest motives of 65–69-year-old single retirees in the US would halve bequests (from 57% to 28% of their non-annuity wealth) and cause more than a six-fold increase in long-term care insurance ownership (from 5.6% to 36.6%).

*Comments appreciated: lockwood@uchicago.edu. I thank Gary Becker, Lars Hansen, Eric Hurst, Ralph Koijen, Casey Mulligan, Kevin Murphy, Derek Neal, and seminar participants at the University of Chicago for helpful comments. I am grateful to the National Institute on Aging for financial support (training grant 5T32AG00243).

1 Introduction

A repeated finding, across different places and times, is that people typically spend down their wealth slowly if at all during retirement.[1] Yet the underlying reason for slow wealth spend down is much disputed. A long-running controversy on the importance of different motives for saving pits life-cycle and precautionary motives against bequest motives (e.g., Kotlikoff and Summers (1981) and Modigliani (1988)). This debate remains unresolved largely because of a fundamental identification problem. As Dynan et al. (2002) note, "[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" (p. 274). Due to the presence of significant uninsured risks, neither high saving nor large realized bequests are prima facie evidence of important bequest motives, as they could instead reflect precautionary saving against medical spending and lifespan risks. Resolving this identification problem is important to formulate good policy, as the nature and strength of bequest motives determine the effectiveness of fiscal policy (Barro, 1974) and the optimal taxation of saving, estates, and gifts.

In this paper, I exploit two empirical patterns to separately identify precautionary and bequest motives: long-term care insurance purchasing decisions and the pattern of saving across the wealth distribution of retirees. Long-term care insurance choices help identify precautionary and bequest motives because the demand for long-term care insurance is strongly increasing in the strength of the precautionary motive and is non-monotonically related to the strength of the bequest motive. Similarly, the pattern of saving across the wealth distribution helps identify precautionary and bequest motives because the strength of each motive varies systematically with wealth. When bequests are a luxury good, as they appear to be, bequest motives have a greater effect on the saving of richer people.

[1] For recent evidence from the U.S., see De Nardi et al. (2009).

Precautionary motives, on the other hand, are generally stronger for poorer people because they face a much greater risk of being driven to bankruptcy by a spending shock.

I use the Method of Simulated Moments to estimate bequest and precautionary motives in a life cycle model of retirement with medical spending and lifespan risk. The estimation is based on the wealth and long-term care insurance ownership of single retirees in the Health and Retirement Study. The limited demand for long-term care insurance and the pattern of saving across the wealth distribution indicate widespread, important bequest motives. The model matches well saving choices over the life cycle and at different parts of the wealth distribution and the limited demand for long-term care insurance, including by the rich. The estimates are robust to different estimating moments and modeling assumptions. Statistical tests strongly reject the model without bequest motives. Moreover, the model with bequest motives comes much closer to matching the limited demand for life annuities than the model without bequest motives can.

The estimates indicate that bequest motives significantly increase saving, even among people in the bottom half of the wealth distribution, and significantly reduce the demand for long-term care insurance and annuities, especially by people in the top half of the wealth distribution. Although bequests are a luxury good—less than half of the richest single retirees with full, actuarially fair insurance would even leave a bequest—with actual insurance markets bequest motives affect much more of the sample. In addition to doubling average bequests by retirees in the top quartile of the wealth distribution, the estimated bequest motive also doubles bequests by retirees in the second and third quartiles. The bequest motive has a much larger effect on saving than does medical spending risk, even among retirees in the second quartile of the wealth distribution. Although the model over-predicts ownership of annuities (15.2% instead of 4.0%), it indicates that bequest motives limit the demand for annuities much more than medical spending risk does.

Two empirical patterns are especially indicative of important bequest motives and modest precautionary motives. The first is the combination of the limited demand for long-term

care insurance (owned by about 10% of retirees) and the slow wealth spend down by middle-class and richer retirees. With weak bequest motives, the model requires a strong precautionary motive (i.e., a strong aversion to Medicaid-financed long-term care) to match the slow wealth spend down by middle-class and richer retirees. Yet with strong Medicaid aversion and weak bequest motives, nearly everyone would buy available long-term care insurance, despite the high loads.[2] Even costly long-term care insurance can dominate "self-insurance" (saving to pay for long-term care) because self-insurance means holding a large stock of wealth to be spent only if one needs costly care. Buying insurance frees up this wealth for consumption.

People who wish to leave bequests, however, may prefer to self-insure their risks because they value the large bequests that often accompany such a strategy. Holding a large stock of wealth into old age to pay for long-term care means leaving large bequests in the likely event that care is not required. Moreover, people can partially insure their consumption by adjusting their bequests based on how their risks unfold. By consuming for themselves most or all of their wealth in states with large spending needs and leaving bequests in states with modest spending needs, people insure their consumption with their bequests. Of course, this strategy of self-insurance means risky bequests, but only people who are unusually risk averse over bequests would be better off insuring their bequests with available long-term care insurance.

The second empirical pattern that indicates important bequest motives and modest precautionary motives is the pattern of saving across the wealth distribution. Except when experiencing large medical spending shocks, people across the wealth distribution typically spend down their wealth slowly if at all during retirement. Although models without bequest motives can reproduce the slow wealth spend down by people at particular parts of the wealth distribution, the same precautionary motive that matches the saving of one part of the distribution simultaneously over-predicts saving by poorer people and under-predicts

[2]The average load on long-term care insurance in the U.S. market is 18% (Brown and Finkelstein, 2007): people who hold their contract for life receive on average about 82 cents of discounted benefits for each dollar of premiums they pay.

saving by richer people. Richer people, although less likely to be bankrupted by spending shocks, save at higher rates than the poor (Dynan et al., 2004), which is inconsistent with saving being driven mostly by precautionary motives.

This paper is most closely related to the literature on precautionary saving in old age (e.g., Hubbard et al. (1995), Palumbo (1999), Dynan et al. (2002), and De Nardi et al. (2009)). A key difference is that the rest of the literature takes risk exposure as given. Given the large spending risks that retirees face, models with strong enough precautionary motives can match the slow wealth spend down by middle-class retirees even without bequest motives,[3] which has led many to conclude that bequest motives have little effect on most people's saving. Dynan et al. (2002), for example, suggest that with the substantial uninsured risk that people face, policies that effectively shut down bequest motives, such as (successfully enforced) confiscatory transfer taxes, would have little effect on most people's saving.[4]

My results indicate that bequest motives are both an important determinant of saving of all but the poorest retirees and a primary reason why people face so much uninsured risk in the first place: many people choose not to buy long-term care insurance and annuities because they are partially insured by their intended bequests. Models in which precautionary motives are the main determinant of saving predict far too much ownership of long-term care insurance and annuities, too much saving by the poor, and too little saving by the rich.

My results complement those of other approaches to estimating the importance of bequest motives. One influential method seeks to infer the importance of bequest motives by splitting the population into groups with different bequest motives and comparing each group's saving. Hurd (1987) finds that people with and without children make similar

[3]Precautionary motives must be very strong for models without bequest motives to match the saving choices of middle-class retirees. For example, Palumbo (1999) uses a consumption floor (consumption by people who exhaust their wealth) of $2,000 (1985 dollars) per year and still finds that empirical wealth levels exceed model predictions. De Nardi et al. (2009) estimate a consumption floor of about $2,600 per year, and find that imposing a floor of $5,000 substantially worsens the model's fit.

[4]This is not to say that confiscatory transfer taxes would have little effect on the economy. The very rich hold a large share of total wealth, so policies that affect their saving have potentially large effects on aggregate wealth.

saving decisions, which has been widely interpreted as strong evidence against the importance of bequest motives, as people without children are presumed to have weak or no bequest motives. Although intuitive, this presumption contradicts evidence from surveys and annuity guarantee choices that many people without children have strong bequest motives.[5] Kopczuk and Lupton (2007) take the same approach of comparing saving across two groups with different bequest motives but allow group membership to be determined as part of the estimation. Their results indicate that about three-fourths of people (and similar fractions of people with and without children) belong to the group with the stronger bequest motive, and the bequest motive they estimate is very similar to the one I estimate.[6] De Nardi (2004) shows how bequest motives help an overlapping generations model match the concentration of wealth and lifetime savings profiles. Ameriks et al. (2007) design a survey specifically to separately identify precautionary and bequest motives and find that the survey responses and spending data together suggest widespread, strong bequest motives.[7]

Several conclusions from the literature partly justify my representative agent-based estimation strategy, while one indicates a shortcoming. The shortcoming is that individual heterogeneity, which might be especially important for bequest motives, limits what can be learned from a representative agent model. On the other hand, the evidence that bequest motives are widespread suggests that a representative agent model could potentially shed

[5]In the Health and Retirement Study, 55% of people without children report that it is somewhat or very important to leave a bequest, and among annuitants in the TIAA-CREF retirement system (mostly high-income professionals), 68% of households without children choose annuities with guarantees (Laitner and Juster, 1996), which reduce income in exchange for greater bequest potential. People with children do, however, have stronger bequest motives by both measures: 67% report that leaving a bequest is somewhat or very important and 88% choose annuities with guarantees.

[6]Kopczuk and Lupton (2007) specify a linear (constant marginal utility) bequest motive and estimate a marginal utility of bequests equal to the marginal utility of consuming about $23,800 per year. My estimates imply that the marginal utility of very small bequests is equal to the marginal utility of consuming about $23,100 per year and that the marginal utility of bequests diminishes slowly in the size of the bequest. The marginal utility of a $100,000 bequest, for example, is about equal to the marginal utility of consuming $25,500 per year.

[7]Because Ameriks et al. (2007) conduct their own survey, their sample is small. As a result, their spending data are not sufficient to separately identify precautionary and bequest motives. Instead, their identification comes largely from questions that ask people to choose between larger bequests and higher-quality long-term care. By using the Health and Retirement Study, which follows a large sample for many years, I am able to identify bequest motives based on spending and saving decisions alone. Despite the very different sources of identification, however, we reach similar conclusions.

light on the quantitative significance of the effects of bequest motives on behavior. Moreover, the evidence that differences in bequest motives are difficult to predict ex ante—that they are not limited to people with children or the rich, for example—is a challenge for approaches that seek to estimate bequest motives based on individual heterogeneity.[8] Finally, recent work suggests that bequest motives so modest as to likely be missed by surveys can have large effects on saving and insurance decisions with imperfect insurance markets. Lockwood (2009), for example, shows that even people who would leave no bequest had they access to actuarially fair insurance markets might, because of their bequest motives, be better off without available life annuities.

Other than strategic bequest motives, which refer to situations in which people exchange bequests for services from their heirs (Bernheim et al., 1985), the literature has mostly ignored bequest motives as a factor in long-term care insurance purchasing decisions. When non-strategic bequest motives are discussed, they are often assumed to *increase* the demand for insurance because long-term care insurance insures bequests (Pauly, 1990). I find, however, that bequest motives consistent with saving behavior reduce the demand for long-term care insurance. People with bequest motives gain less from long-term care insurance because they value the large bequests that arise incidentally from self-insuring risks and because they can use their intended bequests to insure their consumption.[9] My results indicate that were it not for bequest motives, long-term care insurance ownership among single retirees in the US would be more than six times greater (36.6% instead of the 5.6%).

That plausible non-strategic bequest motives reduce the demand for long-term care

[8]There is evidence that survey questions about bequest motives have important limitations. In Laitner and Juster's (1996) sample of people in TIAA-CREF retirement plans, for example, some people who report that leaving bequests is not important choose annuities with substantial guarantees, even though guarantees reduce income in exchange for nothing other than bequest potential.

[9]The consumption-smoothing role of bequests in limiting the demand for long-term care insurance is related to Davidoff's suggestion that housing wealth substitutes for long-term care insurance (Davidoff, 2008, 2009). In his model, people consume their housing wealth if and only if they require long-term care, so home equity insures consumption. The model takes as given that people consume their housing wealth only in loss states. Bequest motives can explain this choice, and can therefore explain the limited market for reverse mortgages and other means of home equity withdrawal, which is puzzling in the context of selfish life cycle models.

insurance helps explain why ownership is rare even among the rich, which is not well-explained by alternative theories. The leading explanations for the limited ownership of long-term care insurance include crowd-out by Medicaid (Brown and Finkelstein, 2008), a preference for informal over formal care (Pauly (1990) and Zweifel and Struwe (1996)), and systematic mistakes, due perhaps to a lack of understanding of the risks, a belief that Medicare or private health insurance covers long-term care, or an aversion to thinking about one's possible long-term care needs. Medicaid provides very incomplete insurance for the rich, as they must spend down almost their entire stock of wealth before becoming eligible for Medicaid. Even if they are indifferent between private and Medicaid nursing facilities, they may wish to buy long-term care insurance to support their consumption *after* leaving a caregiving facility, as many people are able to leave facilities when their health improves. Models in which people prefer informal to formal care, such as models of strategic bequest motives, do not appear to explain the low demand for insurance among the rich, who are less likely than the poor to use informal care. Finally, many of the candidate theories for why people might mistakenly fail to buy long-term care insurance raise the question of what retirees are saving for if not to leave bequests or pay for future long-term care expenses. My results show why people who at least broadly understand the risks they face and who do not wish to rely on Medicaid or their families may prefer to self-insure their long-term care risk.

