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ABSTRACT

Despite facing significant uncertainty about how long they will live and how much costly health care they will require, few retirees buy life annuities or long-term care insurance. Low rates of long-term care insurance coverage are often interpreted as evidence against the importance of bequest motives since failing to buy insurance exposes bequests to significant risk. In this paper, however, I find that low rates of long-term care insurance coverage, especially in combination with the slow rate at which many retirees draw down their wealth, constitute evidence in favor of bequest motives. Retirees' saving and long-term care insurance choices are highly inconsistent with standard life cycle models in which people care only about their own consumption but match well models in which bequests are luxury goods. Bequest motives tend to reduce the value of insurance by reducing the opportunity cost of precautionary saving. Buying insurance reduces one's need to engage in precautionary saving, which is most valuable to individuals without bequest motives who wish to consume all of their wealth. The results suggest that bequest motives significantly increase saving and significantly decrease purchases of long-term care insurance and annuities.

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1 Introduction

Retirees face significant uncertainty about how long they will live and how much money they will spend coping with bad health. Among 65-year-olds in the U.S., for example, about one in five will die before age 75 while another one in five will live to at least age 90 (Bell and Miller, 2005). Over half of 50-year-olds will live in a nursing home before they die (Hurd, Michaud and Rohwedder, 2013), and nursing home stays, which in countries such as the U.S. and U.K. are not covered by universal social insurance programs, cost an average of about \$84,000 per year (MetLife Mature Market Institute, 2010). Although these risks could quickly exhaust the wealth of even relatively wealthy retirees, few retirees choose to insure them. In the U.S., only about 5 percent of retirees buy life annuities to convert their wealth into a lifelong income stream and only about 10 percent buy long-term care insurance to cover the costs of nursing homes and other long-term care.

In this paper, I propose and test a new explanation for why many retirees self-insure: bequest motives. Bequest motives are often thought to increase the demand for products that insure bequests, such as long-term care insurance. But many types of bequest motives—including the type that appears to be widespread among U.S. retirees, in which bequests are luxury goods—decrease the demand for insurance against late-life risks. Bequest motives can decrease the demand for insurance by reducing the opportunity cost of precautionary saving. Without long-term care insurance, people who wish to avoid relying on Medicaid or their families must set aside substantial wealth in case they will require costly care. This greatly limits how much they can consume. Such limits on consumption are much more costly to people without bequest motives, who would like to consume all of their wealth, than they are to people with bequest motives, who value the prospect of leaving wealth to their heirs. For people with bequest motives, self-insurance has a major advantage that is absent for people without bequest motives: Only people with bequest motives value the large bequests that arise incidentally from self-insuring late-life risks.

I estimate several versions of a life cycle model of retirement to answer two main questions. First, can a standard life cycle model match retirees' saving and long-term care insurance choices? Second, can the model match the data without a bequest motive? I solve the problem of separately identifying precautionary and bequest motives by analyzing long-term care insurance decisions together with saving and by comparing the saving behavior of retirees with different levels of wealth. Both of these identification strategies produce the same conclusion: Standard models with bequest motives match retirees' behavior well while models without bequest motives miss badly.

I use the Method of Simulated Moments to estimate bequest and precautionary motives in

a model that nests as special cases models with a wide range of bequest motives, including no bequest motive. This enables me to perform statistical tests of the model's fit and of the restrictions implicit in nested versions of the model. At the core of the model are rich approximations of U.S. social insurance programs and of the medical spending and lifespan risks facing single retirees in the U.S. The estimation is based on the saving and long-term care insurance choices of single retirees in the Health and Retirement Study, a panel study of people over the age of 50.

Without bequest motives, the model is highly inconsistent with three major features of the data and is strongly rejected by over-identification tests of the model's fit. One feature is low long-term care insurance ownership rates, especially among the wealthy. Models without bequest motives predict too much long-term care insurance coverage, especially among retirees in the top quartile of the wealth distribution. Another feature of the data that the model without bequest motives cannot match is the pattern of saving across the wealth distribution. In the model without bequest motives, middle-class retirees save too much relative to both richer and poorer retirees. Middle-class retirees tend to be the ones most affected by the precautionary motive since they are neither so rich as to be well-protected from costly medical needs nor so poor as to be well-insured by means-tested social insurance programs.

The third major feature of the data that the model without bequest motives cannot match is the combination, among middle-class and richer retirees, of low long-term care insurance coverage and slow drawdown of wealth. Previous research has established that standard life cycle models without bequest motives can match the low rates of long-term care insurance coverage among middle-class retirees (Brown and Finkelstein, 2008) and, separately, the slow drawdown of wealth among middle-class retirees (e.g., Palumbo, 1999; De Nardi, French and Jones, 2010; Ameriks et al., 2011). I find, however, that models without bequest motives cannot match both decisions simultaneously. To match the saving decisions of middle-class retirees, the model without bequest motives requires a strong precautionary motive: retirees must be highly risk averse or highly averse to relying on means-tested social insurance programs. But to match the long-term care insurance decisions of middle-class retirees, the model without bequest motives requires that people have a weak precautionary motive. As a result, models without bequest motives that match the long-term care insurance coverage of middle class retirees predict far too little saving and models that match the saving of middle-class retirees predict far too much long-term care insurance coverage.

With bequest motives, by contrast, the model matches retirees' saving over the life cycle and throughout the wealth distribution, and it matches the limited demand for long-term

care insurance, including by the rich. The estimated bequest motive, in which bequests are luxury goods, increases the saving of richer retirees relative to poorer ones and encourages people to self-insure their late-life risks. Although buying long-term care insurance would allow people to consume more of their wealth by reducing their need to engage in precautionary saving, my estimates indicate that most retirees are not willing to pay available insurance prices in order to increase their consumption at the expense of leaving smaller bequests. Buying long-term care insurance would also protect bequests from the risk of being depleted by costly care episodes, but my estimates—as well as other evidence such as the high wealth elasticity of bequests (Auten and Joulfaian, 1996; Hurd and Smith, 2002)—indicate that most retirees are not sufficiently risk-averse over bequests to justify buying available long-term care insurance contracts. For most people, the benefits of buying long-term care insurance are outweighed by the costs, which are comprised of the loads on these contracts (which in the U.S. average 18 percent of premiums [Brown and Finkelstein (2007)]) and the reduced eligibility for means-tested social insurance (Pauly, 1990; Brown and Finkelstein, 2008).¹

My results suggest that bequest motives are central for understanding retirees' saving and insurance decisions. This finding is important because much of the literature on saving and insurance decisions relegates bequest motives to a secondary role or ignores them altogether. One fact that has been cited as evidence against bequest motives is the low rate of long-term care insurance coverage, since (non-strategic) bequest motives are generally thought to increase the demand for long-term care insurance.² My results suggest instead that low rates of long-term care insurance coverage, especially among retirees in the top half of the wealth distribution and especially in combination with the slow drawdown of wealth, are more likely to be evidence in favor of bequest motives. Bequest motives, which primarily affect relatively wealthy retirees, naturally complement Medicaid (Pauly, 1990; Brown and Finkelstein, 2008) and other factors that reduce rates of long-term care insurance coverage primarily among people with little wealth to help explain the low rates

¹An insurance policy with an 18 percent load pays 82 cents of benefits per dollar of premiums on average.

²The view that (non-strategic) bequest motives should increase the demand for long-term care insurance is based on two observations made by Pauly (1990): Bequest motives make spending down wealth to qualify for means-tested programs such as Medicaid less attractive, and long-term care insurance insures bequests. Strategic bequest motives, on the other hand, which refer to situations in which people exchange bequests for services from their heirs, have been proposed as an explanation for why some people do not buy long-term care insurance (Bernheim, Shleifer and Summers, 1985; Pauly, 1990; Zweifel and Struwe, 1996).

of insurance coverage throughout the wealth distribution.^{3,4} The estimated bequest motive also makes the model-predicted annuity ownership rate match closely the low ownership rate observed empirically, despite not targeting this fact.

What is likely a more important reason for the relegation of bequest motives to a secondary role is that standard life cycle models without bequest motives can (separately) match the saving and long-term care insurance decisions of non-rich retirees. A standard finding in the large literature that analyzes saving during retirement (e.g., Hubbard, Skinner and Zeldes, 1995; Palumbo, 1999; De Nardi, French and Jones, 2010; Ameriks et al., 2011; Kopecky and Koreshkova, 2014) is that, given the significant medical spending risk faced by retirees, even models without bequest motives can match well the slow drawdown of wealth by middle-class retirees. Although this finding is sometimes interpreted as evidence against the importance of bequest motives, it actually just reflects the difficulty—due to the uncertainty facing retirees and the nature of non-contingent wealth—of interpreting retirees’ saving. My strategies for separately identifying precautionary and bequest motives—analyzing long-term care insurance decisions together with saving and comparing the saving behavior of retirees with different levels of wealth—complement those of two recent papers that also analyze late-life saving together with other empirical patterns in order to obtain sharper identification. Ameriks et al. (2011) use responses to survey questions about people’s state-contingent plans, and De Nardi, French and Jones (2013) use Medicaid reciprocity rates. Both conclude that bequest motives play an important role in retirees’ choices.

Understanding retirees’ saving and insurance decisions may be more important now than ever before. Individuals have become increasingly responsible for providing for their own retirement—especially with the decline of employer-directed retirement plans—even as medical spending growth and lifespan improvements have made retirement planning more difficult. Retirees’ choices about how much to save and whether to buy insurance already have significant effects on government budgets and the broader economy, and these effects

³Many of the explanations for why few retirees buy long-term care insurance are, like Medicaid, most applicable to people who save little wealth into old age. These include failing to plan for the future or planning to rely on informal care (Pauly, 1990; Zweifel and Struwe, 1996). (See Brown and Finkelstein (2009) for a review.) People with more wealth are more likely to have planned for their retirement (Lusardi and Mitchell, 2007) and are less likely to use informal care (Kemper, 1992; Ettner, 1994). Yet it is difficult to find any group of retirees, even among the rich, in which the long-term care insurance ownership rate exceeds 30 percent.

⁴The role of bequest motives in reducing the demand for long-term care insurance is related to Davidoff’s suggestion that housing wealth can substitute for long-term care insurance (Davidoff, 2009, 2010). Davidoff observes that people who consume their housing wealth if and only if they require long-term care—a strategy that appears to be widespread empirically—are partially insured by their housing wealth. Bequest motives can help explain why people might consume their housing wealth only in high-cost states and not in other states as well. As a result, bequest motives can also help explain the limited market for reverse mortgages, which is puzzling in the context of selfish life cycle models.

will grow in importance as the population ages. People aged 55 and older hold roughly 70 percent of the world's non-human wealth (The Economist, 2007). In 2009, Medicaid, the safety-net health insurance program in the U.S., spent more than \$100 billion on long-term care—43 percent of all spending on long-term care (Kaiser Commission on Medicaid and the Uninsured, 2011). A better understanding of the determinants of retirees' saving and insurance decisions can improve the design and evaluation of several important policies, including policies to encourage private insurance coverage; policies to provide social insurance; and policies regarding the tax treatment of savings, insurance, and inter-household transfers.

2 Long-Term Care Risk and Long-Term Care Insurance

This section summarizes the key features of the long-term care risk facing retirees and of the market for long-term care insurance. These facts guide my choices about the specification of the model and the set of facts with which to estimate and test the model. The model attempts to approximate in detail the key features of long-term care risk and the long-term care insurance market. On dimensions in which the approximation is less good and on which some slippage between the model and reality cannot be avoided, I test the robustness of the conclusions to plausible alternative assumptions and discuss any likely bias in the results. For overviews of long-term care risk and long-term care insurance, see Brown and Finkelstein (2011) and Davidoff (2013). For an overview of the role of the means-tested Medicaid program, see De Nardi et al. (2012).

2.1 Long-Term Care Risk

Long-term care risk is the greatest financial risk facing the elderly. Unlike acute medical care, much of which is covered by the universal Medicare program, long-term care is mostly not covered by Medicare or private health insurance contracts. Recent work (e.g., Hurd, Michaud and Rohwedder, 2013; Friedberg et al., 2014) has improved our understanding of the nature of the risk people face from long-term care. This work indicates that the lifetime risk of requiring costly care is in many ways even greater than previously thought. Between 53 and 59 percent of 50-year-olds will live in a nursing home before they die, and among those who do the average length of stay is about one year (Hurd, Michaud and Rohwedder, 2013). With an average price in 2010 of a year in a private room in a nursing home of about \$84,000 (MetLife Mature Market Institute, 2010), a long stay in a nursing

home can easily exhaust the wealth of most retirees, including those in the upper half of the wealth distribution. As a result, the means-tested Medicaid program covers at least some of the expenses of 70 percent of the nursing home population (Kaiser Commission on Medicaid and the Uninsured, 2013).

Patterns of long-term care usage are not uniform throughout the population. They vary by a variety of personal, household, and family characteristics. Appendix A.1.1 presents the results of several descriptive regressions of long-term care usage. Patterns of long-term care use differ systematically across people with different family structures. Single people use more formal care than married people do, and people without children use more formal care than people with children do. These patterns are consistent with married people and people with children relying more heavily on informal care than single people and people without children do. The regressions reveal a weak positive association between income and formal care use. This association is consistent with quasi-experimental evidence that formal care is a normal good (e.g., Goda, Golberstein and Grabowski, 2010; Tsai, 2015). Tsai (2015), for example, uses the Social Security “notch” as an exogenous determinant of income and finds that having more income leads people to consume more formal care and less informal care. That single people and higher-income people tend to use more formal care and less informal care suggests that a single-agent model that does not explicitly include family dynamics or informal care may provide a reasonable approximation to the tradeoffs facing single retirees in the upper part of the wealth distribution—precisely the people who might potentially buy long-term care insurance. (As Brown and Finkelstein (2008) argue, poorer retirees would be unlikely to buy long-term care insurance even in the absence of informal care since they are well-insured by Medicaid.) Of course, an important cost of focusing on single people is that, because of the importance of informal care among couples, the choices of the retired single people that I investigate may differ in important ways from those of members of couples.

2.2 Long-Term Care Insurance

Despite the significance of the risk that people face from long-term care, relatively few people buy long-term care insurance. The ownership rate among people age 65 and older is only about 10 percent. Under a typical long-term care insurance contract, the insured pays premiums each period in which she does not require long-term care and receives benefits in qualifying periods in which she does require long-term care. Within this common structure, there is substantial heterogeneity in coverage levels, from relatively little coverage (e.g., contracts that do not cover home care or that limit daily benefits to an amount far below the daily cost of nursing homes) to comprehensive coverage of long-term care costs. The

type of contract most often chosen is not very comprehensive.⁵ The modal maximum daily benefit limit is just \$100 (or about 70 percent of the average daily cost of nursing home care of \$143), and typical elimination periods (essentially deductibles, as only stays longer than this period are covered) range from 30 to 100 days (Brown and Finkelstein, 2007). The premium for a “typical policy” purchased at age 65 is about \$1,200 per year (Brown and Finkelstein, 2007).

Underwriting is an important part of the long-term care insurance purchasing process. People who are deemed high risk are charged higher prices or rejected altogether (i.e., not offered insurance at any price). Hendren (2013) shows how such rejections can arise in equilibrium due to adverse selection. Estimates suggest that among 65-year-olds, between 12 and 23 percent would be rejected from purchasing long-term care insurance if they tried (Murtaugh et al., 1997). Would-be rejections increase rapidly with age. Murtaugh et al. (1997) estimate that between 20 and 31 percent of 75-year-olds would be rejected if they tried to buy long-term care insurance, and underwriting guidelines used by an insurance broker for many of the largest long-term care insurance companies advise rejecting anyone over the age of 80 regardless of their health status (Hendren, 2013). This provides a “reclassification risk” motive for buying long-term care insurance relatively early in life, before experiencing any health problems that might increase the premiums one would be charged or prevent one from purchasing long-term care insurance altogether. Empirically, people most often purchase long-term care insurance in their early 60s (America’s Health Insurance Plans, 2007), and the average purchasing age is 67 (Brown and Finkelstein, 2007).

This process of underwriting and rejections appears to greatly limit the extent of adverse selection within the set of people who can purchase long-term care insurance. Finkelstein and McGarry (2006) find that on average people with long-term care insurance do not use long-term care services more than people without long-term care insurance, though they also find evidence of dynamic adverse selection, in which people whose health improves relative to the average health of people in their pool are more likely to drop their long-term care insurance by stopping paying premiums. Finkelstein and McGarry’s (2006) results are also consistent with moral hazard not being a large factor in determining long-term care use. This conclusion is reinforced by Grabowski and Gruber’s (2007) finding that nursing home use is not responsive to Medicaid reimbursement rates.

⁵It is important to note that in the case of long-term care, full *consumption* insurance does not require full coverage of long-term care costs. Full consumption insurance can be achieved with less-than-full coverage of long-term care costs, since long-term care often comes bundled together with a significant amount of non-care consumption, such as room and board for residents of nursing homes and assisted living facilities. As a result, residents’ greater care-related costs are partially offset by their lower non-care costs of living, since they no longer have to provide for their own room and board outside of what they pay for the nursing home.

There is significant heterogeneity in long-term care insurance ownership rates by personal and household characteristics. Descriptive regressions reported in Appendix A.1.1 show that long-term care insurance ownership is strongly related to wealth; ownership rates are very low in the bottom half of the wealth distribution and higher at the top. Yet even in the top wealth quartile, the ownership rate is just 12.5 percent. Controlling for wealth, ownership rates are similar between single and married people and between people with and without children. One explanation for the lack of a strong relationship between family structure and long-term care insurance ownership is that, as discussed above, informal care from children appears to be an inferior good (Tsai, 2015). To the extent that informal care from children is an inferior good, richer people are less likely to have their demand for long-term care insurance affected by whether they have children and their children’s characteristics. For poorer people, the presence of Medicaid suggests that few would buy long-term care insurance even if they did not plan to use informal care (Brown and Finkelstein, 2008).

3 Model

The model follows closely those in Brown and Finkelstein (2008) and De Nardi, French and Jones (2010) in their analyses of the demand for long-term care insurance and saving, respectively. A single retiree decides whether to buy long-term care insurance at the beginning of retirement and how much to consume each period. Each period is one year.

Preferences.— The individual maximizes expected utility from consumption and bequests,

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

subject to the constraints detailed below. t is the individual’s current age. 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,

$$u(c) = \frac{c^{1-\sigma} - 1}{1 - \sigma}.$$

Utility from bequests is

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

$v(b) = c_b^{-\sigma}b$ if $\phi = 1$, and $v(b) = 0$ if $\phi = 0$. This is a re-parameterized version of a commonly-used functional form (e.g., De Nardi, 2004; De Nardi, French and Jones, 2010; Ameriks et al., 2011), which nests as special cases nearly all of the functional forms used in the literature, including linear (e.g., Hurd, 1989; Kopczuk and Lupton, 2007) and constant relative risk aversion (e.g., Friedman and Warshawsky, 1990). This parameterization has good numerical properties and easy-to-interpret parameters. $c_b \geq 0$ is the threshold consumption level below which, under conditions of perfect certainty or with full, fair insurance, people do not leave bequests: $v'(0) = c_b^{-\sigma} = u'(c_b)$. Smaller values of c_b mean the bequest motive “kicks in” at a lower rate of consumption. If $c_b = 0$, preferences over consumption and bequests are homothetic and people are equally risk-averse over consumption and bequests. If $c_b > 0$, bequests are luxury goods and people are less risk-averse over bequests than over consumption. $\phi \in [0, 1)$ is the marginal propensity to bequeath in a one-period problem of allocating wealth between consumption and an immediate bequest for people rich enough to consume at least c_b .⁶ Larger values of ϕ mean that people leave a larger fraction of the wealth left over after buying c_b worth of consumption as bequests. As ϕ approaches one, the bequest motive approaches a linear bequest motive with a constant marginal utility of bequests equal to $c_b^{-\sigma}$.

Health and medical spending risks.— The individual faces uncertainty about how long he or she will live and how much acute medical care and long-term care he or she will require. At any time, the individual is in one of five health states: healthy (*he*), requiring home health care (*hhc*), requiring assisted living facility care (*alf*), requiring nursing home care (*nh*), or dead (*d*). The “healthy” state is healthy in the sense that the individual does not have chronic health problems that compel him or her to receive long-term care. But someone in this state may require acute medical care to deal with acute health problems. The individual’s acute medical care costs and future health depend probabilistically on the individual’s health (*h*), age (*t*), sex (*s*), and income quintile (*q*), $m_t \sim F_m(m; h_t, t, s, q)$ and $Pr(h_{t+1} = h' | h_t, t, s, q)$, while the individual’s long-term care costs depend deterministically on those same characteristics, $ltc_t = ltc(h_t, t, s, q)$.

Public care aversion and the precautionary motive.— Residents of nursing homes and assisted living facilities receive a certain amount of consumption from their long-term care, $c_m(h_t \in \{alf, nh\}, Pub_t) > 0$. This reflects the fact that residents of nursing homes and assisted living facilities receive some non-medical goods and services, such as food and housing, bundled with their long-term care. Individuals who are healthy or who are receiving home health care, on the other hand, do not receive any consumption from any care that they receive, $c_m(h_t \in \{he, hhc\}) = 0$. The consumption value of facility-based

⁶With these utility functions, the optimal bequest by someone maximizing $U = \max\{u(c) + v(b)\}$ subject to $c + b = w$ is $b^*(w) = \max\{0, \phi(w - c_b)\}$.

care potentially depends on whether the care is paid for at least partially by the government: $c_{pub} \equiv c_m(h_t \in \{alf, nh\}, Pub_t = 1)$ may differ from $c_{priv} \equiv c_m(h_t \in \{alf, nh\}, Pub_t = 0)$. Institutional care that is at least partially financed by the government may be less desirable than privately-financed care for several reasons. For example, it may be costly to apply for government support, there may be stigma attached to receiving government support, or recipients of government support may stay in lower-quality nursing homes. These or other factors would give people an additional reason to save or buy insurance beyond a desire to smooth their marginal utility over time and across states. I follow Ameriks et al. (2011) in calling the extent to which people prefer privately-financed care to publicly-financed care “public care aversion”:
 $PCA \equiv [u(c_{priv}) - u(c_{pub})]$. Public care aversion is a key determinant of the precautionary motive to save and the demand for long-term care insurance.

Long-term care insurance.— Individuals who are eligible to purchase long-term care insurance (based on their health status and age) make a once-and-for-all decision about whether to buy long-term care insurance at the beginning of retirement. People who buy long-term care insurance pay premiums when they are healthy ($h_t = he$) in exchange for receiving benefits when they require long-term care ($h_t \in \{hhc, alf, nh\}$). Net long-term care insurance benefits received (net of premiums paid) are $ltci_t(h_t, t; ltci)$, where $ltci$ (without a subscript) is an indicator of whether the individual owns long-term care insurance, $ltci \in \{0, 1\}$.

Timing, budget sets, and social insurance.— The individual enters the period with wealth $w_t \geq 0$. The individual receives non-asset income y , realizes acute medical care costs m_t and long-term care costs ltc_t , and pays or receives any net long-term care insurance benefits due under her contract, $ltci_t$. Then the individual receives any social insurance transfers for which she qualifies and decides how much to consume. Finally, the individual’s rate of return on savings, r_t , and mortality are realized. Individuals who die transfer any remaining wealth to their heirs as a bequest. People cannot die in debt or, equivalently, leave negative bequests. Together with mortality risk, this amounts to a no-borrowing constraint.

Net wealth before government transfers is

$$\hat{x}_t = w_t + y - m_t - ltc_t + ltci_t.$$

This is the financial state variable of the model.⁷ Net wealth before transfers may be negative, as medical needs may exceed the value of assets, income, and net insurance

⁷The reason to use wealth before rather than after transfers as the state variable is that only wealth before transfers encodes whether the individual relies on social insurance. The individual’s reliance on social insurance can affect utility through its effect on the consumption value of facility-based long-term care.

transfers.

Social insurance programs ensure that people enjoy at least a minimum standard of living after paying for any medical care by putting a floor under net wealth. Net wealth after transfers is

$$x_t = \max\{\hat{x}_t, \bar{x}(h_t, ltc_i_t)\}. \quad (1)$$

The individual therefore relies on social insurance if and only if her net wealth before transfers is below the relevant floor,

$$Pub_t = \mathbf{1}(\hat{x}_t < \bar{x}(h_t, ltc_i_t)). \quad (2)$$

The level of the floor depends on whether the individual is in a care-giving facility, since long-term care from care-giving facilities comes bundled with some non-medical consumption. The level of the floor also depends on the individual's net long-term care insurance benefit, since social insurance programs will not pay people's long-term care insurance premiums:

$$\bar{x}(h_t, ltc_i_t) = \begin{cases} \bar{x}_{comm} + \min\{0, ltc_i_t\}, & \text{if } h \in \{he, hhc\}; \\ \bar{x}_{facil}, & \text{if } h \in \{alf, nh\}. \end{cases}$$

Consumption, saving, returns, and next-period assets.— Utility-producing consumption, c_t , is the sum of consumption spending, \hat{c}_t , and the consumption value of long-term care services received, if any, $c_m(h_t, Pub_t)$,

$$c_t = \hat{c}_t + c_m(h_t, Pub_t).$$

Consumption spending is limited by the individual's net wealth after government transfers, $\hat{c}_t \in [0, x_t]$.⁸ Assets earn a real, after-tax rate of return of r_t , which is drawn from a distribution that depends on the individual's income quintile, $r_t \sim F_r(r; q)$. Next-period wealth is

$$w_{t+1} = (1 + r_t)(x_t - \hat{c}_t) \geq 0.$$

Thus, conditional on living, next-period net wealth before transfers is

$$\hat{x}_{t+1} = (1 + r_t)(x_t - \hat{c}_t) + y - m_{t+1} - ltc_{t+1} + ltc_{t+1}. \quad (3)$$

⁸The baseline specification allows residents of nursing homes and assisted living facilities to buy additional consumption beyond the consumption that comes bundled with their care. But because many such individuals may have limited opportunities to buy additional consumption—both because care-giving facilities provide for many of their needs and because of their (usually severe) chronic illnesses—I also test the robustness of the results to an alternative specification in which people in nursing homes and assisted living facilities cannot buy additional consumption beyond that which is bundled with their care.

Solution method and value functions.— Given a set of parameter values, I solve the model numerically by backward induction from the maximum age, T . As long-term care insurance is purchased once-and-for-all, long-term care insurance ownership, $ltci \in \{0, 1\}$, is a fixed characteristic in every period other than the purchasing period, in which it is a control variable. The other fixed individual characteristics are sex (s) and retirement income (y). The time-varying state variables are age (t), health (h_t), and net wealth before government transfers (\hat{x}_t). The individual dies by age $T + 1$ with probability one, and leaves any remaining wealth as a bequest. For younger ages, I discretize wealth into a fine grid and use piecewise cubic hermite interpolation to evaluate the value function between grid points. For each sex-income-long-term care insurance group and at each age-health-wealth node, I solve for optimal consumption. The problem can be written recursively in terms of the value function as

$$V_t(\hat{x}_t, h_t; s, y, ltci) = \max_{\hat{c}_t \in [0, \hat{x}_t]} \left\{ u[\hat{c}_t + c_m(h_t, Pub_t)] + \beta Pr(h_{t+1} = d | h_t, t; s, y) E_t[v(b_{t+1})] \right. \\ \left. + \beta Pr(h_{t+1} \neq d | h_t, t; s, y) E_t[V_{t+1}(\hat{x}_{t+1}, h_{t+1}; s, y, ltci)] \right\}$$

subject to equations 1, 2, 3, and

$$b_{t+1} = (1 + r_t)(x_t - \hat{c}_t).$$

If eligible, the individual makes a once-and-for-all choice about whether to buy long-term care insurance at age l . The individual buys insurance if and only if

$V_l(\hat{x}_l, h_l; s, y, ltci = 1) > V_l(\hat{x}_l, h_l; s, y, ltci = 0)$. Details about the numerical solution procedure and its accuracy are available in Appendix A.2.

4 The Method of Simulated Moments and the Key Parameters in the Estimation

The Method of Simulated Moments (MSM) extends Minimum Distance Estimation to situations in which the model is too complex to admit closed-form analytical solutions.⁹ MSM estimations of life cycle models typically proceed in two stages (e.g., Gourinchas and Parker, 2002; Cagetti, 2003). In the first stage, all of the parameters that can be identified without using the model are estimated or calibrated. In the second stage, the remaining parameters are estimated using the MSM, taking as given the first-stage parameter

⁹See Pakes and Pollard (1989), McFadden (1989), and Duffie and Singleton (1993) for the development of the MSM and Gourinchas and Parker (2002) for its application to the life cycle model.

estimates.

The second stage of the estimation attempts to recover the values of the key preference parameters: the strength and curvature of bequest motives, ϕ and c_b ; the consumption value of publicly-financed nursing care, c_{pub} ; the discount factor, β ; the coefficient of relative risk aversion, σ ; and the net wealth floor for people living in the community, \bar{x}_{comm} . The parameter estimates, $\hat{\theta} \equiv (\hat{\phi}, \hat{c}_b, \hat{c}_{pub}, \hat{\beta}, \hat{\sigma}, \hat{\bar{x}}_{comm})$, minimize the distance between the simulated wealth and long-term care insurance moments and their empirical counterparts, as evaluated by a classical minimum distance-type criterion function. Appendix A.3 contains details about the asymptotic distribution of the parameter estimates and over-identification tests of the model's fit.

5 Data and Parameterization

5.1 Data and Sample Selection Procedure

The main dataset I use is the Health and Retirement Study (HRS), a longitudinal survey of a representative sample of the U.S. population over 50 years old. The HRS surveys more than 22,000 Americans every two years. It is a rich dataset with especially detailed information about health and wealth. 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 six waves, which occur in even-numbered years from 1998–2008. Individuals in my sample are therefore covered for up to ten years. I restrict the analysis to single retirees who are at least 65 years old in 1998 and who do not miss any of the 1998–2008 interviews while they are alive. The resulting sample contains 3,386 individuals. Where possible, I use the RAND version of the variables.¹⁰

Table 1 presents summary statistics from the HRS. The first column corresponds to the

¹⁰I restrict to retirees by dropping individuals who earn more than \$3,000 dollars in any wave 1998–2008. I exclude waves that occur before 1998 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, Haider and Hurd, 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). I exclude waves after 2008 because the sample becomes quite small due to mortality. (Almost two-thirds of the individuals in the sample died before the 2008 wave.) I convert all dollar variables to constant 2010 dollars using the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W), the price index that the Social Security Administration uses to adjust Social Security benefits.

	Everyone 65+	Single retirees 65+
Female	0.58	0.78
Age	74.4	77.5
Wealth	\$419,086	\$238,643
Income	\$33,891	\$18,360
Own LTCI	0.10	0.09
Own annuity	0.06	0.06
Have children	0.91	0.85
Widowed	0.33	0.79
Never married	0.03	0.07
Importance of leaving a bequest		
Very	0.22	0.24
Somewhat	0.46	0.43
Not	0.32	0.32
Sample size	20,072	3,386

Table 1: Summary statistics of the sample of people aged 65 and older in the HRS and the subset of those who are single retirees (my sample). The statistics reported are means and are weighted by HRS respondent-level weights. The measure of wealth is at the household level and includes all non-annuity wealth and excludes annuitized wealth (e.g., the expected present value of future Social Security benefits). The measure of income is annual. The annuity ownership rate corresponds to annuities whose income stream continues as long as the individual lives. The values of all variables other than the importance of leaving a bequest come from the 1998 wave. The question about the importance of leaving a bequest was asked only in the 1992 wave, which primarily sampled cohorts younger than those in my sample. Among my sample of single retirees, less than nine percent answered this question.

population of people aged 65 and over in the U.S., and the second column corresponds to the population of single retirees aged 65 and over, who are the focus of the analysis. The population of single retirees is older, more female, and poorer than the overall elderly population. Only about ten percent of each group owns long-term care insurance and only about six percent owns life annuities. The vast majority of both samples have children; even among the sample of single retirees, 85 percent have children. Slightly more than two-thirds of the people in each group (and more than half of people without children) report that it is somewhat or very important to leave an inheritance to their heirs.¹¹

In order to develop a rich model of the long-term care risk facing different individuals, I supplement the information in the HRS with data from the National Long-Term Care Survey (NLTC). The NLTC is a longitudinal survey of Americans 65 and older that contains detailed information about health and health-related expenditures. Two key features of the NLTC make it a useful supplement to the extensive information available

¹¹This question was asked only in the first wave of the HRS (in 1992), at which time most of the members of my sample were not yet part of the HRS. As a result, less than nine percent of the members of my sample answered this question.

in the HRS. First, the NLTCs has a much larger number of people using long-term care services. Second, the NLTCs includes a measure of the price of care (which is the input required for the model), whereas the HRS has only measures of spending on care. This is a crucial difference given that Medicaid pays for at least part of the care of a majority of residents of nursing homes.

5.2 First-Stage Parameter Values

Table 2 presents the baseline values of the first-stage parameters and the sources from which these values are adopted or estimated. These values are chosen to approximate the situation facing single retirees in the U.S. I adopt some of the values of the first-stage parameters from other sources and estimate the others. Later, I test the robustness of the results to many changes in the values of these parameters. All dollar values are expressed in 2010 dollars.