2 Model

The model and parameterization follow closely Brown and Finkelstein (2008), who study the demand for long-term care insurance.[10] A single retiree who faces medical spending and lifespan risk decides how much to consume and whether to buy long-term care

[10]The main differences between my model and Brown and Finkelstein's (2008) aside from my inclusion of bequest motives are that I use year-long rather than month-long time periods and that I abstract from medical cost growth. These choices significantly reduce computation time, which is especially important because of the computation-intensive estimation strategy. Both assumptions are standard in the saving literature.

insurance. Each period is one year.

Preferences.— A t-year-old maximizes expected utility from consumption and bequests,

$$EU_t = u(c_t) + E_t \left\{ \sum_{a=t+1}^{T} \beta^{a-t} \left(\prod_{s=t}^{a-1} (1-\delta_s) \right) \left[(1-\delta_a) u(c_a) + \delta_a v(b_a) \right] \right\}.$$

T is the maximum possible age. β discounts future utility from consumption and bequests. δ_s is the (stochastic) probability that an $(s-1)$-year-old will die before age s. Utility from consumption is constant relative risk aversion, $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$.

Utility from bequests is

$$v(b) = \left(\frac{m}{1-m} \right)^{\sigma} \frac{\left(\frac{m}{1-m} c_0 + b \right)^{1-\sigma}}{1-\sigma} \quad \text{if } m \in (0,1),$$

and $v(b) = 0$ if $m = 0$. This is a re-parameterized version of a commonly-used functional form (e.g., De Nardi (2004), Ameriks et al. (2007), and De Nardi et al. (2009)). This parameterization has good numerical properties and easy-to-interpret parameters. $c_0 \geq 0$ is the threshold consumption level below which, under conditions of perfect certainty or with full, fair insurance, people do not leave bequests: $v'(0) = c_0^{-\sigma} = u'(c_0)$. The bequest motive is "inoperative" in this perfect certainty case for people who cannot afford to consume c_0 in the sense that their demand for bequests is zero. But they have a bequest motive in the sense that they get utility from the prospect of leaving a bequest, and their bequest motive will affect their saving and insurance decisions in a world with uncertainty. $m \in [0,1)$ is the marginal propensity to bequeath in a one-period problem of allocating wealth w between consumption and an immediate bequest for people rich enough to consume at least c_0 $(w \geq c_0)$.[11] Smaller values of c_0 mean the bequest motive "kicks in" at a lower rate of

[11] With these utility functions, the optimal bequest by someone maximizing $\max\{u(c) + v(b)\}$ subject to $c + b = w$ is $b^*(w) = \max\{0, m(w - c_0)\}$. More generally, whenever the discount rate equals the interest rate and either actuarially fair insurance is available or there is no uncertainty, the first-order condition is $u'(c^*) \geq v'(b^*)$, which implies $b^* = \max\left\{0, \frac{m}{1-m}(c^* - c_0)\right\}$. For every \$1,000 of consumption above c_0, people leave bequests of $\$\frac{m}{1-m} * 1,000$.

consumption. Larger values of m mean a larger fraction of the wealth left over after buying consumption of c_0 is bequeathed. As m approaches one, the bequest motive approaches a linear bequest motive with a constant marginal utility of bequests equal to $c_0^{-\sigma}$. In this case, all wealth in excess of that required to consume c_0 each period is left as a bequest.

This functional form allows a wide range of risk aversion over bequests and extents to which bequests are a luxury good.[12] Preferences over consumption and bequests are homothetic and people are equally risk averse over bequests and consumption if $c_0 = 0$. Bequests are a luxury good and people are relatively less risk averse over bequests than consumption if $c_0 > 0$. This functional form arises naturally from altruism, in which case m and c_0 depend on the degree of altruism and the total wealth of bequest recipients, respectively (Abel and Warshawsky, 1988). But alternative underlying motives, such as enjoying giving for its own sake, are also consistent with this functional form. Together with a parameter measuring the strength of the precautionary motive, the bequest motive parameters, m and c_0, are the main parameters of interest in the estimation.

Health and medical spending risks.— The model of health and medical spending risks is based on an actuarial model of transitions across health states developed by James Robinson.[13,14] At any time, the individual is in one of five health states: healthy (he), requiring home health care (hhc), living in an assisted living facility (alf), living in a nursing home (nh), or dead (d). The (Markov) transition probabilities across these states depend on the individual's current health status and age, $Pr(h_{t+1} = h'|h_t, t)$.

The costs of the long-term care services required in each health state are equal to the U.S. averages in 2002 (MetLife Mature Markets Institute 2002a,b). Nursing homes cost $52,195

[12] Carroll (2000) discusses the close relationship between risk aversion over bequests and the wealth elasticity of bequests.

[13] As Brown and Finkelstein (2008) note, this model is widely-used by insurance companies and governments to predict reimbursement-eligible long-term care usage. See Robinson (2002) and Brown and Finkelstein (2004) for details.

[14] Robinson (2002) estimates separate models for men and women. I use the model for women in the simulations for both men and women because it better approximates the long-term care risk of single individuals. Wives typically outlive their husbands and provide them significant informal care as their health deteriorates. Population averages of formal long-term care use by men therefore understate the risk faced by single men who have less access to informal care.

per year ($143 per day), assisted living facilities cost $26,280 per year ($72 per day), skilled home health care (provided by a registered nurse) costs $37 per hour, and unskilled home health care costs $18 per hour. I convert the hourly wage rates for home health care into yearly spending with Robinson model estimates of average usage as a function of age. Medicare covers 35% of home health care spending and none of the costs of nursing homes or assisted living facilities in the model.[15] Based on these prices and usage rates, a 70-year-old who needs home health care incurs about $5,133 of home health care costs, and a 90-year-old incurs about $11,927. I focus on long-term care spending because this is the main risk facing the elderly in the U.S. and the dominant driver of precautionary saving in numerical life cycle models.[16]

Long-term care insurance.— A long-term care insurance contract specifies benefit eligibility rules, maximum daily benefits, and a state-contingent premium schedule. I model a typical long-term care insurance contract. In exchange for paying premiums each year in which one is healthy ($h = he$), one's long-term care costs are covered up to a maximum of $36,500 in years in which one is sick ($h \in \{hhc, alf, nh\}$) (corresponding to a maximum daily benefit of $100). Premiums exceed expected discounted benefits by 18 percent, the average load on long-term care insurance policies held for life in the US (Brown and Finkelstein, 2007). Individuals make a once-and-for-all choice about whether to buy long-term care insurance. Those who buy it continue paying premiums and receiving benefits for life.[17]

Timing, budget sets, and social insurance.— People receive a constant (real) stream of non-asset income, y, as long as they live. Assets earn a certain, after-tax real return r. A t-year old enters the period with wealth $w_t = (1 + r)s_{t-1} \geq 0$, where $s_{t-1} \geq 0$ is saving at age $t - 1$. Health status is realized at the beginning of each period. People who die leave

[15] In reality, Medicare covers some short-term stays in skilled nursing home facilities. Medicare-covered care is properly excluded from the model.

[16] Medical spending on acute illnesses is much smaller than spending on long-term care for chronic illnesses. According to the National Center for Health Statistics, average out-of-pocket medical spending by non-institutionalized people (including those receiving home health care) over age 65 in the US in 2004 was just $600 (Ameriks et al., 2007).

[17] Although unrealistic, this assumption likely has little effect on the results. Premiums are front-loaded, so existing policies generally become better actuarial bets over time.

bequests $b_t = w_t \geq 0$. People may not die in debt or, equivalently, leave negative bequests. Together with mortality risk, this amounts to a no-borrowing constraint. People who live receive their income and realize their net medical spending (including long-term care insurance premiums and benefits) before receiving government transfers and deciding how much to consume. Net wealth before government transfers is

$$\hat{x}_t = w_t + y - m(h_t, t, ltci),$$

where $m(h_t, t, ltci)$ is total medical spending, which equals the sum of uninsured medical spending and long-term care insurance premiums, less long-term care insurance benefits. Wealth before transfers may be negative, as net medical spending may exceed the value of income and assets.

Public programs or private charities ensure that people receive the medical care they require and enjoy at least a minimum standard of living. The consequences of having too little wealth to pay for medical care and a minimum standard of living depend on one's medical needs. People who do not require institutional care ($h \in \{he, hhc\}$) and cannot afford to consume at least \$6,200 receive transfers that enable them to consume exactly this amount. Their net wealth after government transfers is $x_t = \max\{\hat{x}_t, \$6,200\}$. \$6,200 is roughly the consumption floor provided to single elderly individuals in 2000 by the Supplemental Security Income (SSI) program, which is meant to provide a subsistence level of food and housing.

People who require facility-based care ($h \in \{alf, nh\}$) can have part of their care paid for by Medicaid if they satisfy income- and assets-based means tests. To qualify for Medicaid coverage of institutional costs, people must exhaust all but \$2,000 of their assets ($\hat{x} \leq \$2,000$) and have no more than \$360 of income net of medical spending ($\hat{y}_t \equiv y - m_t \leq \$360$). These were the modal income and asset eligibility requirements employed by U.S. states in 1999 (Brown and Finkelstein, 2008). People who cannot afford

to pay for their own care ($\hat{x}_t < 0$) must claim Medicaid benefits to help finance their care.[18] People who qualify for Medicaid but can afford to pay for their care privately ($\hat{x}_t \in [\$0, \$2,000]$ and $\hat{y}_t \leq \$360$) can choose whether to accept Medicaid support or pay for their care themselves. They forgo Medicaid support if Medicaid-financed care is sufficiently less attractive than privately-financed care. People who receive Medicaid support have net wealth after transfers of $x_t = \min\{w_t, \$2,000\} + \min\{y, \$360\}$. People who do not receive Medicaid support have net wealth of $x_t = \hat{x}_t$.

The consumption value of long-term care and the precautionary motive.— Assisted living facilities and nursing homes provide some goods and services that are close substitutes for standard consumption goods, such as food and housing. I assume that the value of the consumption goods provided by privately-financed nursing homes and assisted living facilities is $6,200, the same food and housing value that social insurance provides for people living outside care facilities. Institutional care that is at least partly financed by Medicaid, however, may be less desirable than privately-financed care. This could be because some nursing homes do not accept Medicaid patients, because it is costly to file for Medicaid benefits, or because people feel a stigma of receiving government support. The extent to which people prefer privately-financed care to Medicaid-financed care is the main determinant of the strength of the precautionary motive. The worse is Medicaid-financed care relative to privately-financed care, the greater the incentive to save or buy insurance to avoid Medicaid. The consumption value of Medicaid-financed institutional care, c_{med}, is therefore a key parameter in the estimation. I also assume that residents of assisted living facilities and nursing homes cannot buy utility-producing consumption above the consumption value of their long-term care. This captures the limited consumption opportunities available to people with serious chronic illnesses. Home health care services do not substitute for private consumption and therefore have no consumption value.

Solution method, value functions, and consumption and long-term care insurance choices.—

[18] People who cannot afford to pay for their care always satisfy Medicaid's asset and income means tests: $\hat{x}_t < 0 \implies \hat{x}_t < \$2,000$, and $\hat{x}_t < 0 \iff w_t + y - m(h_t, t, ltci) < 0 \iff w_t + \hat{y}_t < 0 \implies \hat{y}_t < \$360$.

Given a set of parameter values, I solve the model numerically by backward induction from a maximum age of 105 to a minimum age of 65, with and without long-term care insurance. As long-term care insurance is purchased once-and-for-all, long-term care insurance ownership, $ltci \in \{0, 1\}$, is a state variable in every period other than the purchasing period, in which it is a control variable. The other state variables are age (t), health (h_t), and wealth (w_t). People die by age 105 with probability one, and leave any remaining wealth as a bequest, $V_{105}(w_{105}) = v(w_{105})$. For younger ages, I discretize wealth into a fine grid and use piecewise cubic hermite interpolation to evaluate the value function between wealth grid points. At each age-health-wealth node, I solve for optimal Medicaid-claiming by people who are Medicaid-eligible and for optimal consumption. The problem can be written recursively in terms of value functions as

$$V_t(w_t, h_t, ltci) = \begin{cases} \max\limits_{\hat{c}_t \in [0, x_t]} \Big\{ u\big[\hat{c}_t + c_m(h_t, med_t(w_t, h_t, ltci))\big] \\ \qquad\qquad + \beta E_t V_{t+1}(w_{t+1}, h_{t+1}, ltci) \Big\} & \text{if alive}\,, \\ v(w_t) & \text{if dead}\,, \end{cases}$$

where $med_t(w_t, h_t, ltci)$ is an indicator of whether the individual claims Medicaid, and next-period wealth is $w_{t+1} = (1 + r)(x_t - \hat{c}_t)$. Utility-producing consumption is the sum of consumption spending, $\hat{c}$, and the consumption value of long-term care services, $c_m(h, med)$, which potentially depends on whether the care is at least partly financed by Medicaid. The no-borrowing constraint limits consumption spending to net wealth after transfers, $\hat{c}_t \leq x_t$. People make a once-and-for-all choice about whether to buy long-term care insurance at age 67. They buy insurance if and only if at $t = 67$ $V_t(w_t, h_t, ltci = 1) > V_t(w_t, h_t, ltci = 0)$.