Health and lifespan risk.— The (Markov) transition probabilities across health states are based on a model estimated by Friedberg et al. (2014), which itself is based on a widely-used actuarial model developed by James Robinson (see Robinson, 2002; Brown and Finkelstein, 2004). I use Friedberg et al.’s (2014) model for women for both the men and the women in my sample because it better approximates the long-term care risk facing single individuals, who receive much less informal care than the average man in the full population (Friedberg et al.’s (2014) target population). I adjust the model to match De Nardi, French and Jones’s (2010) estimates of life expectancy conditional on reaching age 70 for different sex and income groups. Women live longer than men, and richer retirees live longer than poorer ones. The life expectancy of 65-year-old women ranges from 16.1 in the bottom income quintile to 20.8 in the top, whereas the life expectancy of 65-year-old men ranges from 9.8 in the bottom income quintile to 14.2 in the top. The expected number of years spent in a nursing home is 0.84 for women and 1.06 for men. Health status tends to be quite persistent, though the persistence of different health states changes a lot as people age. Among 65-year-old women in the third income quintile, 98 percent who are healthy will remain healthy at age 66, 24 percent who require home care will continue to require home care at age 66, but just one percent of those living in a nursing home will continue to do so at age 66 (42 percent will become healthy and 7 percent will die). Among 95-year-old women in the third income quintile, just 70 percent of those who are healthy will remain so at age 96; among the subset of such women in nursing homes, 60 percent will continue to be in a nursing home at age 96, 29 percent will be dead before age 96, and just 11 percent will be healthy 96-year-olds. Details of the health and lifespan risk model

Parameter	Source	Value in source	Value in this paper
Health states and transition probabilities: h_t , $Pr(h_{t+1} = h' h_t, t; s, y)$	Friedberg et al. (2014), De Nardi, French and Jones (2010), author's calculations	h_t : healthy (<i>he</i>), home health care (<i>hhc</i>), assisted living facility (<i>alf</i>), nursing home (<i>nh</i>), dead (<i>d</i>). $Pr(h_{t+1} = h' h_t, t; s, y)$: Friedberg et al. model for females	Adjust health transitions to match life expectancies by sex and income quintile in De Nardi, French and Jones (2010) (see Appendix A.1.2); maximum age (T) is 104
Long-term care costs: $ltc(h_t, t, s, q)$	MetLife Mature Market Institute (2002a,b), Friedberg et al. (2014), author's calculations	U.S. averages in 2002: $ltc(nh) = \$52,195$, $ltc(alf) = \$26,280$, $ltc_i(hhc, t) = \$37 * Q_s(t) + \$18 * Q_u(t)$, where $Q_s(t)$, $Q_u(t)$ from Friedberg et al. model ^a	Scale averages based on heterogeneity in NLTCs. Inflate values to reflect growth in spending, timing of care use. See Appendix A.1.3.
Acute medical care costs: $m_t \sim F_m(m; h_t, t, s, q)$	Author's estimates based on HRS	$m_t \sim \log N(\mu(h_t, t, s, q), \sigma(h_t, t, s, q)^2)$	Inflate values in source to reflect growth in spending, timing of care use. See Appendix A.1.4.
Long-term care insurance: $ltc_i(h_t, t; ltc_i)$	Brown and Finkelstein (2007): Typical contract, average load on policies held for life ^b	Pay premiums when healthy, receive benefits up to \$36,500 when require LTC (\$100/day benefit cap); 18% load	Inflate value in source to 2010 dollars: maximum benefit = \$44,350. Test robustness
Consumption value of privately-financed institutional care: c_{priv}	Author's judgment ^c	$c_{priv} = \$20,000$	Same as source, test robustness
Anticipated returns: $r \sim F_r(r; q)$	Author's estimates	$r \sim N(\mu_r(q), \sigma_r(q)^2)$	Same as source. See Appendix A.4.

Table 2: Baseline values of first-stage parameters. Notes:

(a) Q_s and Q_u are annual hours of skilled and unskilled home care, respectively. In the model, Medicare covers 35 percent of home health care spending (Robinson, 2002; Brown and Finkelstein, 2008), 25 percent of nursing home spending (Friedberg et al., 2014), and 0 percent of assisted living facilities.

(b) In calculating long-term care insurance premiums, future benefits and premiums are discounted at the risk-free interest rate, assumed to be 2 percent per year. The 18 percent load means that on average people receive 82 cents worth of benefits for each \$1 of premiums paid.

(c) As discussed in the text, the main effect of using different values of c_{priv} is to shift the estimated value of c_{pub} to maintain the same utility advantage, if any, of privately-financed care, $PCA = u(c_{priv}) - u(c_{pub})$. As shown in Appendix 6.4, the results are robust to using alternative values of c_{priv} .

are in Appendix A.1.2.¹²

Long-term care costs.— Long-term care costs, $ltc(h_t, t, s, q)$, are a deterministic function of

¹²The major advantage of basing the model of long-term care risk on observed patterns of utilization as opposed to spending is that it captures the care paid for by all sources, not just the care paid for out-of-pocket by households. This is important because Medicaid assists 70 percent of nursing home residents and even higher shares of poorer retirees (Kaiser Commission on Medicaid and the Uninsured, 2013).

the individual’s health, age, sex, and income quintile. I start with the average prices of different long-term care services in the U.S. in 2002 (MetLife Mature Market Institute, 2002*a,b*), $ltc_{2002}(h)$. I estimate scaling factors for these population-average prices for different groups defined by age, sex, and income quintile using individual-level regressions in the NLTCs, $ltc_{2002}(h_t, t, s, q)$. (Details are available in Section A.1.3 of the appendix.) Finally, I inflate these values to reflect the growth in the relative price of long-term care services from the middle of the sample period, 2002, to roughly the average time at which members of the sample will use long-term care services, 2008. Historically, the relative price of long-term care has grown roughly in line with wages, or about 1.5 percent per year in real terms (see Brown and Finkelstein, 2008, and the sources cited therein). For a female in the middle income quintile, the cost of a year of home care ranges from about \$5,000 at age 65 to about \$34,000 at age 105, the cost of a year in an assisted-living facility is about \$33,000 (roughly constant in age), and the cost of year in a nursing home is roughly \$50,000 (also roughly constant in age).

Long-term care insurance.— The baseline long-term care insurance contract, $ltci_t(h_t, t; ltc_i)$, is a simplified version of a typical contract. In exchange for paying annual premiums when healthy ($h = he$), people with insurance have their long-term care costs covered up to a maximum of \$44,350 in years in which they are sick ($h \in \{hhc, alf, nh\}$). This corresponds to a maximum daily benefit of \$100 in 2002 expressed in 2010 dollars.¹³ Premiums exceed expected discounted benefits by 18 percent, the average load on long-term care insurance policies held for life in the U.S. (Brown and Finkelstein, 2007).¹⁴ Only people in good health can purchase long-term care insurance. This reflects the widespread rejections of unhealthy applicants during the underwriting process (Hendren, 2013).

Acute medical care costs.— Acute medical care costs are log-normally distributed, with type-specific means and variances, $m_t \sim \log N(\mu_m(h_t, t, s, q), \sigma_m^2(h_t, t, s, q))$. The log-normal distribution provides a fairly close approximation to the observed distribution of medical spending in the HRS. I estimate the type-specific means and variances using regressions of log medical spending and its square. I limit the sample for these regressions to members of my sample who are not currently receiving long-term care and who have at least \$100,000 in non-housing wealth. As in the case of long-term care, I scale up the means and standard deviations of the acute medical care distributions to capture the rapid growth over time in spending on acute medical care (it grew by about 4.2 percent per year in real terms

¹³Results are robust to instead using a (less-popular) comprehensive long-term care insurance contract. Holding preferences fixed, increasing the comprehensiveness of long-term care insurance tends to reduce the simulated long-term care insurance ownership rate very slightly (typically by less than one percentage point).

¹⁴Brown and Finkelstein (2007) find that men face significantly higher loads on long-term care insurance than women, mainly because married men receive much more care from their spouses—and thus less formal, benefit-eligible care—than married women do. Among single retirees, however, spousal care is not an issue and men and women likely face more similar loads.

between 1975 and 2005 (Orszag, 2007)). I use the distribution of spending by retirees with significant holdings of liquid wealth to minimize the bias introduced by the fact that Medicaid pays for much of the care received by people with little wealth. Further details are available in Appendix A.1.4. To solve the model, I approximate the distribution of acute medical care costs using Gaussian quadrature.

Social insurance and public care aversion.— To qualify for public coverage of nursing care, people must exhaust all of their assets, $\bar{x}_{facil} = \$0$. This is a rough approximation to the stringent asset and income tests imposed by many state Medicaid programs. Using small positive values (e.g., \$2,000, the modal asset eligibility requirement in 1999) has little effect on the results while slightly complicating the exposition and solution of the model, since it means that in some rare cases individuals would have a choice about whether to take up benefits. (This choice could be non-trivial due to the possibility of public care aversion.) The income floor for people living in the community, \bar{x}_{comm} , is estimated in the second stage.

The baseline value of the non-care consumption provided by privately-financed care facilities is $c_{priv} = \$20,000$. The consumption value of publicly-financed care facilities, c_{pub} , is estimated in the second stage. The lower is c_{pub} relative to c_{priv} , the greater is “public care aversion,” and so the greater is the incentive to save or buy insurance in order to avoid relying on publicly-financed care in the future. The main effect of using different values of c_{priv} is to change the value of c_{pub} that maps into a given level of public care aversion, $PCA = u(c_{priv}) - u(c_{pub})$. So to a first approximation, the choice of any particular value of c_{priv} is inconsequential; changing the value of c_{priv} mainly just shifts the estimated value of c_{pub} in order to maintain the level of public care aversion implied by retirees’ saving and insurance choices. But a secondary effect of using different values of c_{priv} is to change the value of resources in bad-health states, which affects precautionary motives to save and buy insurance. This is the way in which the chosen c_{priv} value can have substantive effects. I test the robustness of the results to a wide range of alternative values of c_{priv} .

Anticipated returns on wealth.— Individuals view their annual, real, after-tax rates of return on wealth as arising from independent draws from a normal distribution whose mean and variance depends on the individual’s income quintile. (As discussed below, the return that a particular retiree actually earns each year in the simulations is based on his or her portfolio allocation and the realized returns on different assets in that year.) I estimate the means and variances of these distributions using data on historical asset returns and the average portfolio compositions of the different income quintiles of my sample. Retirees’ portfolios, though not without risk, are roughly an order of magnitude less volatile than the stock market. Over the past 51 years (1960–2010), the standard deviation of the rate of

return based on the average portfolio shares of my sample of single retirees was about 3.3 percent. Additional details of these calculations are available in Appendix A.4.

5.3 Second-Stage Moments: Wealth and Long-Term Care Insurance

Empirical wealth moments.— The wealth moments track the evolution of wealth over time as members of the sample age. I split the sample into six 5-year birth cohorts. The age ranges of these cohorts in 1998 are 65–69, 70–74, 75–79, 80–84, 85–89, and 90–94. For each cohort, I calculate the 25th percentile, 50th percentile (median), and 75th percentile of the wealth distribution in each wave *after* 1998—2000, 2002, 2004, 2006, and 2008—in which there are at least 100 surviving members of the cohort. Thus there are potentially 90 wealth moments: three percentiles for each of five waves for each of six cohorts. Discarding the cohort-waves with fewer than 100 surviving members eliminates the 2008 observations of five of the six cohorts, which leaves 75 wealth moments.¹⁵ Each cohort’s wealth moments trace the evolution over time of the distribution of wealth of its surviving members. Later waves contain fewer people due to deaths. Of the 3,386 individuals in the sample in 1998, 1,183 (34.9 percent) were still alive in the last wave in 2008. The measure of wealth is the total value of non-annuity wealth including housing.¹⁶

Empirical long-term care insurance moments.— The empirical long-term care insurance moments are the ownership rates of each of the four quartiles of the wealth distribution among the subset of the sample who were 70–79 years old in 1998, weighted by their 1998 HRS individual sample weights. These ownership rates are 1.2, 2.6, 6.3, and 12.5 percent (increasing across wealth quartiles), for an overall average of 5.6 percent. As discussed in Section 2.2, wealth is one of the strongest predictors of long-term care insurance ownership in the HRS.

These calculations count 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

¹⁵The results are not sensitive to whether these moments are excluded.

¹⁶In reality, different types of wealth have different properties, including liquidity and how they are treated by means-tested programs. Housing wealth is an important case. It is a major component of household wealth, it is likely to be less liquid than most other components of wealth, and it is sometimes exempted from the asset tests of means-tested programs. I follow much of the literature in lumping it together with other types of wealth. Doing so seems like a reasonable approximation in this case, since reverse mortgages and other products have increased the liquidity of housing wealth, and since the modal state Medicaid program did not exempt the housing wealth of single elderly people from asset testing during the sample time period. I have also tested the robustness of the results to excluding housing wealth entirely and found that the quantitative results are relatively unaffected and the qualitative conclusions are highly robust.

available.¹⁷ Policies that cover both nursing homes and home health care are the most popular type empirically (Brown and Finkelstein, 2007) and are the type I use in the model. Averaging an individual’s reported ownership over time likely provides a better measure of his or her “lifetime” ownership than point-in-time estimates because of measurement error and policy lapsation.¹⁸ The subset of the sample who were 70–79 years old in 1998 completed their prime buying years, age 65–69 (Brown and Finkelstein, 2007), immediately before the sample period, 1998–2008.

5.4 Simulation Procedure and Estimation

For each candidate parameter vector θ , I solve the model separately for men and women, different income groups, and people with and without long-term care insurance. I use the resulting value functions and optimal choice rules to simulate the wealth path and long-term care insurance ownership status of each individual in the simulation sample, which is described below. I use the resulting simulated data to calculate the simulated moments, using the same procedure as that used to calculate the empirical moments from the actual data. Finally, I evaluate the goodness of fit of the simulated moments at this particular set of parameter values θ to the empirical moments using a classical minimum distance-type objective function. Details of the simulation procedure are available in Appendix A.5.

To create the simulation sample, I draw with replacement 10,000 individuals from the sample of single retirees in the HRS. To ensure that the resulting population is representative of the population of single retirees in the U.S., the probability that individual i in the sample of single retirees is chosen on any draw is proportional to i ’s 1998 person-level weight, $\frac{weight_i}{\sum_{j=1}^{3,386} weight_j}$. For each individual in the simulation sample, the simulation uses: three fixed individual characteristics (sex, average retirement income, and long-term care insurance ownership status), three initial state variables (age, health, and wealth in 1998), health status in 1999–2008, and portfolio shares in 1998–2006.¹⁹ The

¹⁷Missing data prevent me from determining the ownership status of 11 individuals. I exclude these individuals from the calculation of the empirical long-term care insurance moments. When simulating the wealth paths of these individuals, I assume that they do not own long-term care insurance.

¹⁸For this group, the point-in-time ownership rate (5.7 percent) is only slightly higher than the “lifetime” ownership rate (5.6 percent).

¹⁹Each individual’s average (real) retirement income equals the simple average between 1998 and 2008 of his or her non-asset income less the cash value of means-tested government transfers received, such as Supplemental Security Income and food stamps. Means-tested transfers are excluded from income because these transfers arise endogenously in the model. Health status in the year of interview j is nursing home if the individual is living in a nursing home when interview j occurs, 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

simulation uses each individual’s health status in 1999–2008 to ensure that individuals contribute to the same wealth moments in the simulation as in the data—individuals who die in 2001 in the data also die in 2001 in the simulation. This protects against bias from the model of health transitions not matching perfectly the true risk facing retirees.

The simulation uses individuals’ portfolio shares in 1998–2008 together with Baker, Doctor and French’s (2007) estimates of the annual returns on various assets to construct person-year-specific realized rates of return on wealth, $r_{i,t}$. Details are available in Appendix A.4. Estimating person-wave-specific rates of return protects against two potential sources of bias. One potential source of bias is that the sample period, 1998–2008, was characterized by unusually high rates of return on many assets. The average real return earned by a portfolio that matches the asset allocations of retirees around the middle of the wealth distribution was about 6 percent per year over the period, compared to about 4 percent in the three-and-a-half decades leading up to the sample period. Failing to account for the unusually—and probably unexpectedly—high rates of return could bias the results; the naive estimation would attribute wealth outcomes as arising solely from purposeful saving behavior whereas unusual capital gains or losses may have been important as well (Baker, Doctor and French, 2007). The other source of bias that this procedure protects against is that retirees’ portfolios vary systematically across the wealth distribution. Retirees in the middle of the wealth distribution, for example, hold more of their wealth in housing than richer and poorer retirees, and the average return on housing wealth was especially high (7.9 percent per year) over the sample period. Ignoring the differences in retirees’ portfolios could bias the results by leading the estimation to wrongly attribute differences in wealth as arising solely from differences in saving behavior whereas differences in realized returns may have been important as well.

Estimation.— The baseline estimation of $\theta \equiv (\phi, c_b, c_{pub}, \beta, \sigma, \bar{x}_{comm})$ is based on 79 moment conditions: four long-term care insurance moments and 75 wealth moments. The baseline weighting matrix is the inverse of the estimated variance-covariance matrix of the second-stage moment conditions, $W = \hat{\Omega}_g^{-1}$. More-precisely estimated moments receive greater weight in the estimation. Although there are many more wealth moments than long-term care insurance moments, the insurance moments receive non-negligible weight in the estimation. For example, the objective-function penalty for a 5-percentage point deviation in the long-term care insurance moments (i.e., for simulated ownership rates that are 5 percentage points greater than their corresponding empirical rates) is roughly equal to the objective-function penalty for an eight percent deviation on all of the wealth moments (i.e., if every simulated wealth moment is 1.08 times its empirical counterpart).

otherwise. I simulate health status between interview years using the model health transition probabilities and Bayes’ rule.

	All moments		Wealth moments only	
	Baseline model (1)	No bequest motive ($\phi = 0$) (2)	Baseline model (3)	No bequest motive ($\phi = 0$) (4)
Parameter estimates, $\hat{\theta}$				
$\hat{\phi}$: bequest motive	0.95 (0.01)	0 -	0.98 (0.02)	0 -
\hat{c}_b : bequest motive (\$1,000s)	16.1 (1.4)	0 -	30.2 (2.5)	0 -
\hat{c}_{pub} : public care value (\$1,000s) ($c_{priv} = \$20,000$)	18.3 (4.7)	20.0 (1.4)	16.6 (2.6)	16.6 (0.7)
\hat{x}_{comm} : wealth floor in community (\$1,000s)	0.9 (0.1)	2.5 (0.2)	2.9 (0.2)	3.3 (0.3)
$\hat{\beta}$: discount factor	0.93 (0.02)	1.06 (0.01)	0.95 (0.02)	1.04 (0.01)
$\hat{\sigma}$: risk aversion	3.0 (0.05)	3.2 (0.2)	5.0 (0.1)	4.8 (0.3)
Goodness-of-fit				
χ^2 stat	67.8	192.0	62.5	78.3
p-value of model	0.65	3.3e-12	0.70	0.26
p-value of no-bequest motive restriction	<2.3e-16	-	3.6e-4	-
Simulated LTCI (%) (Empirical LTCI = 5.6%)	3.9	19.6	21.0	32.9

Table 3: Estimation results. Columns one and two are based on all of the moment conditions. Columns three and four are based on only the wealth moments (no long-term care insurance). The second and fourth columns come from estimating the nested version of the model without a bequest motive ($\phi = 0$). Standard errors are in parentheses.

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 moment conditions as the weighting matrix, $W_{robust} = [diag(\hat{\Omega}_g)]^{-1}$.

6 Results

6.1 The Baseline Model Matches Retirees' Choices

The first column of Table 3 contains the results of the baseline estimation. The overall fit of the model is good. The p-value of the chi-squared test of over-identifying restrictions is 0.65, which indicates that the baseline model cannot be rejected at standard confidence levels. The estimates of the bequest motive parameters indicate important bequest motives

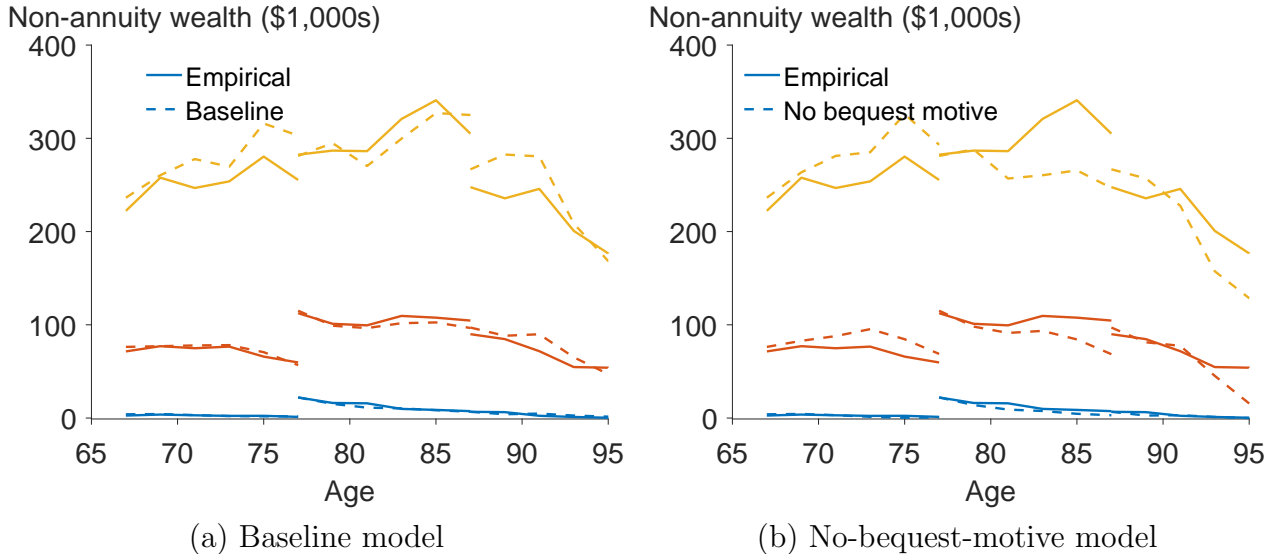


Figure 1: Empirical wealth moments (solid lines) and simulated wealth moments (dashed lines) for odd-numbered cohorts. (Even-numbered cohorts are excluded to avoid overlapping lines and are shown in Appendix A.6.) In panel (a), the simulated moments come from the baseline model. In panel (b), the simulated moments come from the model without bequest motives. The wealth moments track the 25th, 50th, and 75th percentiles of the wealth distribution among surviving members of each cohort. The x-axis shows the average age of surviving members of the cohort. The y-axis shows total non-annuity wealth in \$1,000s. Of the 3,386 individuals in the sample, all of whom were alive in 1998, 1,183 (34.9 percent) were still alive in the last wave in 2008. The empirical and simulated wealth moments do not coincide in 1998 (the left-most points of each set of curves) due to sampling error from drawing a finite sample for the simulation.

in which bequests are luxury goods. The estimates imply that people are only moderately risk-averse over bequests and, equivalently, that among people rich enough to leave bequests, the marginal propensity to bequeath out of wealth is fairly high. The estimated bequest motive is similar to those estimated by Ameriks et al. (2011) and De Nardi, French and Jones (2013). The estimate of the consumption value of publicly-financed facility care indicates that public care aversion is modest, though this estimate has a large standard error.²⁰ The estimates of the discount factor and the coefficient of relative risk aversion yield fairly standard values ($\hat{\beta} = 0.93$ and $\hat{\sigma} = 3.0$). The estimate of the wealth floor for people who do not require nursing care is just \$900, significantly lower than the SSI benefit for single elderly people of about \$7,800. This may indicate some aversion to claiming this form of welfare. The evidence for this is not strong, however, since this parameter is less well-identified than the others and the fit of the model when this parameter is fixed at \$7,800 is not substantially worse.

²⁰As discussed in Appendix A.8, retirees' saving and long-term care insurance choices are highly inconsistent with strong public care aversion but are similarly consistent with a range of public care aversion from none to moderate. It is important to note that even without any public care aversion, there are still reasons to buy long-term care insurance. As discussed in Section 6.3, these reasons include increasing consumption at the expense of bequests and insuring consumption and bequests.

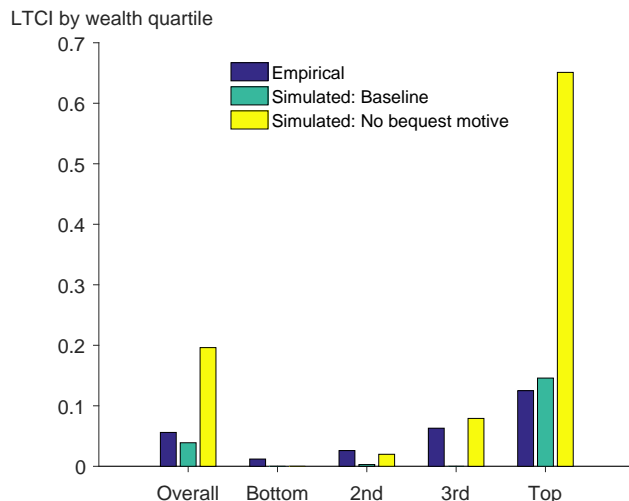


Figure 2: Simulated and empirical long-term care insurance ownership rates, overall and by wealth quartile. The empirical ownership rates correspond to the percentages of single retirees aged 70–79 in 1998 who report owning long-term care insurance that covers both nursing homes and home health care in at least half of the waves between 1998 and 2008 in which they report their ownership status, weighted by HRS respondent weights. The simulated ownership rates are based on two sets of preferences: estimates from the baseline model and estimates from the model without bequest motives.

The good fit of the model is apparent in the wealth and long-term care insurance moments. Panel (a) of Figure 1 plots the empirical and simulated wealth moments of the odd-numbered cohorts (the results for even-numbered cohorts, which look similar, are reported in Appendix A.6). The model reproduces the main patterns in the wealth data and therefore in consumption and saving decisions. Figure 2 shows the empirical and simulated long-term care insurance ownership moments, the ownership rates by wealth quartile. The baseline model under-predicts long-term care insurance ownership in the bottom three wealth quartiles, but it matches the major patterns that long-term care insurance ownership is low throughout the wealth distribution and increasing in wealth. The baseline model also performs well on various validation tests. Appendix A.7 shows, for example, that the simulated bequest distribution matches closely its empirical counterpart.

6.2 The Model Without Bequest Motives is Strongly Rejected

The second column of Table 3 shows results from estimating the model without bequest motives, i.e., under the restriction that $\phi = 0$. The model without bequest motives fits the data poorly, and both the model without bequest motives itself and the restriction of no bequest motive in the baseline model are rejected at the one percent confidence level. The poor fit of the model without bequest motives is evident in both the wealth moments (Panel (b) of Figure 1) and the long-term care insurance moments (Figure 2).

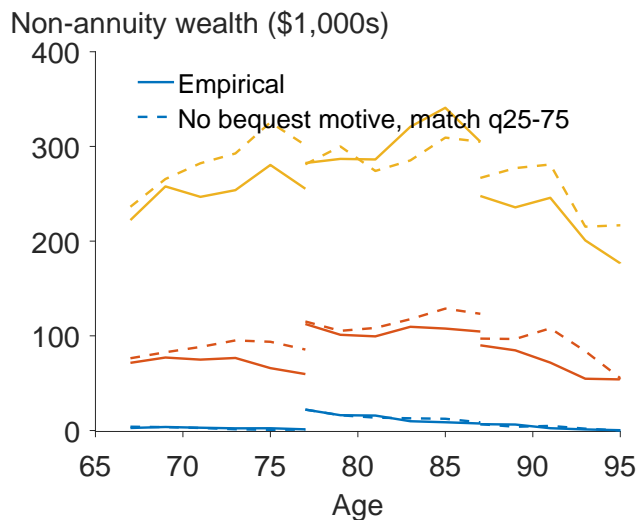


Figure 3: Empirical wealth moments (solid lines) and simulated wealth moments from the model without bequest motives estimated to match the 25th and 75th percentile wealth moments (and not the median wealth moments or long-term care insurance) (dashed lines). The wealth moments track the 25th, 50th, and 75th percentiles of the wealth distributions among surviving members of each cohort. The x-axis shows the average age of surviving members of the cohort. The y-axis shows total non-annuity wealth in \$1,000s.

Three major patterns in the data are responsible for the strong rejection of the model without bequest motives. First are the low rates of long-term care insurance ownership, both overall and, especially, among retirees in the top quartile of the wealth distribution. The model without bequest motives predicts too much long-term care insurance ownership overall (20 percent vs. 5.6 percent observed) and, especially, among retirees in the top wealth quartile (65 percent vs. 12.5 percent observed).

The second major pattern in the data responsible for the strong rejection of the model without bequest motives is the combination among middle-class and richer retirees of the slow rate at which they draw down their wealth and the low rates at which they own long-term care insurance. For these retirees, the model without bequest motives predicts far too much long-term care insurance ownership relative to saving. As Figures 1 and 2 show, the estimated model without a bequest motive predicts both too much long-term care insurance ownership and too little saving. Improving the model’s fit to either of these dimensions worsens its fit to the other. For example, if the model without bequest motives is estimated to match the median wealth moments, the predicted long-term care insurance ownership rate is 45 percent, over eight times the empirical ownership rate. Long-term care insurance ownership is too low—both absolutely and, especially, relative to saving—to be consistent with the model without bequest motives.

The third major pattern in the data responsible for the strong rejection of the model without bequest motives is the pattern of saving across the wealth distribution. Retirees in

the middle of the wealth distribution save too little relative to both richer and poorer retirees to be matched by versions of the model without bequest motives. Although the model without bequest motives can match well the saving of retirees at particular points in the wealth distribution,²¹ the restriction of no bequest motives is strongly rejected when the model is estimated on the basis of all of the wealth moments simultaneously; the p-value of the restriction of no bequest motive is just 3.6e-4. (These estimations exclude long-term care insurance and are reported in the third and fourth columns of Table 3.) Figure 3 shows the wealth moments when the model without bequest motives is estimated to match the 25th and 75th wealth percentiles. The model matches well these targeted percentiles but predicts too much saving around the median. Middle-class retirees are particularly sensitive to precautionary concerns because they have too much wealth to be well-insured by means-tested programs yet too little wealth to pay for especially costly health problems. In the data, retirees around the middle of the wealth distribution save too little relative to both richer and poorer retirees for life cycle models in which saving is driven primarily by medical spending and lifespan risk to match the pattern of saving.²²

Within the context of the standard life cycle model, retirees' saving and long-term care insurance choices indicate that important bequest motives are widespread. As Section 6.4 and Appendix A.8 show in more detail, the model is well-identified and the identification is not driven by any particular moment or set of moments. Non-poor retirees buy too little long-term care insurance—both absolutely and, especially, relative to how much they save—and retirees in the middle of the wealth distribution save too little relative to both richer and poorer retirees to be explained by versions of the model without important bequest motives.

6.3 Bequest Motives Encourage Retirees to Self-Insure

Figure 4 shows simulated and empirical long-term care insurance ownership rates. The three simulated ownership rates correspond to three different sets of preferences: the baseline estimates, the baseline estimates except with the bequest motive turned off, and

²¹Indeed, when the target moments include only the median wealth moments *or* the 75th percentile wealth moments, the model without bequest motives fits the data about as well as the model with bequest motives does. This is a manifestation of the identification problem that arises when analyzing the saving decisions of retirees at a particular point in the wealth distribution (Dynan, Skinner and Zeldes, 2002); the saving of retirees at a particular point in the wealth distribution is consistent with a wide range of combinations of bequest motives and precautionary motives, so long as the combined motive is strong enough to match the slow rates of wealth drawdown observed empirically.

²²Although the significant heterogeneity in wealth at retirement probably at least partly reflects heterogeneity in preferences, such heterogeneity in outcomes arises naturally in life-cycle models with homogeneous preferences. Scholz, Seshadri and Khitatrakun (2006), for example, find that a life cycle model with homogeneous preferences can account for over 80 percent of the variation in retirement wealth.

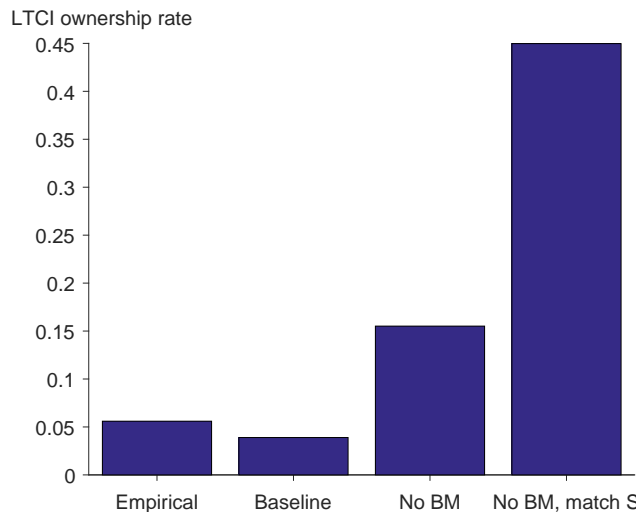


Figure 4: Simulated and empirical long-term care insurance ownership rates. The empirical ownership rate corresponds to the fraction of single retirees aged 70–79 in 1998 who report owning long-term care insurance that covers both nursing homes and home health care in at least half of the waves between 1998 and 2008 in which they report their ownership status, weighted by HRS respondent weights. The simulated ownership rates are based on three sets of preferences: the baseline estimates, the baseline estimates except with the bequest motive turned off (“No BM”), and estimates from the model without bequest motives fitted to the median wealth moments (“No BM, match S”).

the estimates from fitting a model without a bequest motive to the median wealth moments.

One way to judge the effect of the bequest motive on the demand for long-term care insurance is to turn off the bequest motive while holding constant the other preference parameters. This experiment gives the model’s forecast of the effect on long-term care insurance coverage of 100 percent estate (and gift) taxes, if such taxes were levied successfully. Figure 4 reveals the results of such an experiment in the second and third bars. These reveal that the bequest motive decreases the long-term care insurance ownership rate from 16 percent to four percent.