3 Method of Simulated Moments

This section describes my use of the Method of Simulated Moments (MSM) to estimate the parameters of the life cycle model. I follow Gourinchas and Parker (2002), who pioneered

the use of the MSM in life cycle consumption models.[19] The MSM extends Minimum Distance Estimation to situations in which the model is too complex to admit closed-form analytical solutions.[20] The idea is to find the parameter values with which the model most closely reproduces key features of the data. The MSM procedure permits formal testing of parameter estimates and the overall fit of the model.

The MSM minimizes the distance between model-simulated moments and the corresponding empirical moments. Doing so requires solving and simulating the model for each candidate parameter vector. I use retirees' choices about how much to save and whether to buy long-term care insurance to estimate the parameters of the bequest motive and the consumption value of Medicaid-financed nursing care. Given a particular bequest motive and a particular consumption value of Medicaid-financed nursing care, I solve the life cycle model numerically to find value functions and optimal consumption rules. Given these value functions and optimal consumption rules, I simulate the model to generate asset holdings over the life cycle and long-term care insurance ownership. Finally, I calculate aggregate moments from the simulated data and evaluate the closeness of the simulated and empirical moments with a Minimum Distance criterion function.

The model has many parameters in addition to the main parameters of interest, m, c_0, and c_{med}. While one could in principle estimate all the parameters simultaneously by solving and simulating the model for each possible configuration, doing so would involve large computational costs and produce little or no gain in terms of identifying the parameters. Instead, it is standard to adopt a two-stage procedure. The first stage estimates or calibrates as many parameters as can be reasonably identified without using the model. The second stage estimates the remaining parameters using the MSM, taking as given the first-stage parameter estimates.

[19] See Pakes and Pollard (1989), McFadden (1989), and Duffie and Singleton (1993) for the development of the MSM and De Nardi et al. (2009) and Laibson et al. (2007) for recent applications in life cycle models.

[20] MSM estimations typically perform a Generalized Method of Moments (GMM) estimation with simulated moments replacing the (unknown) analytical moments. I perform a Classical Minimum Distance (CMD) estimation rather than the more common GMM because CMD simplifies the calculation of the asymptotic distribution with quantile-based moment conditions.

The remaining first-stage parameters that are not set in the Model section are the interest rate, r, the discount factor, β, and the coefficient of relative risk aversion, σ. For the baseline model, I again follow Brown and Finkelstein (2008) in adopting standard, widely-used values for these parameters and test the sensitivity of the estimation to these values. The coefficient of relative risk aversion is 3, and the real interest rate and the rate of time preference are both 3% per year, $r = .03$ and $\beta = \frac{1}{1.03} \approx .97$.

Call the first-stage parameters χ, their baseline values $\hat{\chi}$, and the second-stage parameters θ. Under the assumption that the model is the true data-generating process, the following second-stage moment conditions hold

$$\pi_0 = g(\theta_0, \chi_0),$$

where π_0 is a vector of r "reduced form" parameters (statistics about the wealth distribution and insurance ownership), θ_0 and χ_0 are vectors of the true values of the "structural" parameters of the model, and $g(\cdot, \cdot)$ is a function that describes the relationship between the reduced form and structural parameters (Ferguson (1958)). The MSM procedure substitutes simulated moments, $g_s(\theta, \chi)$, for the unknown theoretical moments, $g(\theta_0, \chi_0)$, in the estimation stage. Simulated moments should approach their theoretical counterparts as the size of the simulated population approaches infinity. The parameter estimates, $\hat{\theta}$, are those that minimize the following scalar-valued objective function

$$(\hat{\pi} - g_s(\theta, \hat{\chi}))' W (\hat{\pi} - g_s(\theta, \hat{\chi})),$$

where W is a positive definite $r \times r$ weighting matrix. The objective is a quadratic form in the deviations of simulated moments from their empirical counterparts. The resulting estimator is consistent and asymptotically normally distributed (Pakes and Pollard, 1989).

4 Second Stage Moments: Wealth and Insurance

The second stage of the estimation procedure attempts to recover the strength and curvature of bequest motives and the consumption value of Medicaid-financed nursing care, $\theta \equiv (m, c_0, c_{med})$, by minimizing the distance between simulated and empirical wealth and long-term care insurance moments. This section describes how I estimate the empirical moments and simulate the simulated moments.

4.1 Data and Sample Selection Procedure

I use the Health and Retirement Study (HRS), a longitudinal survey of a representative sample of the US population over 50 years old.[21] The HRS surveys more than 22,000 Americans every two years. It is a rich dataset with especially detailed information about wealth and health. The longest-tracked cohort has been interviewed every two years since 1992. Households are initially drawn from the non-institutionalized population, which excludes people living in nursing homes. But members of sampled households who later move into nursing homes remain in the sample. I use data from the five most recent waves, which occur in even-numbered years from 1998–2006.[22] Individuals in my sample are therefore covered for up to eight years. I use the RAND version of all variables.

I restrict the analysis to single retirees who are at least 65 years old in 1998 and who do not miss any of the 1998–2006 interviews while they are alive.[23,24] The resulting sample

[21] The HRS is sponsored by the National Institute of Aging (grant number NIA U01AG009740) and conducted by the University of Michigan.

[22] I exclude earlier waves due to sample size issues and problems with certain key variables. The first two waves of the HRS cohort (1992 and 1994) contain individuals who are too young. The first wave of the AHEAD cohort (1993) has inaccurate data on wealth (Rohwedder et al., 2006) and long-term care insurance (Brown and Finkelstein, 2007). The second wave of the AHEAD cohort (1995) and the third wave of the HRS cohort (1996) have inaccurate wealth data due to problems with information about secondary residences (RAND Codebook).

[23] I restrict to singles by dropping individuals who lived in households with more than one member in any wave 1998–2006. I restrict to retirees by dropping individuals who earn more than $3,000 dollars in any wave 1998–2006.

[24] All dollar figures in this paper are in constant 2000 dollars, deflated by the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W). The CPI-W is the price index that the Social Security Administration uses to adjust Social Security benefits.

Summary statistics

	HRS 65+	Single retirees 65+
Female	0.58	0.78
Age	74.4	77.5
Wealth	$389,308	$220,645
Income	$30,564	$17,914
LTCI	10.4%	8.6%
Lifetime LTCI	7.6%	4.6%

Table 1: Summary statistics for people aged 65 and over in the HRS and for my subsample of single retirees. All values are means, weighted by HRS household weights. Lifetime long-term care insurance ownership equals one if the individual owns a long-term care insurance policy that covers both nursing home care and home health care in at least half of the waves in which information on his or her long-term care insurance is available.

contains 3,446 individuals. Table 1 contains summary statistics for everyone age 65 and over in the HRS and for my subsample of 3,446 single retirees. The subsample of single retirees is older, poorer, and has a higher proportion of women than the overall sample.

4.2 Simulation Procedure

To create the simulated moments, I first draw with replacement 10,000 individuals from the sample of single retirees in the HRS to create a simulation sample. To ensure a population-representative sample, the probability that individual i in the sample of single retirees in the HRS is chosen on any draw is proportional to i's 1998 person-level weight in the HRS, $\frac{weight_i}{\sum_{j=1}^{3,446} weight_j}$. The simulation uses individuals' age in 1998, their total wealth in 1998, their health status in every interview year in which it is available, their average retirement income, and their long-term care insurance ownership status. Age and total wealth correspond exactly to variables in the data. Health status in the year of interview j equals nursing home if the individual is living in a nursing home when interview j occurs,[25] home health care if the individual is not living in a nursing home when interview j occurs and reports using home care anytime in the two years preceding interview j, dead if the individual is dead when interview j would otherwise occur, and healthy otherwise. I

[25]The HRS does not distinguish between assisted living facilities and nursing homes. I assume that all residents of nursing homes and assisted living facilities are residents of nursing homes because the Robinson model predicts much greater usage of nursing homes than assisted living facilities.

simulate health status between interview years using the Robinson model health transition probabilities and Bayes' rule. Average retirement income is equal to the simple average of real non-asset income between 1998 and 2006.

I code an individual as owning long-term care insurance if he or she owns a long-term care insurance policy that covers both nursing home care and home care in at least half of the waves in which information on his or her long-term care insurance is available. An individual does not own long-term care insurance if he or she does not own a qualifying long-term care insurance policy in at least half of the waves in which information on his or her long-term care insurance is available.[26] The average of reported ownership over time likely provides a better measure of "lifetime" ownership than point-in-time estimates because of measurement error and policy lapsation.[27] I restrict attention to policies that cover both nursing homes and home health care because this is the most popular type of policy (Brown and Finkelstein, 2007) and therefore is the type I use in the model.

For each candidate parameter vector θ, I solve the model numerically for individuals with different income levels and with and without long-term care insurance coverage. I use the resulting value functions and optimal choice rules to simulate the wealth path of each individual in the simulation sample and to estimate the demand for long-term care insurance by a subset of the simulation sample. Finally, I calculate aggregate statistics based on the simulated data.

4.3 Long-term Care Insurance Ownership

Empirical long-term care insurance moment.— The empirical long-term care insurance moment is the "lifetime" long-term care insurance ownership rate among the subset of

[26] Missing data prevent me from determining some individuals' ownership status. I exclude these individuals from the calculation of the empirical long-term care insurance moment and assume for the purposes of the simulated wealth moments that they do not have long-term care insurance.

[27] A significant fraction of people who buy long-term care insurance subsequently drop their policy (and thereby forfeit their claims to future benefits), which is surprising given the front-loaded nature of these contracts (Brown and Finkelstein, 2007). See Finkelstein et al. (2005).

single retirees who are 70–79 years old in 1998, weighted by the 1998 HRS individual sample weights. By this measure, this group's ownership rate is 5.6%,

$$ltci^e = .056.^{28}$$

Simulated long-term care insurance moment.— The simulated long-term care insurance moment is the long-term care insurance ownership rate among the subset of the simulation sample who are 65–69 years old in 1998. Given a vector of parameter values, θ, I solve the model to find the value functions, $V_t(w_t, h_t, ltci)$. Simulated long-term care insurance ownership by individual i is one if i would be better off buying long-term care insurance given his or her state variables and is zero otherwise,

$$ltci_i^s = \mathbb{1}\left\{V_{t_i}(x_{i,t_i}, h_{i,t_i}, ltci = 1) > V_{t_i}(x_{i,t_i}, h_{i,t_i}, ltci = 0)\right\}.$$

The simulated aggregate long-term care insurance ownership rate is the average of the individual ownership indicators. Simulated long-term care insurance ownership depends on θ through the value functions' dependence on θ.

The empirical long-term care insurance moment is based on older individuals (70–79-year-olds) than the simulated moment (65–69-year-olds) for two reasons. First, modeling the demand for realistic long-term care insurance contracts is computationally costly. It requires solving the model once for each purchasing age because premiums depend on when the insurance is purchased. I therefore calculate the demand for long-term care insurance at one purchasing age only. Second, ages 65–69 are the main time people buy long-term care insurance.[29] To balance sample size considerations against computation costs and numerical accuracy, I simulate the demand for long-term care insurance by 65–69-year-olds, treating each of them for this purpose as a healthy 67-year-old. I estimate

[28]For comparison, this group's point-in-time ownership rate in 1998 is 8.8%. The estimation results are similar in either case.

[29]The average age of long-term care insurance buyers is 67 (Brown and Finkelstein, 2007), and over 98% of 65-year-olds meet the health-related eligibility criteria to purchase long-term care insurance (Murtaugh et al., 1997).

the empirical ownership rate among individuals who were 70–79 years old in 1998 because they completed their prime buying years before the observation period 1998–2006 but are close enough in age to the simulation group to have similar wealth and income levels and to have experienced similar prices of long-term care and long-term care insurance. The obvious disadvantage of this approach is that it is biased if there are important cohort effects in income, wealth, health risks, or insurance prices. These factors are unlikely to have much effect on the results, however, because the results are not very sensitive to the precise ownership rate and because members of these groups are separated on average by only seven years.[30]

4.4 Saving: Wealth Profiles

Empirical wealth moments.— The empirical wealth moments track the wealth distributions of different cohorts as they age. I split the sample into six groups based on each individual's age in the 1998 wave: 65–69, 70–74, 75–79, 80–84, 85–89, and 90–94. For each group, I calculate four quantiles of the wealth distribution—the 25th, 50th (median), 75th, and 90th—in each wave *after 1998*: 2000, 2002, 2004, and 2006. Thus there are 96 wealth moments: four quantiles in four waves for six groups. Each group's wealth moments trace the evolution over time of the distribution of wealth among its surviving members. Later waves contain fewer people due to deaths.