One major disadvantage of this counterfactual of shutting down the bequest motive is that it conflates the effects of two separate factors that affect the value of long-term care insurance: the value that people place on bequests and the “implicit tax” on private insurance from means-tested programs like Medicaid (Brown and Finkelstein, 2008). The implicit tax from Medicaid is much greater in the model in which the bequest motive is turned off since in this case individuals spend down their wealth much more rapidly and thus qualify for greater transfers from Medicaid. An alternative counterfactual that controls (albeit imperfectly) for the implicit tax from Medicaid to produce a cleaner measure of the effect of bequest motives on the value of insurance involves comparing predicted long-term

	Baseline preferences		Baseline preferences, but turn off bequest motive		No bequest motive, match median wealth	
	No LTCI	Effect of LTCI	No LTCI	Effect of LTCI	No LTCI	Effect of LTCI
Expected consumption (\$)	309,865	-8,412	335,534	-7,643	287,428	36,179
Expected bequest (\$)	67,540	-4,944	46,406	-10,925	88,859	-48,980
Willingness to pay for long-term care insurance (\$)						
Average load (18%)	-8,754	-	212	-	77,597	-
Actuarially fair	-1,761	-	11,233	-	88,121	-

Table 4: Long-term care insurance demand and simulated outcomes with and without long-term care insurance. Expected discounted consumption, expected discounted bequests, and the willingness to pay for long-term care insurance are simulated for a healthy 67-year-old female near the 75th percentile of the wealth distribution ($N = \$200,000$, $y = \$20,000$) with one of three sets of preferences: the baseline estimates, the baseline estimates but with the bequest motive turned off, and the estimates from a model without bequest motives fitted to the median wealth moments. The first column in each pair shows the values of the outcomes for someone without long-term care insurance. The second column in each pair shows the effect of buying long-term care insurance on these outcomes.

care insurance ownership in the baseline model to insurance ownership in a model without bequest motives that matches retirees' saving. Figure 4 reveals the results of such an experiment in the second and fourth bars. This comparison suggests that among similar-saving retirees, the bequest motive significantly reduces the demand for insurance. Long-term care insurance coverage is more than ten times greater in the model without bequest motives than in the baseline model (45 percent vs. 4 percent). Among people who draw down their wealth at similar rates, long-term care insurance is much less attractive to someone with the estimated bequest motive than to someone without a bequest motive.²³

To clarify why the estimated bequest motive reduces the demand for long-term care insurance, Table 4 shows, for a healthy 67-year-old female with a \$20,000 income stream and \$200,000 of non-annuity wealth (placing her around the 75th percentile of the wealth distribution), expected consumption and bequests without long-term care insurance, the

²³These results highlight the difficulty of interpreting comparisons of long-term care insurance ownership rates across groups with different values of proxies for bequest motives. There are at least two major issues. First, both bequests and long-term care insurance appear to be luxury goods. For this reason, the model predicts a *positive* relationship between desired bequests and long-term care insurance coverage, despite predicting that bequest motives reduce long-term care insurance coverage relative to the case of similar-saving people without bequest motives. Second, with heterogeneity in risk aversion over bequests, bequest motives might increase the demand for insurance among people who are especially risk averse over bequests while reducing it for others. Consistent with this, survey evidence suggests that the desire to insure bequests contributes to some people's purchasing decisions (LifePlans, 2004). These considerations might explain why comparisons of long-term care insurance ownership rates across groups with different values of proxies for bequest motives sometimes yield inconsistent results. For example, Sloan and Norton (1997) find no significant relationship between long-term care insurance ownership and reported preferences for leaving bequests, while Brown, Goda and McGarry (2011) find a positive relationship.

effect of buying long-term care insurance on expected consumption and bequests, and the willingness to pay for long-term care insurance. These outcomes are simulated using the three sets of preferences just discussed. With the baseline preferences, the individual is better off not buying long-term care insurance at available prices: The individual would have to be paid more than \$8,000 to be induced to buy (and hold for life) the typical long-term care insurance contract. Although the individual values the consumption and bequest insurance that long-term care insurance provides, she does not value this insurance enough to justify paying the loads on available contracts (which reduce her willingness to pay for long-term care insurance by about \$7,000) and losing access to means-tested benefits in some states of the world. Together, the loads on the typical contract and the loss of means-tested benefits from buying insurance mean that by self-insuring, the individual can on average enjoy more than \$8,000 more consumption and leave almost \$5,000 more wealth as bequests than she could by buying insurance. These considerations are similar for the individual with the baseline preferences except with the bequest motive turned off, although this individual does not value bequest insurance and instead wants to increase consumption at the expense of bequests. This individual slightly prefers buying available long-term care insurance to self-insuring and would be willing to pay up to about \$11,000 for access to actuarially fair long-term care insurance.

An individual without bequest motives whose saving is similar to the median retiree, by contrast, is much better off buying available long-term care insurance. Whereas the individual with the baseline preferences is better off not buying long-term care insurance at typical loads, an individual without bequest motives who saves a similar amount is willing to pay almost \$78,000 for access to long-term care insurance—almost 40 percent of her initial non-annuity wealth. Long-term care insurance is so valuable in this case because, by reducing the individual's need to engage in precautionary saving, it allows her to enjoy a higher rate of consumption. Without insurance, the individual's strong desire to avoid running out of wealth forces her to consume much less—and leave much larger bequests on average—than the individual would otherwise like. The individual leaves bequests of almost \$89,000 on average without insurance—about 44 percent of her initial wealth—despite not valuing bequests at all. Buying long-term care insurance allows the individual to convert much of these bequests into greater consumption; she consumes over \$36,000 more on average with insurance than without it, despite the loads on insurance and the foregone Medicaid benefits.

Among retirees who do not wish to rely on social insurance or their families, a key determinant of how much they should value long-term care insurance is the value they place on the bequests that arise incidentally from self-insuring their long-term care risk. People who value the prospect of leaving wealth to their heirs but are not very risk-averse over

how much they leave—a preference that is consistent with altruism and that appears to be widespread—are in many cases better off not buying available long-term care insurance. The wealth they hold into old age serves the dual purpose of paying for costly care episodes in some states and of augmenting bequests in others. For them, the benefits of buying long-term care insurance—of being able to choose a more desirable mix of consumption and bequests, of insuring their consumption and bequests, and of avoiding public care—are outweighed by the costs: insurance loads and reduced social insurance transfers.²⁴

6.4 The Results are Robust to Many Alternative Assumptions

Table 5 presents results from estimating the model with different “first-stage” parameter values and estimating moments. The estimations based on different first-stage parameter values include: increasing long-term care costs by 50 percent, strengthening the relationship between health spending and income,²⁵ disallowing residents of nursing homes and assisted living facilities from buying additional consumption beyond what they receive from their care (to reflect the many limitations they may face in buying and enjoying additional consumption), and setting the consumption value of privately-financed care facilities to \$5,000 (whereas in the baseline model it is \$20,000). The specifications with different estimating moments or weights include: using the robust weighting matrix (the inverse of the diagonal of the estimated variance-covariance matrix of the second-stage moment conditions, Pischke, 1995); estimating the model based on the baseline wealth moments and a single, overall long-term care insurance ownership rate of 15 percent (over 2.5 times the observed ownership rate); and estimating the model based on the baseline long-term care insurance moments and only the median wealth moments (excluding the 25th and 75th percentile wealth moments). Although most of the alternative versions of the model do not fit the data as well as the baseline specification does, the parameter estimates are fairly similar across specifications, and the key conclusion—that retirees’

²⁴To understand saving decisions, it can be useful to think of bequest motives as effectively extending an individual’s lifespan. To understand insurance decisions, however, this analogy is much less useful. The reason that bequest motives are central for decisions about how much to insure against late-life risks is that they smooth the marginal utility of wealth across states. Bequest motives disproportionately increase the marginal utility of wealth in short-lifespan, low-medical spending states—exactly those states that would otherwise have especially low marginal utility levels. The low marginal utility levels of these states without bequest motives explain the high valuation in models without bequest motives of insurance products like long-term care insurance and annuities that shift wealth out of these states and into others.

²⁵This specification strengthens the (positive) relationship between income and health spending (on both acute care and long-term care) beyond what is observed empirically. In particular, I scale the health spending faced by someone in income quintile q —which already reflects the greater spending by higher-income people observed in the HRS and NLTC data—by 1.15^{q-3} . Health spending in the middle income quintile is unchanged, health spending among lower-income people is decreased, and health spending among higher-income people is increased.

	Different first-stage parameter values				Different estimating moments or weights			
	Baseline model (1)	50% greater LTC costs (2)	Stronger health spending-income relationship (3)	No consump. in nursing facilities (4)	c_{priv} is \$5,000 (5)	Robust weighting matrix (6)	Target LTCI ownership rate = 15% (7)	Exclude 25th and 75th percentiles (8)
Parameter estimates, θ								
$\hat{\phi}$: bequest motive	0.95 (0.01)	0.94 (0.01)	0.95 (0.01)	0.92 (0.01)	0.96 (0.005)	0.93 (0.02)	0.95 (0.01)	0.95 (0.02)
\hat{c}_b : bequest motive (\$)	16.1 (1.4)	7.5 (0.7)	15.1 (0.6)	11.7 (1.6)	19.2 (1.3)	10.9 (2.1)	17.5 (1.7)	16.6 (2.7)
\hat{c}_{pub} : public care value (\$) ($c_{priv} = \$20,000$)	18.3 (4.7)	13.8 (3.6)	6.1 (0.3)	14.7 (6.3)	4.5 (0.6)	8.9 (5.1)	17.5 (3.9)	20.0 (11.9)
\hat{x}_{comm} : wealth floor in community (\$1,000s)	0.9 (0.1)	0.1 (0.1)	1.7 (0.2)	0.7 (0.02)	0.2 (0.1)	0.3 (0.3)	2.5 (0.1)	1.4 (0.2)
$\hat{\beta}$: discount factor	0.93 (0.02)	0.88 (0.01)	0.93 (0.01)	0.94 (0.02)	0.94 (0.01)	0.94 (0.02)	0.87 (0.02)	0.93 (0.02)
$\hat{\sigma}$: risk aversion	3.0 (0.05)	2.0 (0.03)	3.0 (0.05)	2.8 (0.1)	2.0 (0.02)	2.0 (0.1)	5.0 (0.1)	3.3 (0.1)
Goodness-of-fit								
χ^2 stat	67.8	75.0	68.3	71.4	67.1	73.2	67.0	17.9
p-value of model	0.65	0.41	0.63	0.53	0.67	0.47	0.58	0.76
p-value of no-bequest motive restriction	<2.3e-16	<2.3e-16	<2.3e-16	5.0e-7	<2.3e-16	<2.3e-16	7.2e-10	<2.3e-16
Simulated LTCI (%)								
(Empirical LTCI = 5.6%)	3.9	5.7	4.5	3.6	7.8	3.6	17.0	4.5

Table 5: Robustness of results to different first-stage parameter values and estimating moments. The first column reproduces the baseline estimates. The next set of columns shows results based on different values of important first-stage parameters. The final set of columns shows results based on estimating the model based on different sets of moments or weights. The second column shows results based on a model with 50 percent greater long-term care costs. The third column shows results based on a model with a much stronger positive relationship between income and health spending (both acute and long-term care) than is observed empirically. In particular, I scale the health spending faced by someone in income quintile q by 1.15^{q-3} . Health spending in the middle income quintile is unchanged, health spending among lower-income people is decreased, and health spending among higher-income people is increased. The fourth column shows results based on a model that does not allow residents of nursing homes and assisted living facilities to buy consumption over and above the consumption they receive from their long-term care. This is meant to reflect the many limitations they may face in buying and enjoying additional consumption. The fifth column shows results based on a model in which the consumption value of privately-financed care facilities is \$5,000 (whereas in the baseline model it is \$20,000). The sixth column shows results based on a “robust weighting matrix,” the inverse of the diagonal of the estimated variance-covariance matrix of the second-stage moment conditions (Pischke, 1995). The seventh column shows results from estimating the model based on the baseline wealth moments and a single, overall long-term care insurance ownership rate of 15 percent (about three times the observed ownership rate). The eighth and final column shows results from estimating the model based on the baseline long-term care insurance moments and only the median wealth moments (excluding the 25th and 75th percentile wealth moments). Standard errors are in parentheses.

decisions favor models with important bequest motives—is extremely robust. In every specification, the model without bequest motives is highly inconsistent with some of the main features of the data and can be rejected at the one percent confidence level.²⁶

The robustness of the results is driven by three main factors. First, multiple major patterns point to the same conclusion in that they are highly inconsistent with the model without bequest motives and matched well by the model with bequest motives. These are the three patterns discussed already: the low rates of long-term care insurance ownership, both overall and among retirees at the top of the wealth distribution; the combination among middle-class and richer retirees of the slow rate at which they draw down their wealth and the low rates at which they own long-term care insurance; and the pattern of saving across the wealth distribution. Additional information about how various features of the data contribute to identifying the key parameters of the model is presented in Appendix A.8.

The second factor driving the robustness of the conclusion that the model requires a bequest motive to match retirees’ choices is that many alternative modeling assumptions or parameter values that would help the model without bequest motives match the slow rates at which retirees draw down their wealth would hurt that model’s ability to match the low rates of long-term care insurance ownership and vice-versa. For example, retirees might think that Medicare covers more long-term care expenses than it does, they might underestimate the cost or risk of requiring long-term care, or they might be more myopic than is allowed for by the model of exponential discounting. Each of these factors would improve the ability of the model without bequest motives to match the low rates of long-term care insurance ownership. But at the same time, each of these factors would hurt the ability of the model without bequest motives to match the slow drawdown of wealth.

The third factor driving the robustness of the conclusion that the model requires a bequest motive to match retirees’ choices is the large magnitude of the mismatch between the predictions of the model without bequest motives and the combination of saving and long-term care insurance decisions among middle-class and richer retirees. There are a variety of ways to measure the size of this mismatch, including some that have been discussed already, such as statistical measures of the goodness of fit of alternative versions of the model and comparisons of empirical and simulated choices. This section presents the results of alternative measures that answer the question: How much less attractive would long-term care insurance have to be in order for the model without bequest motives to match the saving and long-term care insurance decisions of middle-class retirees?

²⁶An important caveat of these exercises is that many of the contemplated changes in the environment facing retirees would be expected to affect people’s wealth at retirement, not just their behavior after retirement.

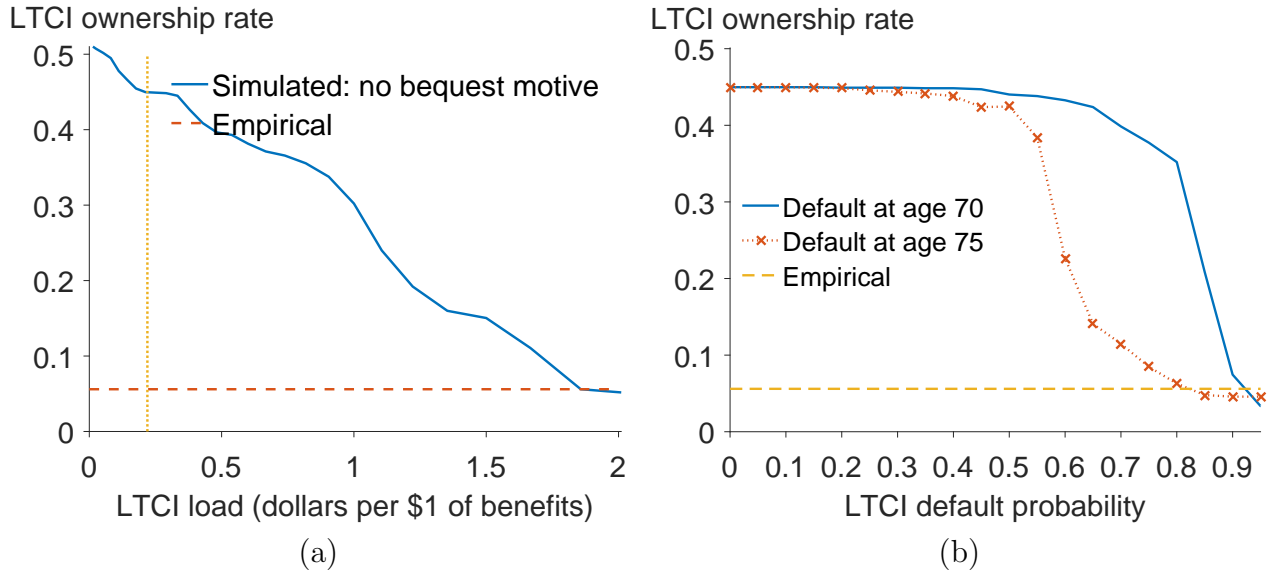


Figure 5: Long-term care insurance ownership rate in the model without bequest motives fitted to the (median) wealth moments.

Panel (a): Long-term care insurance ownership rate as a function of the load. The load is measured in dollars of load per dollar of benefits. Actuarially fair insurance corresponds to a load of zero. The vertical dotted line shows the average load on contracts in the U.S. market, about 22 cents per dollar of benefits (which corresponds to the 18 percent load as a fraction of premiums found by Brown and Finkelstein (2007)).

Panel (b): Long-term care insurance ownership rate as a function of the default probability. Default means that the contract vanishes at the specified age.

The two panels of Figure 5 show two possible answers to this question. Panel (a) shows, in the model without bequest motives fitted to the median wealth moments, the simulated long-term care insurance ownership rate as a function of the load on the contract. As already reported, at the average load in the U.S. predicted ownership in this model is 45 percent—more than eight times greater than the 5.6 percent empirical ownership rate. Panel (a) shows that in order to match both the saving and long-term care insurance choices of middle-class retirees, the model without bequest motives requires extremely high loads on long-term care insurance, far greater than those observed in the U.S. market. Whereas the average load on long-term care insurance contracts in the U.S. requires people to pay about 22 cents worth of loads per dollar of benefits (corresponding to an 18 percent load as a fraction of premiums, $\frac{\$0.22}{\$1.22} = 0.18$), the model without bequest motives requires a load of more than \$1.85 per dollar of benefits—over eight times the market average.

Panel (b) shows, in the same model without bequest motives fitted to the median wealth moments, the simulated long-term care insurance ownership rate as a function of the probability that the insurance contract vanishes at some point in the future. The risk that the contract vanishes is meant to capture in a simple way the possibility that the insurer defaults on its obligations to the insured or the possibility that the individual, for one

reason or another, allows his or her contract to lapse and thus loses coverage thereafter. The results show that in order to simultaneously match retirees’ saving and long-term care insurance decisions, the model without bequest motives requires extremely high probabilities of long-term care insurance vanishing at about the worst possible time.²⁷ Only extremely high probabilities of default (around 80 percent) at the worst times allow the model without bequest motives to simultaneously match the saving and long-term care insurance choices of middle-class retirees. These results suggest that default risk and other un-modeled potential disadvantages of long-term care insurance are unlikely to overturn the result that the model without bequest motives is inconsistent with the behavior of middle-class retirees. Middle-class (and richer) retirees buy far too little long-term care insurance relative to how much they save to be consistent with the model without bequest motives.