Simulated wealth moments.— The simulated wealth moments are analogous to their empirical counterparts. Given a vector of parameter values, θ, I solve the model to find optimal consumption spending, $\hat{c}_t(w_t, h_t, ltci)$. Given these consumption functions and each individual's wealth in 1998, health status in 1998–2006, income, and long-term care insurance coverage, I simulate the wealth of each individual in the simulation sample in 1999–2006. Age, health, wealth, and long-term care insurance coverage, together with the

[30] There is little difference in age-specific ownership rates of long-term care insurance for all but the oldest retirees. For example, "lifetime" ownership among five-year age groups of single retirees between age 65 and 84 ranges from a low of 4.3% among 80–84-year-olds to a high of 6.3% among 70–74-year-olds.

optimal Medicaid claiming rule if the individual is eligible, gives net wealth after government transfers, x_t. Then wealth at age $t+1$ is

$$w_{t+1} = (1+r)(x_t - \hat{c}_t(w_t, h_t, ltci)),$$

which depends on θ through the optimal consumption rule. I use the same procedure to calculate the simulated wealth moments from the simulated individual-level wealth data that I use to calculate the empirical wealth moments from the individual-level wealth data. I split the simulation sample into the same six age groups based on each individual's age in the 1998 wave. For each group, I calculate the same four quantiles of the wealth distribution in exactly those years that the empirical moments are calculated: 2000, 2002, 2004, and 2006. This produces 96 simulated wealth moments.

All of the identification from the wealth moments comes from the panel aspect of the data because I condition on each individual's initial wealth in 1998. Using the empirical health and mortality realizations to construct the simulated moments reduces the mortality bias from richer people living longer: individuals who die in 2001 in the data also die in 2001 in the simulation and thus contribute to exactly the same moment conditions in the simulation and in the data.[31] I use quantiles instead of means because wealth is extremely concentrated, and I group by five-year age groups to increase cell sizes.

4.5 Moment Conditions and Estimation

The baseline estimation of $\theta = (m, c_0, c_{med})$ is based on 97 moment conditions: one long-term care insurance moment and 96 wealth moments. The MSM estimator is

$$\hat{\theta} = \arg\min_{\theta} (\hat{\pi} - g(\theta, \hat{\chi}))' W (\hat{\pi} - g(\theta, \hat{\chi})),$$

[31] My estimation suffers some residual mortality bias by ignoring anticipated differences in longevity prospects by economic status not captured by differences in health status and age. People with better longevity prospects likely save more for old age. By assuming that longevity prospects are independent of wealth, the model ignores these differences and so tends to underpredict saving by the healthy rich, but this effect is likely to be small.

where $\hat{\pi}$ is a 97×1 vector of the empirical moments and $g(\theta, \hat{\chi})$ is a 97×1 vector of simulated moments evaluated at the first-stage parameter values, $\hat{\chi}$. I minimize this function using Matlab's Nelder-Meade algorithm.

The baseline weighting matrix is the inverse of the estimated variance-covariance matrix of the second-stage (empirical) moments, $W = \hat{V}(\hat{\pi})^{-1}$. More-precisely estimated moments receive greater weight in the estimation.[32] I estimate the variance-covariance matrix of the second-stage moments by bootstrap. Following Pischke (1995), I check the robustness of the results to using the inverse of the diagonal of the estimated variance-covariance matrix of the second-stage moments as the weighting matrix, $W_{robust} = diag(\hat{V}(\hat{\pi}))^{-1}$. I check the robustness of the results to using alternative sets of moments.

5 Results

5.1 Baseline Results

The first column of Table 2 contains the results of the baseline estimation. The parameters are fairly precisely estimated and the overall fit of the model is good: the p-value of the chi-squared test of over-identifying restrictions is .904, which indicates an unusually good fit for a model of this kind. The estimate of the consumption value of Medicaid facility care indicates moderate Medicaid aversion: whereas the consumption value of private care is \$6,200, the estimated consumption value of Medicaid care is \$5,897. The estimates of the bequest motive parameters indicate important bequest motives in which bequests are a luxury good. With actuarially fair insurance, people would devote all of their resources below $\hat{c}_0 = \$23,097$ per year to their own consumption and for every \$1,000 per year of

[32] Although the wealth moments far outnumber the single long-term care insurance moment, the insurance moment still carries some weight in the estimation because it is much more precisely estimated and because each age group's 24 wealth moments are fairly correlated with each other. With the baseline weighting matrix, the objective function penalty for over- or under-predicting long-term care insurance ownership by 5% (e.g. predicting a 10.6% ownership rate when the actual rate is 5.6%) is roughly equal to the penalty for over- or under-predicting every wealth moment by 10%.

Estimation Results

	Baseline		Robust W		No LTCI	
Parameter estimates $\hat{\theta}$						
$\hat{c}_{med}$	5.897	6.2	6.019	6.2	6.085	5.2
s.e.	0.15	0.02	0.09	0.02	0.36	0.11
$\hat{c}_0$	23.097	-	26.090	-	21.530	-
s.e.	1.06	-	1.92	-	1.25	-
$\hat{m}$	0.975	0	0.982	0	0.974	0
s.e.	0.01	-	0.01	-	0.01	-
Goodness-of-fit						
χ^2 stat	76.7	583.0	81.1	583.0	75.6	166.9
p-value	0.904	$< 1e10$	0.827	$< 1e10$	0.905	$7.4e-6$
Simulated LTCI	5.7%	18.5%	5.6%	18.5%	0.3%	52.4%

Table 2: Estimation results based on the baseline weighting matrix, the robust weighting matrix, and the baseline weighting matrix except with zero weight on the long-term care insurance moment. The second column of each set of results comes from estimating the model with no bequest motive. The empirical long-term care insurance ownership rate is 5.6%.

consumption above \$23,097 would leave bequests of $\$\frac{\hat{m}}{1-\hat{m}} * 1,000 = \$39,000$.[33] The marginal propensity to bequeath out of wealth above the \$23,097 threshold for people with one year to live is $\hat{m} = .975$. For 65-year-olds in the model with fully-insured long-term care costs and with access to complete, actuarially fair annuity markets, the marginal propensity to bequeath is .615.[34] Were complete, actuarially fair long-term care insurance and annuities available, 45.6% of the individuals in the sample and 39.1% of individuals aged 65–69 would have "operative" bequest motives, i.e., would leave bequests.

The model's good fit is apparent in both the long-term care insurance ownership rate and the wealth moments. Simulated long-term care insurance ownership at the estimated coefficients is 5.7%, compared to 5.6% in the data. Figure 1 plots the simulated and empirical wealth moments, with the even- and odd-numbered age groups separated for clarity. The model reproduces the main patterns in the wealth data and therefore in consumption and saving decisions. Moreover, the results are similar in the estimation based on the robust weighting matrix and in the estimation based on only the wealth

[33] With actuarially fair insurance, optimal consumption and bequests satisfy $b^* = \max\left\{0, \frac{m}{1-m}(c^* - c_0)\right\}$.

[34] The marginal propensity to consume out of wealth is greater for people with more years (in expectation) over which to spread their consumption.

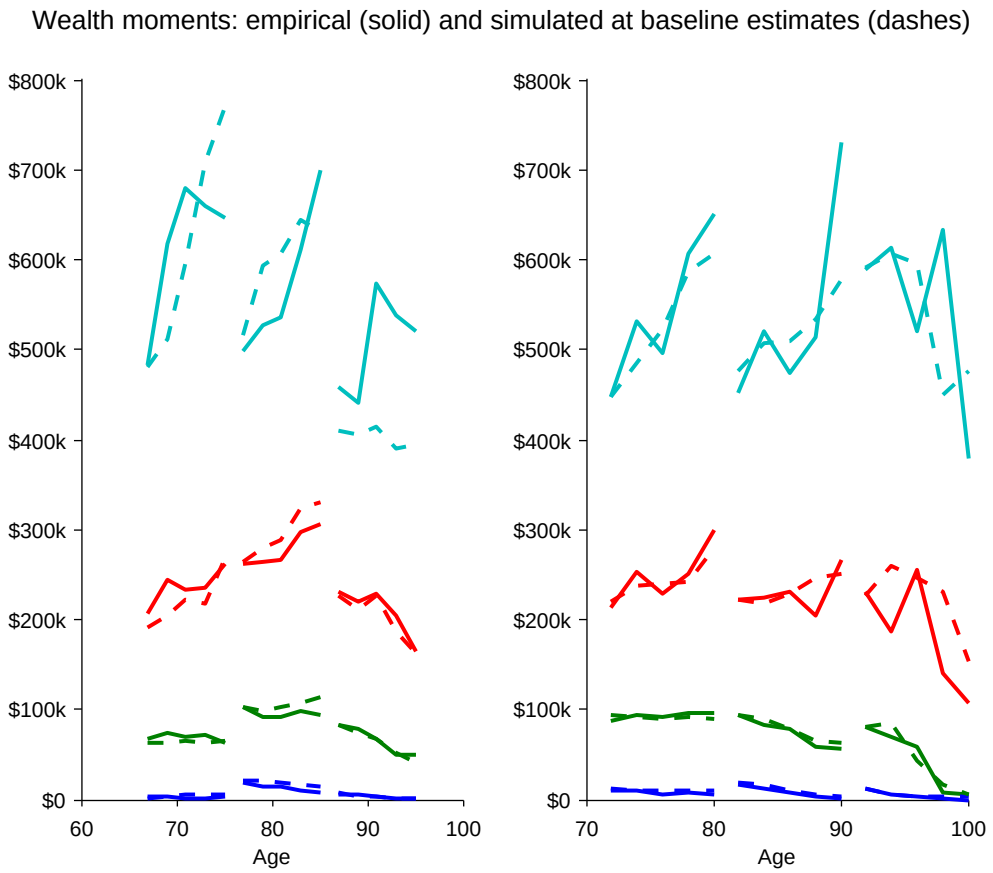

Figure 1: Empirical wealth moments (solid lines) and simulated wealth moments at the baseline estimates (dashed lines). Odd-numbered age groups are on the left; even-numbered age groups are on the right.

moments, excluding long-term care insurance.

5.2 Restricted Results: No Bequest Motive

The second column of each pair of estimations in Table 2 shows results based on imposing the restriction of no bequest motive, $m = 0$. The fit of the model is much worse under each of the weighting matrices, and the restriction of no bequest motive is in all cases easily rejected at the 1% confidence level. Figures 2 and 3 show why. Figure 2 shows simulated long-term care insurance ownership as a function of the consumption value of Medicaid-financed long-term care, and Figure 3 shows for odd-numbered age groups the empirical wealth moments (solid lines) and simulated wealth moments for strong (dashed

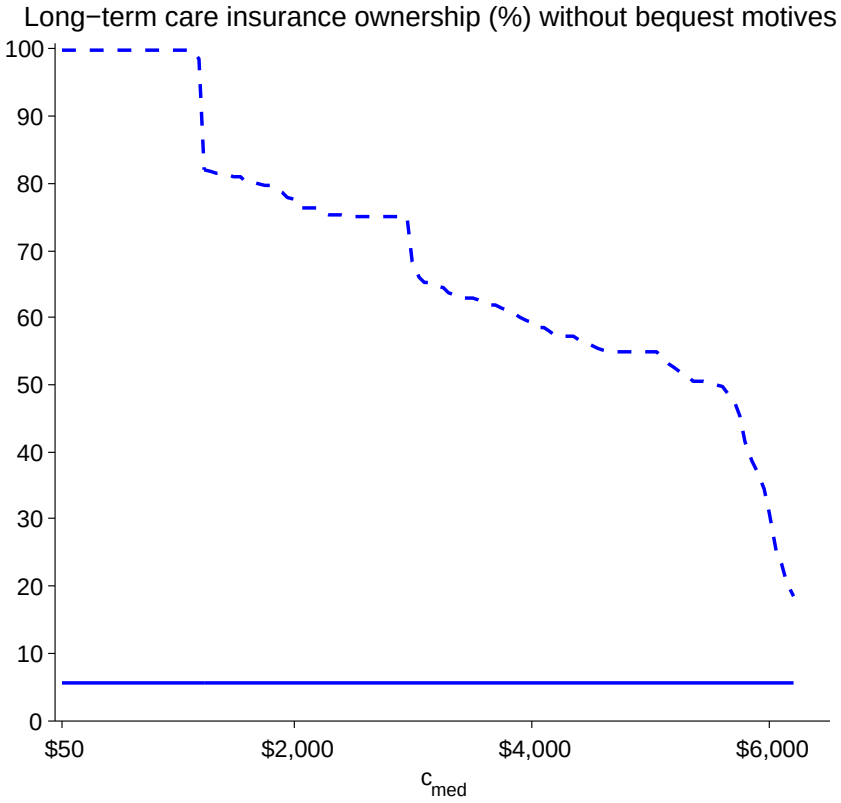

Figure 2: Simulated long-term care insurance ownership in the model without a bequest motive as a function of the consumption value of Medicaid-financed long-term care (dashed line). The solid line is the empirical ownership rate.

lines) and weak (dotted lines) Medicaid aversion. Figure 2 shows that without bequest motives, simulated long-term care insurance ownership always significantly exceeds the 5.6% ownership rate in the data. Even without Medicaid aversion, simulated long-term care insurance ownership is 18.5%, more than three times greater than in the data. Moreover, Figure 3 shows that weak Medicaid aversion (dotted lines) causes the model to significantly under-predict saving by all but the poorest. Long-term care insurance ownership is too low—both absolutely and, especially, relative to the saving of all but the poorest retirees—for saving to be due primarily to precautionary motives.

The inability of the model without bequest motives to match the pattern of saving behavior is apparent in its poor fit in the wealth-only estimation results in Table 2. Figure 3 reveals the reason for this failure. With weak Medicaid aversion (dotted lines), the model

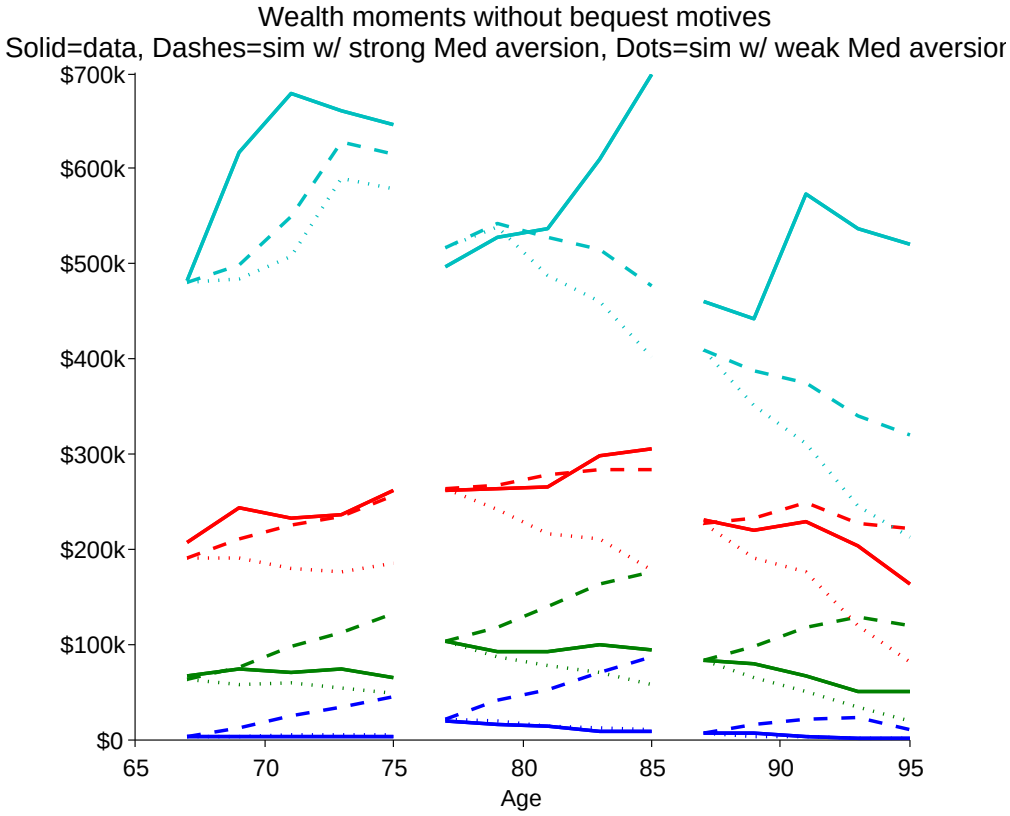

Figure 3: Empirical wealth moments (solid lines) and simulated moments for the odd-numbered age groups. The simulated moments come from the model without a bequest motive when the precautionary motive is strong (dashed lines, $c_{med} = \$1,000$) or weak (dotted lines, $c_{med} = c_{private} = \$6,200$).

matches the 25th quantile wealth moments but significantly under-predicts the 50th, 75th, and 90th wealth quantiles. With strong Medicaid aversion (dashed lines), the model roughly matches the 75th wealth quantiles but over-predicts the 25th and 50th wealth quantiles and under-predicts the 90th wealth quantiles. More generally, the model requires progressively stronger levels of Medicaid aversion to match the saving decisions of people at progressively higher points in the wealth distribution. The model without bequest motives therefore cannot match the pattern of saving across the wealth distribution. Saving by wealthier people is too high relative to saving by poorer people to be due primarily to precautionary motives.

5.3 Identification

Figure 4 shows a contour plot of the objective function in (c_0, m)-space with c_{med} fixed at

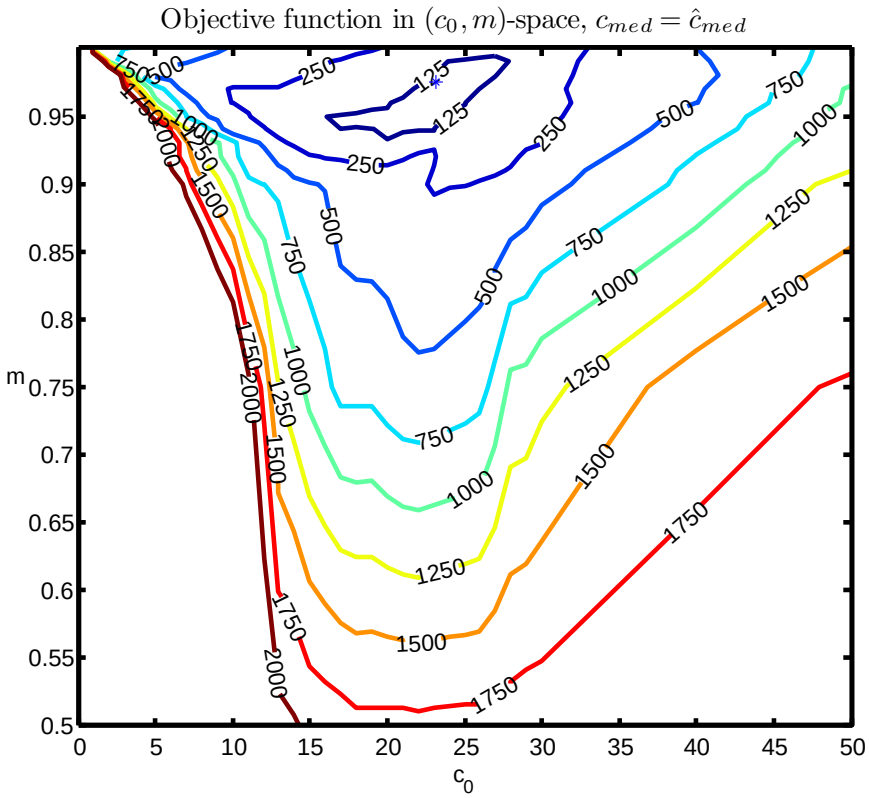

Figure 4: Contour plot of the objective function in (c_0, m)-space with $c_{med} = \hat{c}_{med}$. Higher contours indicate greater mismatch between the simulated and empirical moments.

its estimated value, $c_{med} = \hat{c}_{med} = 5.897$. Higher contours indicate greater mismatch between the simulated and empirical moments. The asterisk marks the baseline estimates ($\hat{c}_0 = 23.097,\ \hat{m} = .975$). The figure reveals that the model is well-identified: the objective function increases steeply as one moves away from the parameter estimates in any direction. Retirees' saving and long-term care insurance decisions are much more consistent with models that have important bequest motives and relatively modest Medicaid aversion than with any other combination of bequest motives and Medicaid aversion. In this section, I briefly highlight which features of the data are most informative about each of the key parameters of the model. But as the Appendix shows in more detail, the identification is not driven by any particular moment or set of moments, and each of the

main subsets of moments is most consistent with the combination of modest Medicaid aversion and important bequest motives.

Modest Medicaid aversion: c_{med} not too low.— Saving by people in the bottom and middle of the wealth distribution and long-term care insurance ownership both suggest that Medicaid aversion is modest. People in the bottom and middle of the wealth distribution have relatively little wealth and are therefore are likely to be bankrupted by uninsured long-term care costs. Yet while buying long-term care insurance or rapidly accumulating wealth would reduce the likelihood of bankruptcy, few people buy long-term care insurance and most people (slowly) spend down their wealth. Models with strong Medicaid aversion predict almost universal ownership of long-term care insurance and, for people with little wealth who for whatever reason do not buy long-term care insurance, rapid wealth accumulation. Both predictions are at odds with the data.

Bequests are a luxury good: c_0 not too low.— Saving by people in the bottom and middle of the wealth distribution and long-term care insurance ownership also suggest that bequests are a luxury good, for reasons similar to those that suggest modest Medicaid aversion. If failing to leave at least a small bequest carried a high utility cost, people would buy long-term care insurance or accumulate a large stock of wealth to reduce the chances that long-term care costs would wipe out their bequests. That few people with little wealth rapidly accumulate wealth and that few people buy long-term care insurance suggests that most people, if they care about bequests, are not too concerned about the prospect of leaving small bequests in high-spending states.

Important bequest motives: m close to one and c_0 not too high.— Saving by people in the top part of the wealth distribution and long-term care insurance ownership indicate important bequest motives. Like other authors (e.g., Carroll (2000) and Dynan et al. (2004)), I find that people in the upper part of the wealth distribution save too much, especially relative to poorer people, for their saving to be driven by precautionary motives. A more novel finding is that the limited demand for long-term care insurance, especially

among the rich, may also be evidence of important bequest motives. The rich are poorly insured by Medicaid, so they must choose between buying long-term care insurance and self-insuring.[35] Self-insuring means holding a large stock of wealth to be spent only if costly long-term care is required. Buying insurance, on the other hand, allows people to consume more aggressively (and leave smaller bequests) if they wish, but at the cost of paying thousands of dollars worth of insurance market loads.[36] People without bequest motives tend to be better off buying available long-term care insurance because they gain so much from increasing their consumption at the expense of bequests. People who wish to leave bequests, however, clearly gain less from increasing their consumption at the expense of bequests and would instead use long-term care insurance mostly to insure their bequests. The estimated bequest motive implies, consistent with altruism and other fundamental motivations for leaving bequests in which bequests are a luxury good, that bequest insurance is not sufficiently valuable to warrant paying the loads on available long-term care insurance contracts.[37] Both the giver of the bequest and his or her heirs are likely to prefer the higher-variance, higher-mean distribution of bequests from self-insuring than the lower-variance, lower-mean distribution from buying available long-term care insurance. The Appendix contains a more detailed analysis of the effect of bequest motives on the value of long-term care insurance.

5.4 Implications of Results

Table 3 shows the simulated effects of bequest motives and long-term care risk on saving and insurance outcomes. The measures of saving are expected discounted bequests as a share of baseline (1998) non-annuity wealth and the expected share of nursing home

[35] Medicaid provides very incomplete insurance because its means tests require people to spend down nearly all of their wealth before qualifying for support. People whose health improves enough to move back into the community after receiving Medicaid-financed care are therefore left with little wealth to support their consumption. According to the Robinson model, about two-thirds of people who at some point use a nursing home are able to leave the nursing home for other living arrangements at least once (Brown and Finkelstein, 2008).

[36] According to the Robinson model, expected premiums paid by a 67-year-old buyer of a typical long-term care contract exceed expected benefits received by over $6,300.

[37] For estimates of the value of bequest insurance for various bequest motives, see Lockwood (2009).