6.5 Implications of the Results

Bequest motives increase saving significantly.— Figure 6 shows, for three different simulations, the simulated evolution of the median and 75th percentile of the distribution of total non-annuity wealth for a balanced panel of retirees in the first cohort (aged 65–69 in 1998, with an average age of 67).²⁸ Bequest motives significantly slow the speed at which retirees’ draw down their wealth: Wealth declines more slowly in the baseline model (solid lines) than in the model without bequest motives (dashed lines). The bequest motive-induced slowing of the drawdown of wealth leads to significantly greater wealth holdings among the oldest retirees and significantly larger bequests. Compared to bequest motives, medical care costs (including both long-term care and acute medical care) have a smaller effect on saving among people around the 75th percentile and a greater effect among people around the median of the wealth distribution (dotted lines with x markers).²⁹

²⁷These simulations are based on two ages at which long-term care insurance potentially vanishes, 70 and 75. Because of the front-loading of premiums in long-term care insurance contracts, these ages are the worst ones (among all “round” ages between 65 and 95 ending in fives or zeros) for long-term care insurance to vanish. Healthy 65-year-olds tend to remain healthy for several years, during which time they would pay premiums, before becoming sick and collecting benefits. The worst time for a contract to vanish is immediately after the “premiums phase” and before the “benefits phase.”

²⁸Constructing the figure involves three main steps. First I clone each member of the first cohort ten times to increase the sample size. Then I simulate each clone’s subsequent health realizations over the next 23 years (at which time the average age of the cohort is 90), and simulate the wealth paths of only those clones who live at least 23 years. Finally, I calculate the median and 75th percentile of the simulated wealth distribution in each of those years and plot it against the average age of the cohort on the x-axis. The figure therefore shows the evolution of the wealth distribution as the cohort ages of only those cloned members of the first cohort who survive at least 23 years. This balanced panel construction avoids the bias that can result from selective mortality.

²⁹An important caveat of these exercises is that many of the contemplated changes in the preferences or budget constraints of retirees would be expected to affect people’s wealth at retirement, not just their

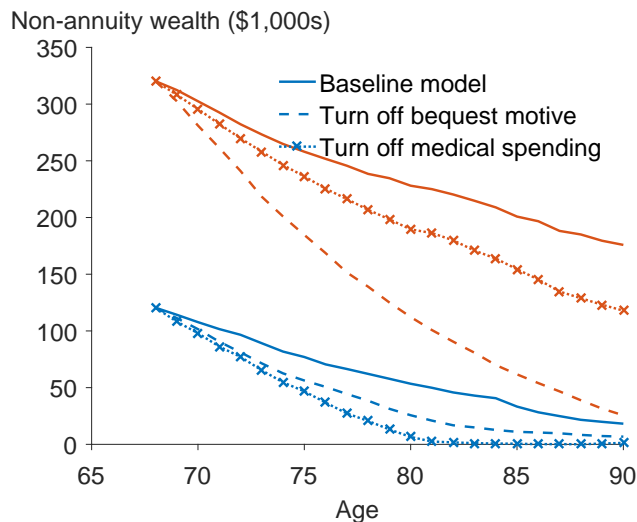


Figure 6: Simulated evolution of the median and 75th percentile of the distribution of non-annuity wealth among members of the first cohort (aged 65–69 in 1998) who remain alive for at least 23 years into their simulated future (at which time their average age is 90). The solid lines track the wealth distribution in the baseline model. The dashed lines track the wealth distribution if the bequest motive is turned off. The dotted lines with x markers track the wealth distribution if medical spending, including spending on both acute and long-term care, is shut down. Specifically, the decision rules come from a model without any long-term care or acute medical care costs ($ltc(h, t) = m_t = 0 \forall h, t$), but the simulation of wealth profiles includes medical costs. Differences in wealth therefore reflect differences in saving behavior rather than differences in realized medical expenses. Individuals in the simulation are assigned their reported (empirical) long-term care insurance ownership status.

Bequest motives significantly reduce purchases of annuities.— Figure 7 shows how the estimated bequest motive affects purchases of an annuity that pays \$5,000 of (real) income per year for life and has a ten percent load, a typical load in the U.S. private market (Brown, 2007). The estimated bequest motive significantly reduces the demand for annuities. Whereas without bequest motives about 40 percent of the sample buys the annuity—virtually everyone who can afford the premium,—in the baseline model only 10 percent buys the annuity, much closer to the empirical ownership rate of 7 percent. This is consistent with Lockwood’s (2012) conclusion that relatively modest bequest motives can significantly reduce the demand for available annuities.

Bequest motives increase the scope for and effectiveness of policies to encourage private long-term care insurance coverage.— Several U.S. states have implemented policies designed to increase private insurance coverage, presumably with the goal of reducing spending by means-tested programs. There are at least two reasons why the role of bequest motives in reducing private long-term care insurance coverage could be of interest to policymakers who wish to increase private insurance coverage. First, as Brown and

behavior after retirement.

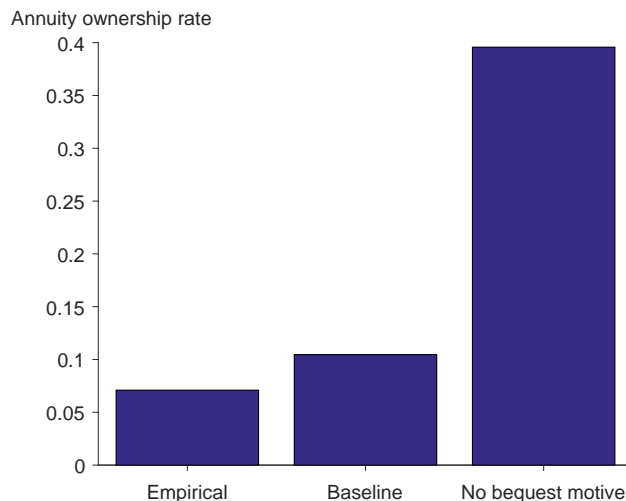


Figure 7: Empirical and simulated ownership rates of life annuities. The empirical annuity ownership rate corresponds to the fraction of single retirees aged 70–79 in 1998 who in the 1998 wave report owning an annuity that lasts for life, weighted by HRS respondent weights. The simulated annuity ownership rates are based on an annuity that pays the annuitant \$5,000 of real income each year for life and has a ten percent load, typical of the U.S. private market (Brown, 2007). “Baseline” is the simulated ownership rate with the baseline estimates. “No bequest motive” is the simulated ownership rate with the baseline estimates, except without the bequest motive.

Finkelstein (2008) show, to the extent that means-tested programs like Medicaid explain the low rates of private insurance coverage, the potential for premium subsidies to expand coverage are extremely limited, since the “net load” on insurance, inclusive of public benefits foregone, remains large even if policies such as premium subsidies reduce the “gross load” on private contracts. But bequest motives, by increasing saving, reduce Medicaid’s implicit tax on long-term care insurance and increase the own-price elasticity of demand for long-term care insurance. The first bar in Figure 8 shows the increase in the simulated long-term care insurance ownership rate from a premium subsidy that reduces the after-tax price of insurance exactly enough to make the policy actuarially fair. This subsidy increases predicted coverage more than four-fold, from four percent to 18 percent.³⁰

The second reason that the role of bequest motives in reducing private long-term care insurance coverage could be of interest to policymakers who wish to increase private insurance coverage is that it admits new possibilities for the types of policies that could encourage private coverage. One such policy is a long-term care insurance-contingent estate and gift tax, under which only people *without* long-term care insurance must pay taxes on their gifts and bequests; buying (qualifying) long-term care insurance allows one to escape

³⁰Although the subsidy has a noticeable effect on private insurance coverage, Medicaid still severely limits the market for private insurance, as even with actuarially fair insurance only about one in every five single retirees is predicted to buy insurance. Moreover, and consistent with Goda’s (2011) empirical findings, the subsidies increase coverage primarily among rich retirees. The subsidies are therefore unlikely to pay for themselves by reducing Medicaid expenditures, since the rich seldom rely on Medicaid even without insurance.

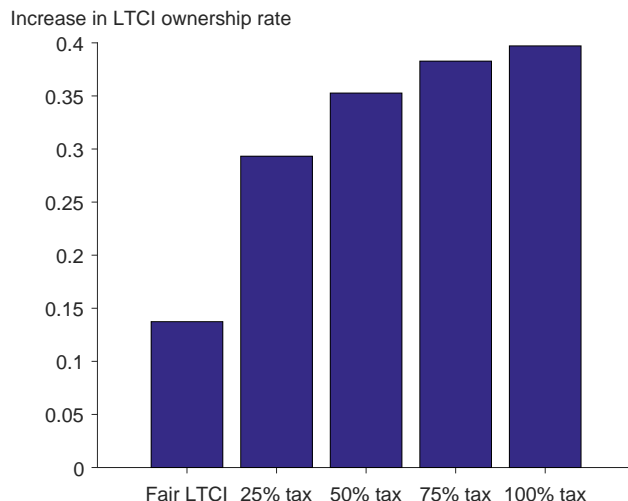


Figure 8: Percentage point increase in the simulated long-term care insurance ownership rate in the baseline model from two types of policies. The first bar shows the increase in long-term care insurance ownership from a subsidy for long-term care insurance that makes its subsidy-inclusive price actuarially fair. The remaining bars show the increase in long-term care insurance ownership from long-term care insurance-contingent estate and gift taxes at various tax rates, under which only people *without* long-term care insurance pay taxes on their gifts and estates (people with long-term care insurance pay no transfer tax).

transfer taxation. As Figure 8 shows, an insurance-contingent transfer tax of 25 percent increases predicted insurance ownership in the baseline model by about twice as much as the premium subsidy (29 vs. 14 percentage points), and a 75 percent tax increases predicted insurance ownership by 38 percentage points. Such a policy could partly correct the externality that, because of Medicaid, taxpayers at large benefit from the decision of any individual to buy insurance.

7 Conclusion

Rather than buy insurance against some of the main risks they face, many retirees self-insure by holding much of their wealth into old age. Although the choice of many retirees to self-insure is often viewed as evidence against the importance of bequest motives since it exposes bequests to significant risk, I find that the choice to self-insure constitutes evidence in favor of bequest motives. Bequest motives reduce the demand for insurance by reducing the opportunity cost of precautionary saving; setting aside wealth to pay for possible future contingencies is much more costly for people without bequest motives who would otherwise like to consume all of their wealth.

The evidence in favor of bequest motives is perhaps surprisingly strong given that models without bequest motives can roughly match either the saving or long-term care insurance

decisions of middle-class retirees and given the elusive nature of bequest motives in which bequests are luxury goods. By their nature, such bequest motives tend to have a marginal rather than a decisive impact on most decisions: Few choices involve a clear tradeoff between bequests and other goods.³¹ Despite this, several patterns in the data are much more consistent with a standard life cycle model with bequest motives than with a model without bequest motives.

Although the elusive nature of bequest motives necessarily makes the conclusion that bequest motives play an important role in retirees' behavior more tentative than the conclusion that standard models without bequest motives cannot match retirees' behavior, a variety of evidence supports the idea that bequest motives—or preferences like altruism that might lead people to value bequests—are widespread. This evidence includes the prevalence and size of inter-household transfers during life (e.g., Gale and Scholz, 1994), survey responses about the importance of leaving bequests (e.g., Ameriks et al., 2011), and annuity guarantee choices (Laitner and Juster, 1996). In light of this evidence and my results, bequest motives are a high priority for future research.

My results suggest that the term *accidental bequests*, which is used to describe bequests that arise as a byproduct of precautionary saving against uninsured risks, may be misleading in its connotation that such bequests are neither intended nor valued. Although self-insurance tends to produce bequests that are both larger on average and more variable than those that would occur under full insurance, my results suggest that the value people place on these *incidental bequests* plays a key role in their decisions of how much risk to bear in the first place. Even individuals who would leave small bequests or even no bequest if perfect insurance were available, may—because of the value they place on bequests—choose far less insurance coverage than they would if insurance markets were perfect (Lockwood, 2012). If bequests were accidental in the sense that people did not value bequests, realized bequests would likely be much smaller, both because people would save less and, even more important for the non-rich, because people would buy more insurance.

My results highlight the importance of accounting for bequest motives in evaluating policies that affect people's exposure to late-life risks. The decision about how to model bequest motives can have first-order consequences for estimates of the welfare and other impacts of

³¹The elusive nature of bequest motives helps explain why bequest motives have been the subject of a prolonged debate in economics (e.g., Kotlikoff and Summers, 1981; Modigliani, 1988). Even life insurance decisions, perhaps the main decision that involves a clear tradeoff between bequests and other goods, would only register much stronger bequest motives (at least among retirees) than those identified in this paper. Due to the actuarial unfairness in life insurance, only retirees who wish to leave more than their entire non-annuity wealth as a bequest should consider buying life insurance to augment their bequest (Bernheim, 1991). With the preferences that I estimate, by contrast, many retirees would leave *no* bequest if fair insurance were available. These results are consistent with Brown's (2001) conclusion that few retirees buy life insurance to increase their bequests.

changes to insurance-related policies such as Social Security, Medicare, and Medicaid. Policies that affect the behavior of retirees, owners of much of the world's non-human wealth, are likely to have significant effects on the economy, especially through their effects on the budgets of means-tested social insurance programs and on the size, distribution, and risk of bequests received by future generations. My results suggest that taxes on saving and inter-household transfers are likely to affect bequests by affecting retirees' decisions about their insurance coverage as well as their saving. The induced changes in insurance coverage can change not only the magnitude but even the direction of policies' effects on bequests.

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A Appendix

A.1 Health Uncertainty: Mortality, Long-Term Care, and Acute Medical Care Risks

This section reports the results of descriptive regressions about long-term care and long-term care insurance and describes the key elements of the model of health risks. I test the robustness of the results to a variety of changes to these risks in Section 6.4.

A.1.1 Long-Term Care and Long-Term Care Insurance: Descriptive Regressions

Table A.1.1 reports results from descriptive regressions of long-term care usage and long-term care insurance ownership on key demographic and economic variables. These regressions are based on a sample of people 65 and older in the 1998 wave of the Health and Retirement Study. The regressions of long-term care usage further restrict the sample to people who report difficulties with at least two activities of daily living (ADLs). The table shows the estimated marginal effects from probit regressions.

Use of formal care is much greater among people with more ADL limitations, is slightly greater among single people and people without children, and is perhaps slightly greater among people with greater income, though the income results are statistically insignificant and the point estimates are non-monotonic in the income quartile. Long-term care insurance ownership is strongly increasing in wealth but is otherwise not well predicted by the other demographic variables, including whether someone is single and whether he or she has children.

A.1.2 Health Transitions

An individual's future health prospects depend probabilistically on the individual's current age and health status as well as on the individual's sex (s) and (permanent) income (y), $Pr(h_{t+1} = h' | h_t, t; s, y)$. I base the model of health transitions on a new model developed by Friedberg et al. (2014). This model makes a number of important improvements on the widely-used Robinson model of long-term care requirements (Robinson, 2002), including using updated data and more robust procedures.

I make three small adjustments to the Friedberg et al. (2014) model in order to cater it to my application. First, I convert the monthly health transitions calculated by Friedberg et al. (2014) into annual transitions. This choice is driven both by computation time considerations and by data limitations, since the Health and Retirement Study and many other datasets measure medical spending and other variables at lower frequencies (e.g.,

every year or every second year). Second, I use the estimated transition matrices for women as the baseline transition matrices for both the single men and the single women in my sample. The care usage patterns of women likely provide a closer approximation to the usage patterns of single people, whether male or female, because women receive a much smaller fraction of their long-term care from their spouses than men do. Women receive less informal care from their spouses because their spouses (predominantly men) tend to get sick and die at earlier ages than they do. As a result, a smaller fraction of women’s care episodes occur when their husbands are alive and well enough to provide them with informal care. Of course, the care use patterns of women in the general population—including married women—suffers from this same problem and so tends to understate the care needs of singles, but the bias is less severe than it is for men.

The third set of adjustments I make is to adjust the Friedberg et al. (2014) transition probabilities to match De Nardi, French and Jones’s (2010) estimates of life expectancy conditional on reaching age 70 for different sex and income groups. A t -year-old in sex-income quintile group (s, q) faces the Friedberg et al. (2014) transition probabilities of a $(t + \Delta(s, q))$ -year-old female, where $\Delta(s, q)$ is chosen to minimize the difference between predicted life expectancy at age 70 and De Nardi, French and Jones’s (2010) estimates of life expectancy at age 70. The only wrinkle arises due to censoring: Friedberg et al. (2014) estimate transition matrices only for people aged 65 to 110, so it is not possible to assign the age-63 (say) transition matrix to a 65-year-old in a long-lived group. I deal with this censoring in the simplest possible way, by assuming that t -year-olds with sex s and income quintile q face the age- $\max\{65, \min\{105, t + \Delta(s, q)\}\}$ Friedberg et al. (2014) health transition matrix.