Effect of bequest motives and long-term care risk on saving and insurance

Model:	Baseline		Full, fair LTCI		No LTC		Data
Bequest motive:	Base	None	Base	None	Base	None	
Share of wealth bequeathed							
Full sample	65.9%	37.5%	65.9%	37.5%	63.2%	30.6%	
65–69-year-olds	56.6%	27.9%	56.6%	27.9%	53.6%	22.9%	
Bottom wealth quartile	346.4%	68.8%	346.4%	68.8%	211.4%	34.8%	
2nd wealth quartile	27.9%	14.8%	27.8%	14.8%	20.0%	10.7%	
3rd wealth quartile	45.4%	21.0%	45.4%	21.0%	37.6%	14.3%	
Top wealth quartile	59.8%	29.7%	59.7%	29.7%	57.9%	25.0%	
Medicaid share of nursing home costs							
Full sample	38.0%	41.9%	38.0%	41.9%	40.4%	48.3%	45.0%
65–69-year-olds	44.5%	49.7%	44.5%	49.7%	47.1%	55.1%	
Bottom wealth quartile	79.5%	80.4%	79.5%	80.4%	79.8%	80.5%	
2nd wealth quartile	64.2%	67.9%	64.2%	67.9%	67.1%	69.7%	
3rd wealth quartile	29.3%	41.0%	29.3%	41.0%	35.0%	50.5%	
Top wealth quartile	3.7%	8.5%	3.7%	8.5%	5.3%	18.9%	
LTCI ownership							
Overall	5.7%	36.6%	22.4%	36.6%	-	-	5.8%
Bottom wealth quartile	0.0%	0.0%	0.0%	0.0%	-	-	0.4%
2nd wealth quartile	0.0%	5.2%	10.1%	4.9%	-	-	2.8%
3rd wealth quartile	8.4%	46.5%	38.6%	46.5%	-	-	6.2%
Top wealth quartile	14.4%	94.8%	40.8%	95.1%	-	-	13.9%
Annuity ownership							
Overall	15.2%	46.4%	12.6%	46.4%	8.3%	46.4%	4.0%
Bottom wealth quartile	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
2nd wealth quartile	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.0%
3rd wealth quartile	45.9%	86.7%	36.1%	86.7%	28.3%	86.7%	4.8%
Top wealth quartile	15.0%	98.9%	14.1%	98.9%	4.9%	98.9%	8.0%
Can afford	32.6%	99.4%	26.9%	99.4%	17.8%	99.4%	-

Table 3: Simulated saving and insurance with and without the estimated bequest motive and long-term care risk. The saving outcomes (the share of non-annuity wealth bequeathed and the share of nursing home costs paid by Medicaid) are based on simulations that assign to individuals their reported (empirical) rather than simulated insurance ownership. The differences between columns in bequests and Medicaid spending therefore reflect different consumption and saving decisions and do not reflect differences due to differences in insurance ownership. The empirical Medicaid share of nursing home costs is the average over the period 2000 to 2003 (Current Medicare Beneficiary Survey 2004). The empirical long-term care insurance ownership rate is the fraction of single retirees aged 70–79 in 1998 who report owning long-term care insurance that covers both nursing homes and home health care in at least half of the waves between 1998 and 2006 in which they report their ownership status. The empirical annuity ownership rate is the fraction of the same group who in the 1998 wave report owning an annuity that lasts for life. Both are weighted by HRS household weights.

spending paid by Medicaid. Higher saving leads to larger bequests and smaller Medicaid shares. Bequests and Medicaid spending are simulated using the same model used in the baseline estimation, with individuals assigned their empirical long-term care insurance ownership.

Saving.— The first two columns of Table 3 show that the estimated bequest motive significantly increases saving. The bequest motive increases the average share of baseline (1998) non-annuity wealth left as bequests from 37.5% to 65.9%, and roughly doubles the share of wealth bequeathed by 65–69-year-olds, from 27.9% to 56.6%. This is not driven solely by the rich: the bequest motive roughly doubles the share of wealth bequeathed by people in the second and third quartiles of the wealth distribution as well as in the fourth quartile. The bequest motive has a more modest effect on the share of nursing home costs paid by Medicaid, reducing the overall share from 41.9% to 38.0%. The bulk of this reduction in Medicaid usage comes from people in the third quartile of the wealth distribution, who are rich enough that their saving is significantly increased by the bequest motive but poor enough that without bequest motives Medicaid pays 41% of their nursing home costs.[38]

Compared to bequest motives, medical spending has little effect on saving. The third and fourth columns show results from simulations in which the decision rules come from a model in which people are forced to purchase full, actuarially fair long-term care insurance, i.e., a model without long-term care *risk*. Long-term care risk has almost no effect on saving; the bequest and Medicaid shares are almost identical to those based on the simulation of the baseline model. De Nardi et al. (2009) also find that medical spending risk has little effect on saving, even with strong Medicaid aversion. The fifth and sixth columns show results from simulations in which the decision rules come from a model without long-term care costs. Eliminating long-term care has a modest effect on saving given the estimated bequest motive, reducing expected bequests from 65.9% to 63.2% of

[38]Empirically, Medicaid pays a similar share (45%) of total nursing home costs for the elderly but the statistics are not directly comparable because my sample is limited to single retirees.

baseline non-annuity wealth and increasing Medicaid's share of long-term care costs from 33.7% to 35.7%. Eliminating long-term care has a larger effect in the model without bequest motives, reducing expected bequests from 37.5% to 30.6% of baseline non-annuity wealth, but this effect is small compared to the effect of bequest motives.

Figure 5 shows simulated wealth paths for people who live to age 104 and remain healthy

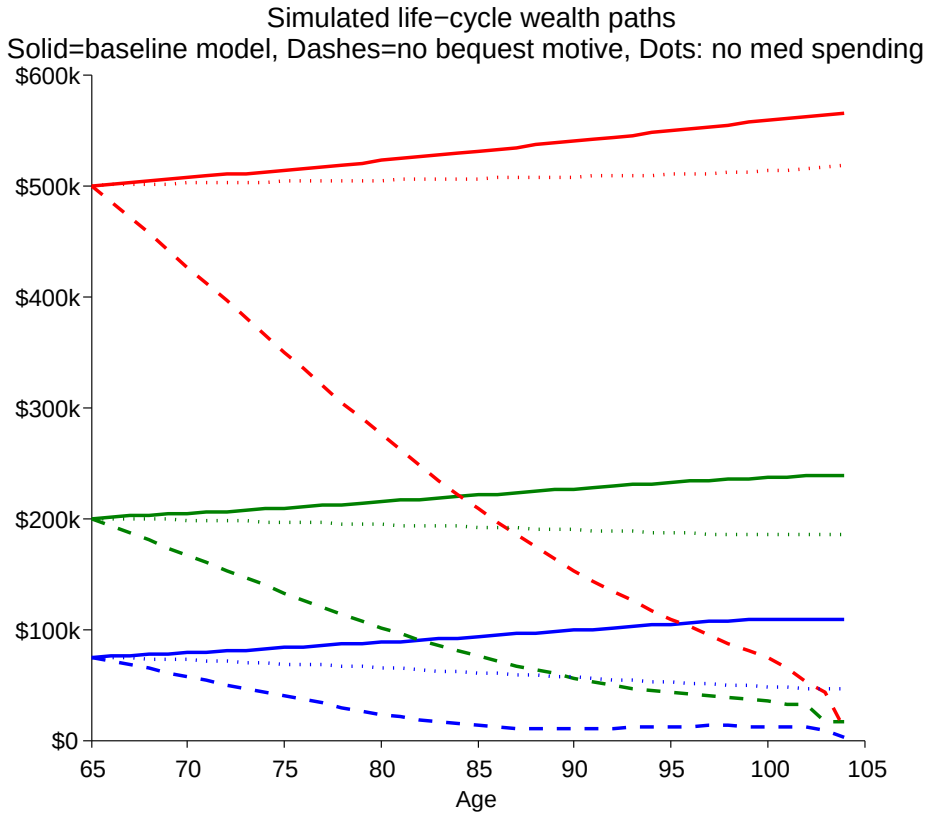

Figure 5: Simulated wealth paths for people without long-term care insurance who live to age 104 and remain healthy throughout retirement. Each has real income of $22,500 (roughly the median of 65–69-year-olds single retirees). The initial non-annuity wealth levels roughly correspond to the median and the 75th and 90th quantiles among the 65–69-year-old single retirees group.

throughout retirement. Each has real income of $22,500 (roughly the median of 65–69-year-olds single retirees) and begins with $75,000, $200,000, or $500,000 of non-annuity wealth, roughly the median and 75th and 90th quantiles of this age group. The estimated bequest motive has a large effect on saving, even for retirees around the middle of the wealth distribution (the lowest set of lines). Whereas without bequest motives, even

people who remain in good health (and who therefore spend nothing on medical care and have good survival prospects) spend more than half their wealth by age 83 (and often much earlier), with the estimated bequest motive retirees in the middle and upper parts of the wealth distribution roughly maintain their wealth during retirement, letting it grow slowly by consuming less than their annuity- plus interest-income. This is consistent with the evidence that outside of large shocks, households typically maintain their wealth during retirement and that many retirees *actively save*, i.e., spend less than their after-tax income Dynan et al. (2004). In comparison, medical spending has a minor effect on saving. Eliminating medical spending from the model causes the wealth paths around the 90th quantile to flatten and those around the 50th and 75th quantiles to decline slightly.

Long-term care insurance.— Table 3 also shows that the bequest motive significantly reduces long-term care insurance ownership (from 36.6% to 5.7%), mostly by reducing ownership in the top half of the wealth distribution. The bequest motive reduces ownership in the third quartile from 46.5% to 8.4% and in the fourth quartile from 94.8% to 14.4%. Moreover, in addition to matching closely the overall long-term care insurance ownership rate, the simulated pattern of ownership across the wealth distribution—which was not targeted by the estimation procedure—also matches closely the empirical pattern. Both exhibit around zero ownership in the bottom quartile and increase to about 14% ownership in the top quartile. The model without bequest motives, on the other hand, not only predicts far too much long-term care insurance ownership overall, it especially over-predicts ownership in the top half of the distribution, predicting in the top quartile almost universal ownership (94.8%).

The estimated bequest motive also affects the model's predictions about how loads affect the demand for long-term care insurance. The model without bequest motives predicts almost identical demand for a comprehensive, actuarially fair contract as for the typical contract, which covers nursing home costs incompletely and has an 18% load. The roughly two-thirds of people who forgo long-term care insurance in this case do so mostly because of Medicaid, which makes the effective load on private insurance (inclusive of the resulting

reduction in Medicaid benefits), relatively insensitive to the load on the contract itself (Brown and Finkelstein, 2008). The model with the estimated bequest motive, however, predicts that long-term care insurance ownership would be almost four times greater (22.4% instead of 5.7%) if comprehensive, actuarially fair contracts were available. The bequest motive reduces the extent to which Medicaid "crowds out" the demand for long-term care insurance.

Annuities.— The last rows of Table 3 show how bequest motives and long-term care risk affect simulated annuity ownership. I consider annuities that pay $5,000 (real) per year for life and have a ten percent load, typical of the U.S. private market. The estimated bequest motive significantly reduces the demand for annuities. Whereas 46.4% of the sample buys this annuity in the models without bequest motives—basically everyone who can afford the premium—only 15.2% do in the baseline model. Yet the baseline model does not fully explain why so few people buy annuities, as empirically only about 4% of single retirees own life annuities. The model over-predicts demand for annuities mostly among people in the third wealth quartile, who are rich enough to afford the annuity but not so rich that the estimated bequest motive significantly reduces their desire to increase consumption at the expense of bequests. Like long-term care insurance, the main determinant of the gain from annuities is the value of increasing consumption at the expense of bequests (Lockwood, 2009). Simulated annuity ownership is rapidly decreasing in c_0 around the estimated value because lower c_0 reduces the number of people who wish to increase their consumption at the expense of bequests.

Long-term care risk *increases* the demand for annuities: only 8.3% of retirees buy the annuity without long-term care compared to 15.2% in the baseline model. Theoretically, liquidity risks could increase or reduce the demand for (illiquid) annuities depending mostly on the timing of the risks (Davidoff et al., 2005). Long-term care risk increases the demand for annuities in this model because most long-term care expenses occur late in life (thereby effectively reversing some annuitization) and because Medicaid means tests allow people to keep their annuity wealth (though not their annuity income) while receiving

Effect of incomplete insurance on bequests		
Fraction with "operative" bequest motive, $b^* > 0$		
Full sample	45.6%	
65–69-year-olds		
Overall	39.1%	
Bottom wealth quartile	3.0%	
2nd wealth quartile	7.9%	
3rd wealth quartile	47.3%	
Top wealth quartile	98.1%	
Share of wealth bequeathed		
	Baseline	Full, fair insurance
Full sample	65.9%	57.5%
65–69-year-olds		
Overall	56.6%	50.9%
Bottom wealth quartile	346.4%	162.0%
2nd wealth quartile	27.9%	7.7%
3rd wealth quartile	45.4%	28.2%
Top wealth quartile	59.8%	56.8%

Table 4: Top: Fraction of population that would leave bequests if long-term care costs were fully insured at actuarially fair prices and actuarially fair annuities were available. Bottom: Share of non-annuity wealth bequeathed in the baseline model and with full, actuarially fair insurance.

Medicaid support. Among people with enough non-annuity wealth to potentially benefit from annuities, bequest motives rather than long-term care risk appear to be the main reason for annuities' unpopularity.

The effect of incomplete insurance on bequests.— Table 4 shows the fraction of people who would leave bequests and expected discounted bequests with full, actuarially fair insurance and expected discounted bequests with actual insurance.[39] In the full insurance case, less than half of the sample (45.6%) and just 39.1% of 65–69-year-olds has an operative bequest motive in the sense of actually leaving a bequest. Incomplete insurance has potentially large effects on bequests because self-insuring risks means leaving large bequests in some states. Yet the results indicate that incomplete insurance has a relatively modest effect on

[39]Because of Medicaid, few people would choose to fully insure even if actuarially fair insurance were available. The results in the table therefore correspond to a hypothetical in which risks are fully insured and not a prediction of the effects of introducing actuarially fair insurance.

aggregate bequests: only about 6% more non-annuity wealth is bequeathed by 65–69-year-olds in the baseline model (with incomplete insurance) than in the full-insurance model (56.6% versus 50.9%). On average, therefore, most of the dollars of aggregate bequests are bequeathed purposefully—i.e., they would have been bequeathed even with full insurance—rather than arising as a byproduct of self-insuring risks. But this relatively modest difference in the overall share hides large differences in the shares of all but the richest retirees. Whereas retirees in the top quartile, nearly all of whom have an operative bequest motive in the full insurance case, bequeath almost as much with full insurance as in the baseline model (56.8% versus 59.8%), retirees in the bottom three wealth quartiles leave much larger bequests on average in the baseline model than with full insurance. Part of the difference is due to Medicaid. People without full insurance receive Medicaid benefits in some states, which allows them to consume and bequeath more on average. The other part of the difference is due to how insurance changes the mix of consumption and bequests. Insurance allows people to increase consumption at the expense of bequests, which is especially valuable for people with weak bequest motives.

Estate (and gift) taxes.— Table 5 shows the effects of imposing 25%, 50%, and 100% taxes on bequests.[40] Although a 100% estate tax has a large effect on the share of wealth bequeathed, reducing the share from 65.9% to 37.2%, the 50% estate tax has little effect, reducing the share by 1.4% to 64.5%. Estate taxes increase the share of long-term care costs paid by Medicaid but the effects are small. Higher estate taxes increase ownership of long-term care insurance and annuities, with especially large effects of full confiscatory taxes.

[40]The goal of this experiment is to learn about the bequest motive more than to evaluate policy. To the extent that inver-vivos gifts are close substitutes for bequests, as they are in many models of inter-household transfers, this policy experiment should be thought of as a tax on both bequests and inter-vivos gifts. Moreover, this experiment holds fixed the interest rate and ignores any effects of tax revenue on preferences or budget constraints.

Effect of estate taxes on saving and insurance

Estate tax rate:	0%	25%	50%	100%
Share of wealth bequeathed				
Full sample	65.9%	65.6%	64.5%	37.2%
65–69-year-olds	56.5%	56.4%	55.2%	26.0%
Medicaid share of nursing home costs				
Full sample	37.9%	38.5%	39.1%	41.4%
65–69-year-olds	44.0%	44.4%	44.6%	45.2%
LTCI ownership				
Overall	5.7%	7.9%	14.2%	36.6%
Bottom wealth quartile	0.0%	0.0%	0.0%	0.0%
2nd wealth quartile	0.0%	0.8%	1.9%	5.2%
3rd wealth quartile	8.4%	12.2%	28.8%	46.5%
Top wealth quartile	14.4%	18.5%	26.1%	94.8%
Annuity ownership				
Overall	15.2%	16.0%	18.1%	46.4%
Bottom wealth quartile	0.0%	0.0%	0.0%	0.0%
2nd wealth quartile	0.0%	0.0%	0.0%	0.0%
3rd wealth quartile	45.9%	48.6%	50.5%	86.7%
Top wealth quartile	15.0%	15.5%	21.7%	98.9%
Can afford	32.6%	34.4%	38.7%	99.4%

Table 5: Bequests and Medicaid shares are based on simulated insurance ownership.

6 Conclusion

Rather than buying insurance against the main risks they face, most retirees "self-insure" by spending their wealth only if losses occur. I show that in the context of a standard life-cycle model these choices indicate widespread, important bequest motives. The results indicate that bequest motives matter for many retirees' saving and insurance decisions, and that they matter in a particular sense. Even people who would leave *no* bequest if perfect insurance were available may be led by their bequest motives to make very different choices with imperfect insurance markets. Bequest motives encourage people to self-insure late-life risks because doing so gives them the chance of leaving large bequests and because they can support their consumption if necessary by leaving small bequests.

The results have important policy implications. People age 55 and older hold roughly 70% of the world's wealth so policies that affect their saving and insurance decisions have important effects on the size, distribution, and risk of bequests received by future generations. Retirees' decisions about how much to save and whether to buy insurance significantly affect government spending on means-tested social insurance programs such as Medicaid. The results indicate that policies that make bequests and inter-vivos gifts less attractive, such as estate and transfer taxes, would reduce average bequests both by reducing the incentive to save and by encouraging more retirees to buy long-term care insurance and life annuities.

APPENDIX

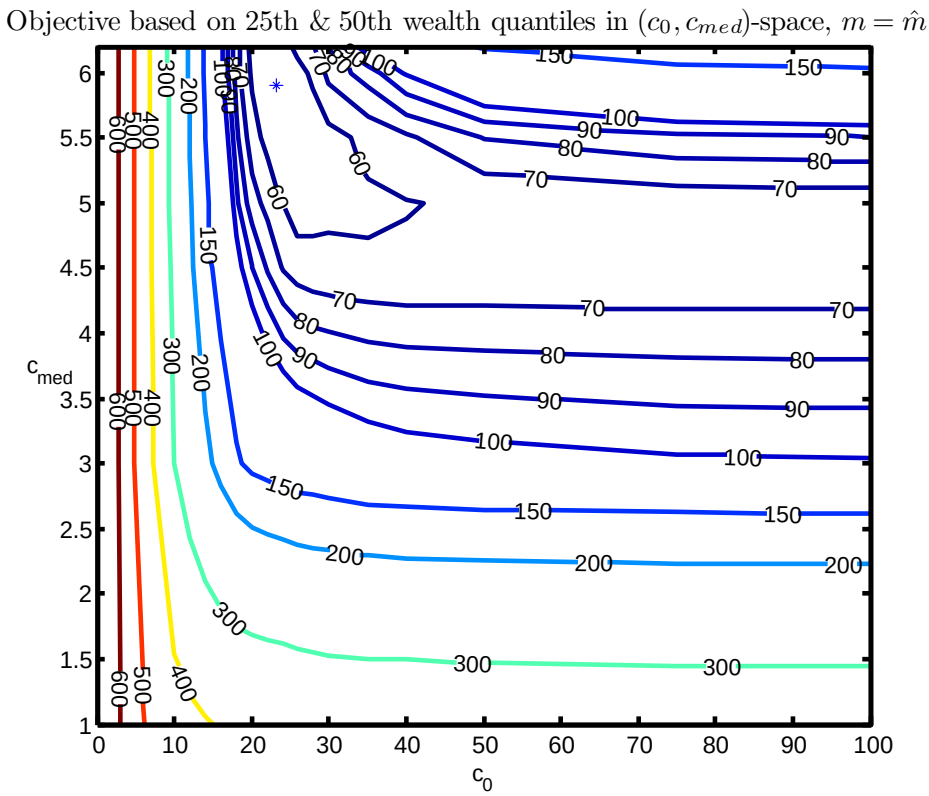

Figure 6: Objective function based on the 25th and 50th wealth quantiles as a function of (c_{med}, c_0). m is fixed at its estimated value, $\hat{m} = .975$. The asterisk marks the baseline estimates $(\hat{c}_{med} = 5.897, \hat{c}_0 = 23.0974)$.

A Identification of the Model

A.1 Contribution of Different Moments to the Identification of the Model

Saving by people in the bottom and middle parts of the wealth distribution.— Figure 6 is a contour plot of an objective function based on the 25th and 50th wealth quantiles as a function of (c_{med}, c_0), where m is fixed at its estimated value, $\hat{m} = .975$.[41] Higher contours indicate greater mismatch between simulated and empirical moments. The asterisk marks the baseline estimates $(\hat{c}_{med} = 5.897,\ \hat{c}_0 = 23.097)$. The figure shows that saving by people

[41] The weighting matrix is the baseline weighting matrix with the rows and columns corresponding to the moments other than the 25th and 50th wealth quantiles zeroed out.

around the 25th and 50th wealth quantiles is inconsistent with: very strong bequest motives ($c_0 < 15$), very strong Medicaid aversion ($c_{med} < 4$), and the combination of weak bequest motives and weak Medicaid aversion ($c_0 > 50$ and $c_{med} > 5.5$). People in the bottom and middle of the wealth distribution save too little to have strong bequest motives or to be highly averse to Medicaid, but they save too much to neither have bequest motives nor be averse to Medicaid. Instead, their saving is most consistent with a combination of fairly strong bequest motives and modest Medicaid aversion ($c_0 \in [20, 35]$ and $c_{med} \in [4.75, 6.2]$). But the identification problem is apparent: a wide range of combinations of bequest motives and Medicaid aversion are roughly consistent with the data. Models with no bequest motive and moderate Medicaid aversion ($c_0 = \infty$ and $c_{med} = 4.5$) fit the data almost as well as models with moderate bequest motives and no Medicaid aversion ($c_0 = 25$ and $c_{med} > 6.2$).

Saving by people in the top part of the wealth distribution.— Figure 7 is a contour plot of an objective function based on the 75th and 90th wealth quantiles as a function of (c_{med}, c_0), where m is fixed at its estimated value, $\hat{m} = .975$. Saving by people around the 75th and 90th wealth quantiles is inconsistent with weak bequest motives ($c_0 > 40$) and strong bequest motives ($c_0 < 20$), and is somewhat inconsistent with extremely strong Medicaid aversion ($c_{med} < 2$). The 75th and 90th wealth quantiles therefore identify bequest motives fairly precisely (indicating $c_0 \approx 25$) but are almost completely uninformative about Medicaid aversion. People in the upper part of the wealth distribution are influenced much more by the desire to leave bequests than the remote possibility of exhausting their wealth and requiring Medicaid support.

Long-term care insurance ownership.— Figure 8 shows a contour plot of the simulated long-term care insurance ownership rate as a function of Medicaid aversion and the bequest motive. The contour labeled 5 is the one closest to the empirical ownership rate of 5.6%. Strong Medicaid aversion ($c_{med} < 4$) or extremely strong bequest motives ($c_0 < 5$) produce much greater long-term care insurance ownership than the 5.6% observed in the data. The low empirical rate of long-term care insurance ownership therefore suggests a combination

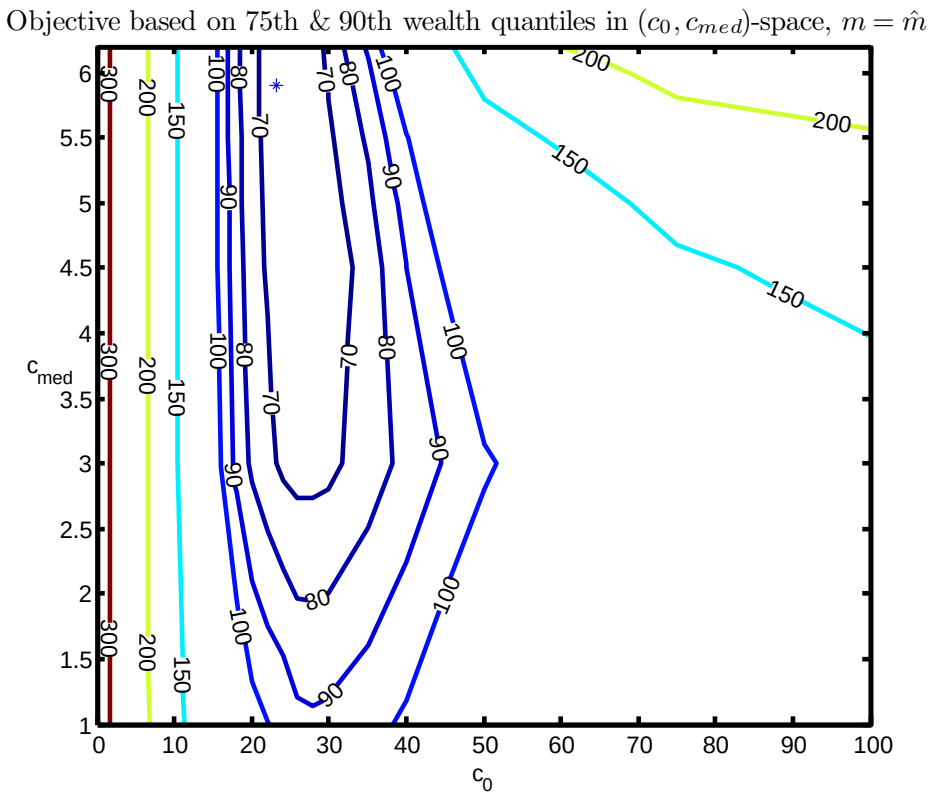

Figure 7: Objective function based on the 75th and 90th wealth quantiles as a function of (c_{med}, c_0). m is fixed at its estimated value, $\hat{m} = .975$. The asterisk marks the baseline estimates $(\hat{c}_{med} = 5.897, \hat{c}_0 = 23.0974)$.

of moderate to very strong bequest motives ($c_0 \in [5, 30]$) and modest to no Medicaid aversion ($c_{med} \in [4.5, 6.2]$).