Table A2 shows the age adjustments, $\Delta(s, q)$, and the resulting life expectancies of each group. The differences in life expectancies at age 70 across sex and income groups are substantial: Women live more than five years longer than men in the same income quintile, and men and women in the top income quintile live almost four years longer than their counterparts in the bottom quintile. Each group’s adjusted life expectancy is within 0.3 years of De Nardi, French and Jones’s (2010) estimate. It is important that the model of health risk be consistent with this substantial heterogeneity in life expectancy, since life expectancy can have an important impact on saving and insurance decisions (De Nardi, French and Jones, 2009).

Table A3 presents statistics related to the unconditional and conditional probabilities of being in different health states in the original and adjusted Friedberg et al. (2014) models. The adjusted model preserves the essential character of the original model in terms of the key determinants of saving and insurance decisions: the expected fraction of remaining life spent in different health states. The key difference is that males spend a greater fraction of their remaining lives in nursing homes under the adjusted model than under the original model. This is due to the much greater supply of informal care to married than to single men and is the reason that I base the model of health transitions for single males on the Friedberg et al. (2014) model for females. The other main differences have to do with time aggregation. Using yearly rather than monthly transitions reduces the probability of ever experiencing a nursing home stay and of leaving a nursing home alive, since yearly transitions rule out the possibility of stays of less than one year in duration. Although it would be desirable to base the model of health transitions on a model specifically estimated

to match the heterogeneous experiences of single men and women with different levels of income, such a model is not available, and, as discussed in Section 6.4, the conclusions are robust to many alternative assumptions and are unlikely to be affected by plausible changes in the model of health risk.

A.1.3 Long-term Care Prices

The cost of the individual’s long-term care is a deterministic function of the individual’s health, age, sex, and income quintile, $ltc(h_t, t, s, q)$. Part of this heterogeneity could reflect differences in the prices that people face for the same care, due, for example, to differences in prices across different locations. Other sources of heterogeneity could include unmeasured and un-modeled differences in the quantity or quality of the long-term care services consumed by different groups, conditional on their health status. For example, higher-income people might purchase higher-quality (and so costlier) long-term care.

To estimate $ltc(h_t, t, s, q)$, I combine two sources of data. The first is data from a MetLife survey about long-term care prices (MetLife Mature Market Institute, 2002*a,b*). This reports average prices for different long-term care services (including stays in nursing homes and assisted living facilities and skilled and unskilled home care). According to this survey, average prices in 2002 were \$52,195 per year in a nursing home, \$26,280 per year in an assisted living facility, \$18 per hour for unskilled home care, and \$37 per hour for skilled home care.

The second source of data is the National Long-Term Care Survey (NLTC). This is a longitudinal survey of Americans age 65 and older with detailed information about health and health-related expenditures, including information about the prices of any long-term care services that surveyed individuals consume. I use the NLTC data to estimate the following regression:

$$\frac{p_i}{\bar{p}} = \alpha + \beta \text{female}_i + \gamma \text{age}_i + \sum_{q=2}^5 \delta_q \text{income quintile } q_i + \varepsilon_i,$$

where p_i is the price per month of care in i ’s nursing facility, \bar{p} is the average price per month of care in facilities, and female_i and $\text{income quintile } q_i$ are indicators for whether i is a female and in income quintile q , respectively. I use the predicted values from this regression to scale the average prices of each long-term care service (nursing homes, assisted living facilities, skilled home care, and unskilled home care).³²

A summary of the results is presented in Table A.1.3. Females pay slightly higher prices than males (about 6 percent) and higher-income people pay slightly higher prices than lower-income people (the top income quintile pays about 12 percent more than the bottom). Conditional on the type of care being used, age has little effect on long-term care prices (the coefficient estimate is a precise zero). The biggest source of heterogeneity is

³²Data considerations lead me to estimate a single scaling factor to apply to all types of long-term care rather than estimating different scaling factors for different types of care. These considerations are the difficulty of distinguishing between nursing homes and assisted living facilities and the difficulty of estimating hourly prices of skilled and unskilled home care in the data.

between people in the bottom income quintile and everyone else; the prices that people in the bottom income quintile pay are between 1.6 and 11.5 percent lower than the prices paid by people in higher income quintiles. But a striking feature of the results is how little heterogeneity there appears to be on average across different sex, age, and income groups. None of the individual coefficients is significant at standard confidence levels, and the covariates taken as a whole are not significant either.

A.1.4 Acute Medical Care Spending

The cost of an individual’s acute medical care is log-normally distributed with the mean and variance depending on the individual’s health, age, sex, and income quintile, $m_t \sim \log N(\mu_m(h_t, t, s, q), \sigma_m^2(h_t, t, s, q))$. That the mean and variance are allowed to depend on health, age, sex, and income quintile allows for rich heterogeneity in the spending risk facing different people.

I estimate the mean and variance of different groups’ spending on acute medical care in two steps, using data from the HRS. First, I decompose total out-of-pocket spending (the variable in the RAND release of the HRS) into separate acute and long-term care components. To do this, I use disaggregated data on out-of-pocket spending by service type in 2006. For each health status (healthy, home care, and nursing home), I estimate the fraction of total out-of-pocket spending that is due to acute medical care (as opposed to long-term care). The sample is everyone age 65 and older whose combined previous-wave non-annuity wealth and annual income is at least \$100,000. I convert observed total out-of-pocket spending to acute out-of-pocket spending by multiplying observed total out-of-pocket spending by the estimated fractions of spending on acute care for each health status. The estimates imply that among healthy people, about 97 percent of total out-of-pocket spending is due to spending on acute medical care. Among people who require home care, this fraction is 72 percent. Among people who require nursing home care, this fraction is just 11 percent.

I restrict the sample to people whose combined annual income and initial wealth is at least \$100,000 in order to reduce the bias from censoring by Medicaid, charities, and uncompensated care. These factors tend to limit an individual’s out-of-pocket medical spending to his or her net wealth or liquid assets, which means that including low-net worth individuals in the sample tends to bias downward the true medical spending risk that people face.³³

Second, I estimate the means and variances of the acute medical spending distributions by running two versions of the following regression:

$$m_{it} = \alpha + \beta \text{female}_i + \gamma \text{age}_{it} + \sum_{h \in \{hc, nh\}} \phi_h \text{health } h_{it} + \sum_{q=2}^5 \delta_q \text{income quintile } q_i + \varepsilon_{it},$$

³³The proper input to the life cycle model is total medical spending net of care paid for by Medicare, not just out-of-pocket spending by the individual. The key difference between these two objects is care paid for by Medicaid, charities, and uncompensated care. The extent to which care that is not covered by Medicare is paid for by the individual vs. by Medicaid and other means-tested programs is an endogenous outcome of the model that depends in an important way on people’s preferences.

where health is either healthy (omitted), home care, or nursing home and the remaining variables are as defined in Section A.1.3. In one version of this regression, the dependent variable is the log of out-of-pocket acute medical spending. In the other, the dependent variable is the square of the log of out-of-pocket acute medical spending. In both cases, I set out-of-pocket spending equal to the maximum of its value in the data and \$1 in order to take logs. Together, these regressions and the identity $Var(X) = E(X^2) - (E(X))^2$ identify the mean and variance of the distribution of acute medical spending facing these groups. The sample is the subset of my main sample (single retirees 65 and older) whose combined previous-wave non-annuity wealth and annual income is at least \$100,000 to avoid the censoring issue discussed above.

Table A.1.4 presents the results. Both the signs and the quantitative magnitudes of the coefficients are as expected. On average people in worse health spend more than people in better health, women spend more than men, older people spend more than younger people, and higher-income people spend more than lower-income people.

A.2 Numerical Solution Procedure: Details and Accuracy

I solve the model numerically using value function iteration. The method proceeds by backward induction, beginning from the maximum possible age T . Because the individual dies by age $T + 1$ with probability one and leaves any remaining wealth as a bequest, the age- T value function can be found easily. To solve for the value function at younger ages, I discretize wealth into a fine grid and use piecewise cubic hermite interpolation to evaluate the value function between grid points. For each sex-income-long-term care insurance group and at each age-health-wealth node, I solve for optimal consumption.

The solution produced by such a method is necessarily an approximation, and its accuracy depends on a number of factors, including the wealth grid. The existence of means-tested programs poses a special challenge, since they cause the value function to be non-concave, which in turn means that the individual's first-order condition for optimal consumption is necessary but not sufficient for an optimum. The effects of means-tested programs on the value function are especially pronounced in the regions of the function in which wealth is relatively small. For this reason, I ensure that the wealth grid is especially fine at small values of wealth by combining (i) a grid that is equally-spaced in logs from the maximum of \$1,000 and the Medicaid wealth threshold (which in the baseline specification is \$0) to \$6 million with (ii) a grid that is equally-spaced in levels from -\$1,000 to the maximum of \$1,000 and the Medicaid wealth threshold. The resulting grid has 196 distinct values.

I turn now to tests of the accuracy of the numerical solution. The tests are based on the Euler equation, the fundamental condition for intertemporal optimization. The Euler equation is

$$u'(c_t^*) = \beta \left\{ Pr(h_{t+1} = d|h_t, t; s, y) E_t[(1 + r_t)v'(b_{t+1})] + Pr(h_{t+1} \neq d|h_t, t; s, y) E_t \left[(1 + r_t) \frac{\partial V_{t+1}(\hat{x}_{t+1}, h_{t+1}; s, y, ltc_i)}{\partial \hat{x}_{t+1}} \right] \right\}.$$

The Euler equation holds whenever consumption is not at a corner, $c^* \in (c_m(h_t, Pub_t), x_t)$. This condition about consumption not being at a corner involves one more element than the usual case because of the consumption value of long-term care, $c_m(h_t, Pub_t)$. The usual situation in which optimal consumption is a corner solution is when borrowing constraints bind, i.e., when the marginal utility of consumption today when borrowing as much as possible exceeds the expected discounted marginal utility of resources tomorrow. The consumption value of facility-based care creates another type of corner solution. In certain circumstances, people in facilities might wish they could save some of the consumption that is bundled together with their long-term care, which is not possible. In states of the world in which this is true, the Euler equation does not hold, since the marginal utility of consumption today (when consuming only the goods and services bundled together with long-term care) is strictly less than the expected discounted marginal utility of resources next period. Euler equation-based tests exclude states of the world in which optimal consumption is a corner solution from the set of states at which the Euler equation error is calculated.

The idea underlying the Euler equation test is to measure the closeness of the approximate (numerical) solution to the exact solution that satisfies the Euler equation. I follow Judd (1992) and Fella (2014) in calculating Euler equation errors in units of current consumption:

$$EE(s) = \left| 1 - \frac{c^*(s)}{\bar{c}(s)} \right|,$$

where s is the state vector, $c^*(s)$ is the analytical solution of the Euler equation (the exact consumption level at which the marginal utility of consumption equals the expected discounted marginal utility of resources in the next period), and $\bar{c}(s)$ is the (approximate) optimal consumption rule delivered by the numerical solution algorithm. I calculate Euler equation errors for each member of the simulation sample in each year in which he or she is alive over my sample period, from 1998 to 2008.

The results suggest that the numerical solution method is performing fairly well. The maximum Euler equation error is about 0.27, or -1.3 natural log units, which is similar to though slightly worse than the values achieved by Fella's (2014) value function iteration methods, which ranged from -1.4 to -2.6. The average and median Euler equation errors are both less than 0.03, or -3.6 in natural log units. This is in the middle of the range of values achieved by Fella's (2014) value function iteration methods, though worse than the values achieved by Fella's (2014) endogenous grid method.

A.3 Asymptotic Distribution of the MSM Estimator and Over-identification Tests of the Model's Fit

Pakes and Pollard (1989) and Duffie and Singleton (1993) show that the MSM estimator, $\hat{\theta}$, is consistent and asymptotically normally distributed under regularity conditions satisfied here. The variance-covariance matrix of $\hat{\theta}$ is

$$\Omega_{\theta} = (G'_{\theta} W G_{\theta})^{-1} G'_{\theta} W \left[\Omega_g + \frac{N_d}{N_s} \Omega_g + G_x \Omega_x G'_x \right] W G_{\theta} (G'_{\theta} W G_{\theta})^{-1},$$

where G_θ and G_χ are the gradient matrices of the moment conditions with respect to θ and χ , Ω_g is the variance-covariance matrix of the second-stage moment conditions, Ω_χ is the variance-covariance matrix of the first-stage parameter estimates, and N_d and N_s are the empirical sample size and the simulation sample size, respectively. I approximate the derivatives in the gradient matrices numerically. The square roots of the diagonal entries of Ω_θ are the standard errors of the second-stage parameter estimates, $\hat{\theta}$.

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

$$\hat{\varphi}(\hat{\theta}, \chi_0)' R^{-1} \hat{\varphi}(\hat{\theta}, \chi_0)$$

converges in distribution to a chi-squared random variable with degrees of freedom equal to the number of second-stage moments less the number of second-stage parameters. In this formula, $\hat{\varphi}(\hat{\theta}; \chi_0)$ is the vector of moment conditions and

$$R = P \left(\frac{\Omega_g}{N_d} + \frac{\Omega_g}{N_s} + G_\chi \Omega_\chi G_\chi' \right) P,$$

where $P = I - G_\theta(G_\theta' W G_\theta)^{-1} G_\theta' W$, except if $W = \Omega_g^{-1}$, in which case

$$R = \left(\frac{\Omega_g}{N_d} + \frac{\Omega_g}{N_s} + G_\chi \Omega_\chi G_\chi' \right).$$

I use this matrix for all of the results in the paper.

I estimate Ω_g and W from the data. Because I adopt many of the first-stage parameter values from other sources rather than estimating them, I treat χ as if it were known with certainty, $G_\chi = 0$. Excluding the correction for the uncertainty in the first-stage parameters tends to make the second-stage parameter estimates appear more precise than they actually are and the fit of the model (as measured by the chi-squared test) appear worse than it actually is. To estimate G_θ , I follow the procedure for analyzing moment conditions of non-smooth functions (Pakes and Pollard, 1989; Newey and McFadden, 1994; Powell, 1994), since the functions inside the moment conditions $\varphi(\theta; \chi)$ are non-differentiable at certain points. This involves estimating the derivatives of the simulated moments with respect to the parameters θ . The procedure approximates the change in the fraction of people with wealth no larger than a threshold level by assuming that the density of the wealth distribution is constant within a small neighborhood of that threshold.

A.4 Anticipated and Realized Rates of Return on Wealth

Table A6 lists the historical returns data that I use to estimate the anticipated and realized rates of returns on retirees' portfolios. I follow Baker, Doctor and French (2007) and French and Benson (2011) in terms of data sources and assumptions.³⁴ Using data from the HRS, I classify retirees' assets into the six categories shown in the table as well as a residual "Other" category (which includes vehicles, for example) that I assume earns 0 percent real, after-tax returns. Following Baker, Doctor and French (2007), I assume that Individual Retirement Account (IRA) assets are allocated 60 percent to stocks and 40

³⁴The main exception is that I use a different rate-of-return series for bonds because Baker, Doctor and French's (2007) series does not extend to 2008, the end of my sample period. I am very grateful to Eric French for providing me with the historical returns data.

percent to bonds and that the rate of return on business assets is a weighted average of the returns on housing and stocks, with an 85 percent weight on housing.

Anticipated returns on wealth in the model.— Individual i in income quintile q believes that she draws an (annual) rate of return on any saving she might have from the following distribution: $r_i \sim N(\mu_r(q), \sigma_r(q)^2)$, where $\mu_r(q)$ and $\sigma_r(q)$ are estimated based on (i) the average portfolio shares of individuals in income quintile q in the data and (ii) historical data on the realized rates of return on different types of assets. For each income quintile, I estimate the average shares of their portfolios held in the asset classes listed in Table A6. Then, using annual rate-of-return data for each asset class from 1960–2010, I estimate the mean and variance of the distribution of annual rates of return for each income quintile based on their portfolio shares. The resulting means and variances are similar if I instead estimate them based on returns during the time period immediately preceding the sample period (1960–1997), rather than including data through the sample period.

Realized returns on wealth in the simulation, $r_{i,t} = \sum_j \alpha_{i,j,t} r_{j,t}$.— Retiree i 's realized rate of return in year t is the weighted average of the realized rates of returns on different assets j in year t ($r_{j,t}$), weighted by i 's portfolio shares in that year ($\alpha_{i,j,t}$). The portfolio shares of retirees with zero or negative net wealth are set equal to the median shares among people with between \$5,000 and \$15,000 of net worth. I assume that individuals' portfolio shares are the same in years between interviews as they were in the previous year.

A.5 Simulation Procedure

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, $\hat{c}_t(\hat{w}_t, h_t, t; s, y, ltc_i; \theta)$. I use these decision rules together with each individual's fixed characteristics, initial state, subsequent health path, and year-specific rates of return on wealth to simulate each individual's wealth as long as they live between 1999–2008. Given the simulated wealth profiles of each individual in the simulation sample, I use the same procedure to calculate the simulated wealth moments from the simulated data as I use to calculate the empirical wealth moments from the actual data.