Neither saving by people at any particular part of the wealth distribution nor the lack of demand for long-term care insurance alone reveals important bequest motives. But collectively the saving and long-term care insurance choices of single retirees strongly suggest that important bequest motives in which bequests are a luxury good are widespread.

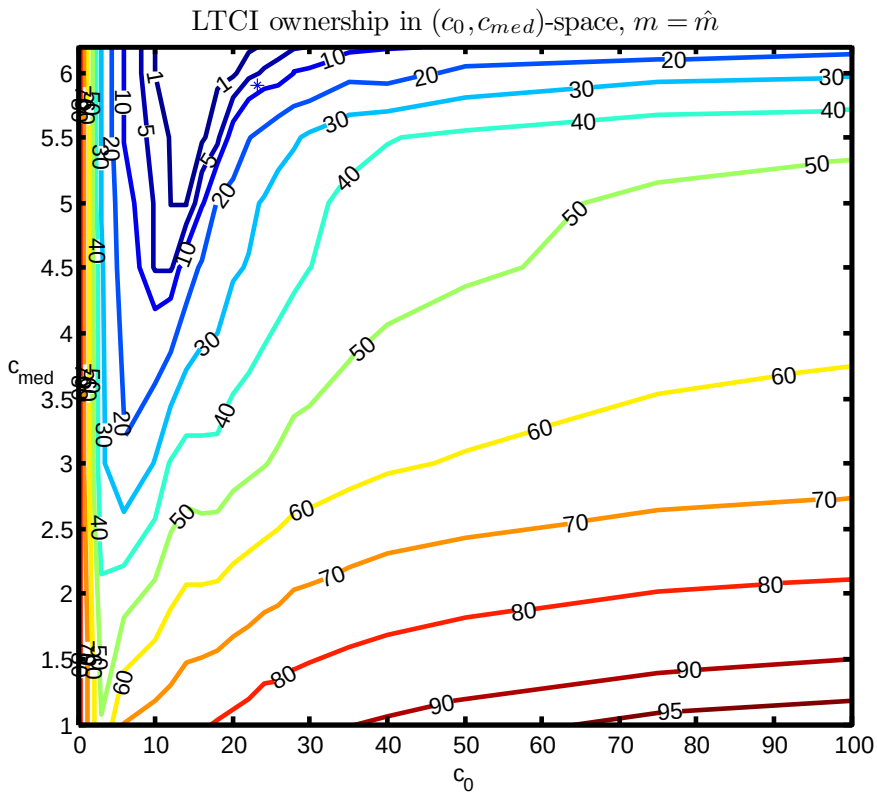

Figure 8: Simulated long-term care insurance ownership as a function of the parameters (c_{med}, c_0). m is fixed at its estimated value, $\hat{m} = .975$. The asterisk marks the baseline estimates $(\hat{c}_{med} = 5.897, \hat{c}_0 = 23.0974)$. The empirical ownership rate is 5.6%.

A.2 Bequest Motives and the Demand for Long-term Care Insurance

Figure 8 shows that as the bequest motive increases in strength (from higher to lower c_0), long-term care insurance ownership first decreases and then increases in the strength of the bequest motive. When bequest motives are very strong, people buy long-term care insurance to ensure that they can leave bequests even if they require costly care. People with very strong bequest motives therefore may have greater demand for long-term care insurance than people without bequest motives. People with moderate bequest motives, on the other hand, gain less from long-term care insurance than people with stronger or weaker bequest motives. They gain less than people with stronger bequest motives because they do not suffer a large utility loss from failing to leave a bequest when they require

Effect of the estimated bequest motive on the value of long-term care insurance

Medicaid aversion:	Modest ($c_{med} = \hat{c}_{med} = 5.897$)				Strong ($c_{med} = 2.5$)			
Bequest motive:	No		Yes		No		Yes	
LTCI:	No	Yes	No	Yes	No	Yes	No	Yes
$WTP(ltci)$	21.6	-	-4.3	-	94.1	-	5.0	-
$EDV(c)$	423.4	423.0	354.6	354.8	365.7	423.0	338.1	354.8
$EDV(b)$	50.5	40.3	115.4	108.6	104.5	40.3	131.6	108.6
E(mos in Med)	4.7	0.0	0.4	0.0	0.4	0.0	0.1	0.0
EDV(Med bens)	4.2	0.0	0.3	0.0	0.3	0.0	0.1	0.0

Table 6: Willingness to pay for long-term care insurance, expected discounted consumption spending, bequests, and Medicaid spending, and expected months in Medicaid facilities for a healthy 67-year-old with $200,000 in non-annuity wealth and a $22,500 real income stream. All figures other than months in Medicaid facilities are in thousands of dollars.

costly long-term care. And they gain less than people with weaker bequest motives because they get more utility from the bequests that arise incidentally from self-insuring their risk and because their risk is partially insured by their bequests.

Table 6 shows how buying a typical long-term care insurance contract affects expected discounted consumption, bequests, and Medicaid usage by a healthy 67-year-old around the 75th percentile of the wealth distribution.[42] People without bequest motives gain significantly more from long-term care insurance than people with the estimated bequest motive do. With the estimated (modest) Medicaid aversion, people without bequest motives are willing to pay $21,600 for access to a typical long-term care insurance contract whereas people with the estimated bequest motive are worse off with the contract: they must be paid $4,300 to be as well off with insurance as without. The difference is much larger when Medicaid aversion is strong. Then people without bequest motives are willing to pay $94,100 while people with the estimated bequest motive are willing to pay $5,000.

To understand why people with the estimated bequest motive gain so much less from long-term care insurance than people without bequest motives, it is helpful to decompose

[42]The long-term care insurance contract under consideration is the one from the baseline model, which covers all forms of long-term care, has a $100 maximum daily benefit, and whose expected discounted premiums exceed expected discounted benefits by 18%, or about $6,300. The individual begins with $200,000 in non-annuity wealth and real annuity income of $22,500 per year for life.

the effects of buying long-term care insurance into five components. First, buying long-term care insurance reduces expected resources available for consumption and bequests because of its $6,300 load and because it reduces expected Medicaid benefits. Second and related, buying long-term care insurance reduces the expected time spent in Medicaid facilities. Retirees around the 75th percentile of the wealth distribution, however, have enough wealth that they seldom use Medicaid even without insurance: even without bequest motives or strong Medicaid aversion, they spend on average less than five months in Medicaid facilities. Buying long-term care insurance therefore has little effect on their Medicaid usage and, as a result, differences in expected Medicaid usage with and without insurance have little effect on their demand for insurance.

Third and fourth, buying long-term care insurance insures consumption and bequests against long-term care risk. People with bequest motives gain less from the consumption-insurance aspect of long-term care insurance because without insurance they can partially insure their consumption by leaving smaller bequests in states with high long-term care costs. Insuring consumption with bequests means that bequests absorb much of the difference in long-term care costs in different states, but as long as people are not unusually risk averse over bequests it is not worth paying available long-term care insurance loads to insure bequests.

Finally and most importantly, buying long-term care insurance allows people to consume more aggressively (and leave smaller bequests) if they wish. This is best seen in the case when people are highly averse to Medicaid. Without insurance, people must save a lot (and consume little) to reduce the risk of being forced onto Medicaid. Buying insurance significantly reduces this risk, which allows people to consume more aggressively. The fifth and sixth columns show that by buying long-term care insurance, people without bequest motives who are highly averse to Medicaid are able to increase their consumption by almost 16% (from $365,700 to $423,000) by reducing their "accidental" bequests by $60,200 (from $104,500 to $40,300). For people without bequest motives, this is the key gain from long-term care insurance. It is also the reason they gain so much more than

people with bequest motives, as the greater consumption necessarily comes at the expense of smaller bequests. The seventh and eighth columns show that people with bequest motives increase their consumption and reduce their bequests much less when they buy long-term care insurance.

Compared to buying long-term care insurance, self-insuring long-term care risk involves three costs that are smaller for people with bequest motives: it limits consumption because people must save for (possible) future long-term care; it increases the probability that consumption will be driven down by long-term care costs; and it increases time spent in Medicaid facilities. The one cost of self-insurance that is greater for people with bequest motives is that self-insurance leaves bequests significantly more exposed to long-term care risk. But people with the estimated bequest motive—and most other bequest motives in which bequests are a luxury good—gain little from bequest insurance and are therefore likely to self-insure their risk to avoid insurance loads.

B Numerical Solution of the Life Cycle Model

This section describes how I solve the model. The model must be solved separately for different income levels and with and without long-term care insurance. Given income, long-term care insurance coverage, and a candidate parameter vector, θ, I numerically approximate the value and optimal choice (consumption) functions, $V_t(w_t, h_t, ltci; \theta)$ $t \in \{65, 66, ...105\}$ and $c_t(w_t, h_t, ltci; \theta)$ for $t \in \{65, 66, ...104\}$.

I solve the model via backward induction from age 105, when the individual is certain to be dead. I discretize wealth to lie on a fine grid, which is especially fine at low values where nonlinearities are likely to be most significant. Both the borrowing constraint and means-tested social insurance can cause jumps in the consumption function and non-convexity in the value function, which make many numerical maximization methods inappropriate. The solution procedure chooses the expected utility-maximizing

consumption level from a grid of possible consumption levels spaced every \$50 at each wealth-age-health node. This simple grid search is robust to functions with multiple local maxima and it economizes on computation time by requiring fewer interpolations of the value functions. To approximate the value function between wealth nodes I use piecewise cubic hermite interpolation, which preserves the data's monotonicity and shape, and I use linear extrapolation outside the grid range.

C Asymptotic Distribution of the MSM Estimator

The MSM estimator is

$$\hat{\theta} = \arg\min_{\theta} (\hat{\pi} - g(\theta, \hat{\chi}))' W (\hat{\pi} - g(\theta, \hat{\chi})),$$

where $\hat{\pi}$ is the vector of the empirical moments and $g(\theta, \hat{\chi})$ is a the vector of simulated moments evaluated at the first-stage parameter values, $\hat{\chi}$. Pakes and Pollard (1989) show that $\hat{\theta}$ is consistent and asymptotically normally distributed under regularity conditions satisfied here, $\hat{\theta} \rightsquigarrow N(\theta_0, \Omega_\theta)$. The variance-covariance matrix of $\hat{\theta}$ is

$$\Omega_\theta = (G_\theta' W G_\theta)^{-1} G_\theta' W \left[V(\hat{\pi}) + \frac{N_d}{N_s} V(\hat{\pi}) + G_\chi \Omega_\chi G_\chi' \right] W G_\theta (G_\theta' W G_\theta)^{-1},$$

where G_θ and G_χ are the gradient matrices of the moment conditions with respect to θ and χ, $V(\hat{\pi})$ is the variance of the reduced form estimates, Ω_χ is the variance of the first-stage estimates, and N_d and N_s are the empirical sample size and the simulation sample size, respectively. The square root of the diagonal entries of Ω_θ are the standard errors of the second-stage parameter estimates, $\hat{\theta}$. I replace the derivatives with numerical approximations. The baseline estimates use the inverse of the variance of the second-stage moment estimates as the weighting matrix, $W = V(\hat{\pi})^{-1}$, which would be optimal were it not for uncertainty in the first-stage parameter estimates. Because optimally-weighted minimum distance estimators sometimes perform poorly in small samples (e.g., Altonji and

Segal (1996)), as a robustness check I use an alternative weighting matrix suggested by Pischke (1995), $W_{robust} = diag(\hat{V}(\hat{\pi}))^{-1}$.

The variance of the second stage estimates, Ω_θ, includes a correction for simulation error, $\frac{N_d}{N_s}V(\hat{\pi})$, but does not correct for the uncertainty in the first-stage parameter estimates because I set rather than estimated the first-stage parameters, $\Omega_\chi = 0$. Excluding the correction for the uncertainty in the first-stage parameters tends to make the parameter estimates appear more precise than they actually are and makes the fit of the model (measured by a chi-squared test) appear worse than it actually is. The first-stage correction would be increasing in the uncertainty of the first-stage parameter estimates and in the sensitivity of the second-stage moments to the first-stage parameters. Simulation error (and the correction for it) approaches zero as the size of the simulated population relative to the size of the sample goes to infinity. Without the simulation and first-stage corrections, Ω_θ would be the standard variance of minimum distance estimators, $\Omega_\theta = (G'_\theta V(\hat{\pi})^{-1} G_\theta)^{-1}$, and the baseline weighting matrix would be optimal.

The number of second-stage moment conditions exceeds the number of second-stage parameters, so over-identification tests of the model are possible. If the model is correct, the (scalar) statistic

$$(\hat{\pi} - g_s(\hat{\theta}, \hat{\chi}))' W_{opt} (\hat{\pi} - g_s(\hat{\theta}, \hat{\chi}))$$

is a chi-squared random variable with $(r - length(\theta))$ degrees of freedom.

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