Simulated long-term care insurance moments.— The simulated long-term care insurance moments are the long-term care insurance ownership rates by wealth quartile among the subset of the simulation sample who were 65–69 years old in 1998. Only people in good health in 1998 are allowed to buy long-term care insurance in the simulation. This is meant to capture the fact that people in bad health are prevented from buying long-term care insurance—their applications are rejected by insurers (Murtaugh et al., 1997; Hendren, 2013). Given a vector of parameter values, θ , I solve the model to find the value functions, $V_t(\hat{x}_t, h_t; s, y, ltc_i; \theta)$. Simulated long-term care insurance ownership by individual i is one if both (i) i is healthy in 1998 and (ii) i would be better off buying long-term care insurance given his or her state variables; it is zero otherwise:

$$ltci_i^s = \mathbb{1}(h_{i,t_i} = he) \times \mathbb{1} [V_{t_i}(\hat{x}_{i,t_i}, h_{i,t_i}; s, y, ltc_i = 1; \theta) > V_{t_i}(\hat{x}_{i,t_i}, h_{i,t_i}; s, y, ltc_i = 0; \theta)].$$

The simulated aggregate long-term care insurance ownership rates are the averages of the individual ownership indicators among individuals in each wealth quartile. Simulated long-term care insurance ownership depends on θ through the value functions' dependence on θ .

Because long-term care insurance premiums depend on the age at which long-term care insurance is purchased, and because the model must be solved separately for each long-term care insurance premium schedule, I simulate the demand for long-term care insurance only among healthy 65–69-year-olds and treat them for this purpose as if they were all 67 years old, the average age at which people buy long-term care insurance (Brown and Finkelstein, 2007). Everyone who can buy long-term care insurance therefore faces the same load (proportional markup over actuarial cost); there is no adverse selection in the model once insurance rejections are accounted for.³⁵ The assumption that people face a one-time decision about whether to buy long-term care insurance—which I make to economize on computation time—is a rough approximation to the fact that people most often purchase long-term care insurance in their 60s (America's Health Insurance Plans, 2007), with an average purchasing age of 67 (Brown and Finkelstein, 2007). Simulations of the model indicate that other plausible purchasing ages produce quite similar results. For example, with the baseline preferences the simulated ownership rates for purchasing ages of 65, 70, and 75 are 4.7 percent, 3.8 percent, and 4.8 percent, respectively, compared to a 3.9 percent ownership rate in the baseline model.

A.6 The Full Set of Simulated Wealth Moments

Figure A1 shows the full set of wealth moments under the baseline model. Panel (a) shows the wealth moments of the odd-numbered cohorts, and Panel (b) shows the wealth moments of the even-numbered cohorts.

A.7 The Distribution of Realized Bequests

Figure A2 shows, for individuals who die during the sample period, the simulated and empirical distributions of wealth in the last wave in which the individual is alive, a proxy for realized bequests.³⁶ The simulated distribution matches closely its empirical counterpart, which reinforces the conclusion that the baseline model does a good job matching important empirical patterns related to retirees' saving and insurance decisions. Of course, wealth is targeted by the estimation, so this is not an out-of-sample test of the

³⁵In practice, insurance companies limit adverse selection by denying coverage to people with certain health conditions (Murtaugh et al., 1997; Hendren, 2013) and by front-loading premiums to minimize policy lapsation by people who remain healthy (Hendel and Lizzeri, 2003). In long-term care, Finkelstein and McGarry (2006) find that average long-term care usage is roughly equal for the insured and uninsured population, though Finkelstein, McGarry and Sufi (2005) find that people who become healthier than average are more likely than others to drop their coverage.

³⁶I follow De Nardi, French and Jones (2010) in using wealth in the last wave in which an individual is alive as a proxy for realized bequests because wealth while an individual is alive appears to be measured much better than realized bequests are.

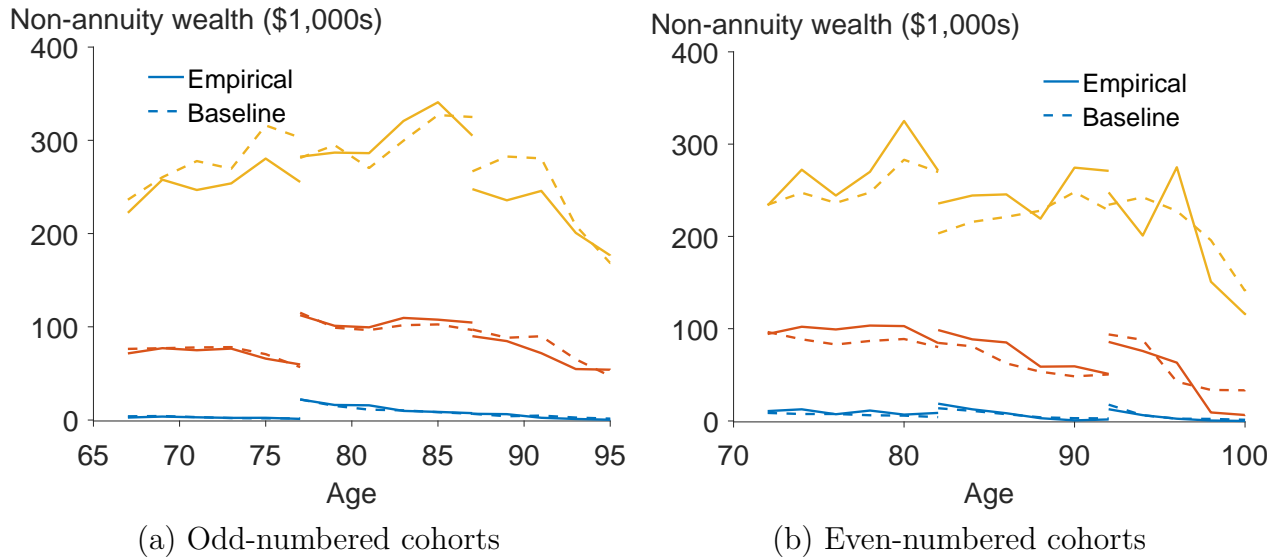


Figure A1: Empirical wealth moments (solid lines) and simulated wealth moments (dashed lines) for odd- and even-numbered cohorts under the baseline model. The wealth moments track the 25th, 50th, and 75th percentiles of the wealth distributions among surviving members of each cohort. The x-axis shows the average age of surviving members of the cohort. The y-axis shows total non-annuity wealth in \$1,000s.

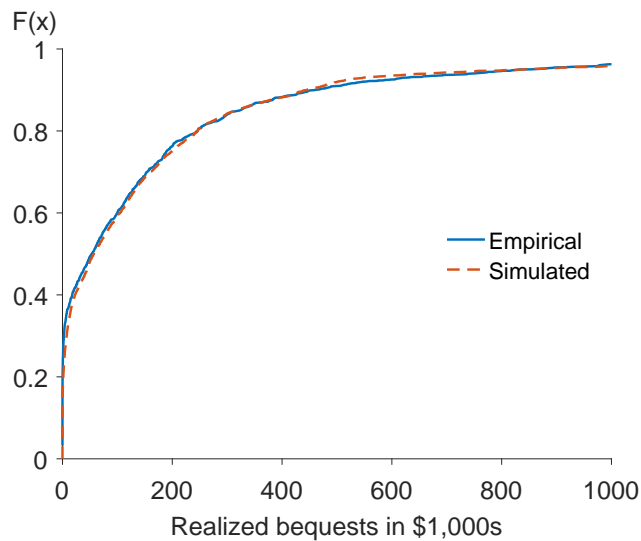
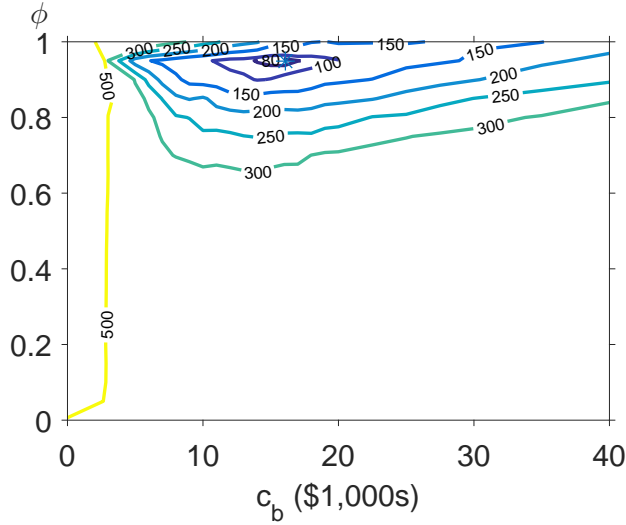
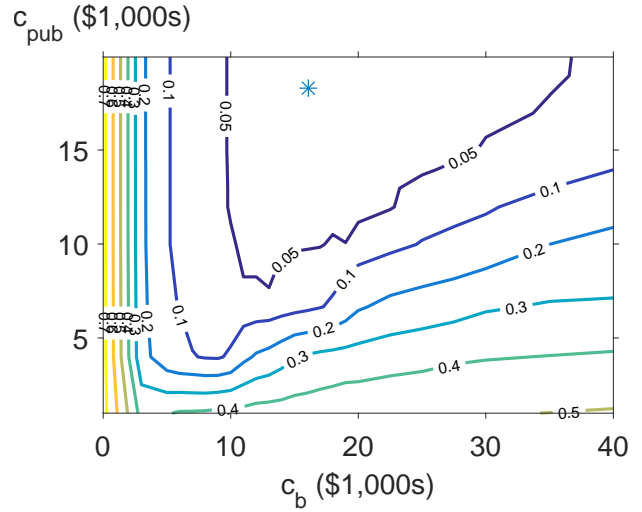


Figure A2: Cumulative distribution function of wealth in the last wave in which an individual is alive among individuals who die during the sample period. Wealth in the last period in which an individual is alive is a better-measured proxy for realized bequests. The simulated distribution is generated by the baseline model and parameter estimates.

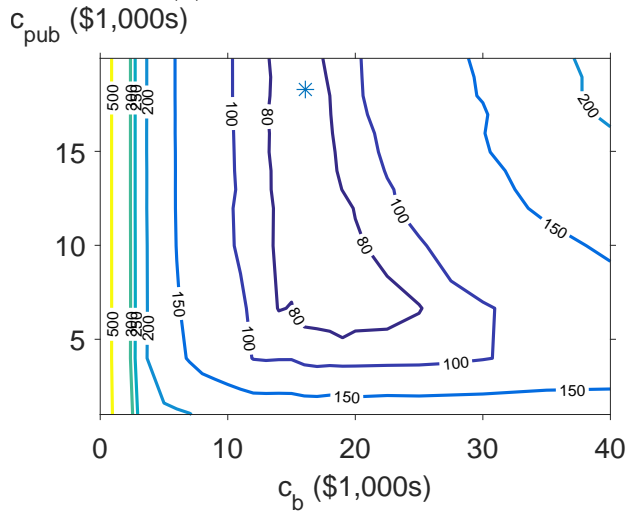
model. But the relatively close match of simulated to actual bequests throughout the distribution is reassuring nonetheless.



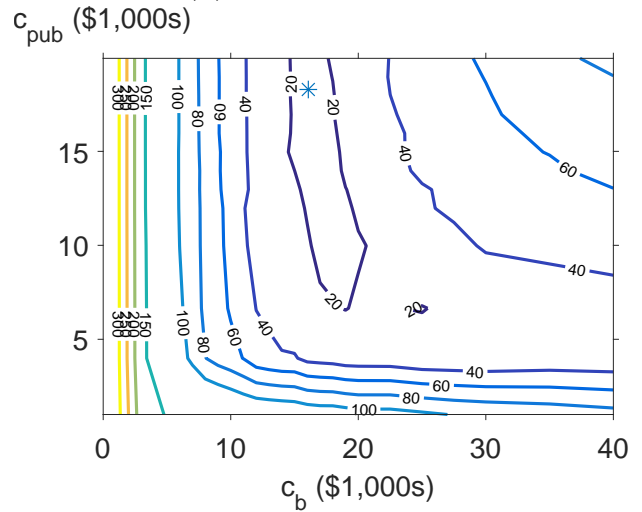
(a) Objective function



(b) LTCI ownership



(c) Objective function: wealth only



(d) Objective function: median wealth only

Figure A3: Panel (a): Contour plot of the objective function in (c_b, ϕ) -space with the other parameters held fixed at their baseline estimated values. Higher contours indicate greater mismatch between the simulated and empirical moments. (The asterisk marking the estimates is hard to see but is right where it should be in the valley.)

Panel (b): Contour plot of the simulated long-term care insurance ownership rate in (c_{pub}, c_b) -space with the other parameters held fixed at their baseline estimated values. The empirical ownership rate is 5.6 percent.

Panel (c): Contour plot of the objective function based on only the wealth moments in (c_{pub}, c_b) -space with the other parameters held fixed at their baseline estimated values.

Panel (d): Contour plot of the objective function based on only the median wealth moments in (c_{pub}, c_b) -space with the other parameters held fixed at their baseline estimated values.

All panels: The asterisk marks the baseline estimates.

A.8 Identification of the Model

This section shows which features of the data are most informative about the key parameters of the model. Panel (a) of Figure A3 shows a contour plot of the objective

function in (c_b, ϕ) -space with the rest of the preference parameters held fixed at their estimated values. The figure reveals that the bequest motive 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 more consistent with models that have important bequest motives in which bequests are luxury goods than with any other type of bequest motive, including no bequest motive. The remaining panels, which show contour plots in (c_{pub}, c_b) -space with the other parameters held fixed at their estimated values, show how different moment conditions contribute to the identification of the key parameters of the model.

Panel (b) shows the simulated long-term care insurance ownership rate. The 5.6 percent empirical long-term care insurance ownership rate suggests a combination of modest to no public care aversion ($c_{pub} \geq \$7,500$) and luxury bequest motives ($c_b \geq \$9,000$).

Panel (c) shows an objective function based on the wealth moments. The pattern of saving across the wealth distribution leads to a fairly tight identification of the bequest motive ($c_b \in [\$15,000, \$25,000]$)—both weaker and stronger bequest motives are much less consistent with the data. In other words, and as discussed in Section 6.4, although the saving of retirees at a particular point in the wealth distribution can be matched well by the model without bequest motives, the pattern of saving across the wealth distribution is highly inconsistent with that model but is matched well by the model with bequest motives. Even if long-term care insurance choices are ignored, retirees' saving decisions suggest that bequest motives in which bequests are luxury goods are widespread.

Panel (d) shows an objective function based on only the median wealth moments. The saving of middle-class retirees is most consistent with important bequest motives ($c_b \in [\$15,000, \$25,000]$) and moderate to no public care aversion ($c_{pub} \geq \$5,000$) but can be matched fairly well by many different combinations of bequest motives and public care aversion, and is not that inconsistent with models with no bequest motives and moderate to strong public care aversion. This illustrates the identification problem that arises when limiting attention to only the saving choices of retirees at a particular point in the wealth distribution.

	(1) Used formal home care since last interview	(2) Stayed in nursing home since last interview	(3) Owns long-term care insurance
Female=1	0.0494 (0.0333)	-0.0548* (0.0262)	0.0123* (0.00512)
Single=1	0.0263 (0.0402)	0.124*** (0.0299)	-0.0207*** (0.00564)
No kids=1	0.0310 (0.0448)	0.0905** (0.0336)	0.00535 (0.00973)
Age	0.0219 (0.0309)	0.0721** (0.0247)	-0.00438 (0.00711)
Age ²	-0.0000788 (0.000194)	-0.000360* (0.000151)	0.00000950 (0.0000468)
Number of ADLs (0-5)=3	0.0759* (0.0367)	0.0429 (0.0282)	
Number of ADLs (0-5)=4	0.187*** (0.0425)	0.107** (0.0327)	
Number of ADLs (0-5)=5	0.292*** (0.0431)	0.276*** (0.0321)	
Income quartile=2	0.0371 (0.0379)	0.0262 (0.0281)	
Income quartile=3	0.0618 (0.0475)	0.0127 (0.0375)	
Income quartile=4	0.0391 (0.0551)	0.0719 (0.0451)	
Wealth quartile=2			0.0124** (0.00464)
Wealth quartile=3			0.0482*** (0.00577)
Wealth quartile=4			0.137*** (0.00776)
Observations	1083	1360	10599
ymean	0.422	0.283	0.0738
Sample restrictions	Age 65+ 2+ ADLs	Age 65+ 2+ ADLs	Age 65+

Marginal effects; Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A1: Marginal effects from probit regressions, i.e., the increase in the average predicted probability of the dependent variable being one if everyone in the sample had their value of the indicator variable in question increased from zero to one or their value of the continuous variable in question (age) increased by one unit. Columns 1, 2, and 3 report results from probit regressions of indicator variables for whether the individual used any (formal) home care since the last interview, whether the individual stayed in a nursing home since the last interview, and whether the individual owns long-term care insurance, respectively. All of the columns restrict the sample to people age 65 and older. Columns 1 and 2 further restrict the sample to people who report having problems with at least two activities of daily living. The difference in the number of observations between columns 1 and 2 reflect a difference in the number of missing values of the dependent variables. Age is measured in years. Wealth quartiles are calculated based on wealth values that are adjusted for whether the individual is part of a one- or two-person household according to the widely-used square root equivalence scale (e.g., OECD, 2011) (so an individual in a couple is assigned a wealth value equal to his or her household wealth divided by $\sqrt{2}$ before calculating quartiles). The qualitative results are not sensitive to plausible alternatives.

Income quintile	Healthy males			Healthy females		
	Age adjustment to FHSWL, Δ	Life expectancy at 70		Age adjustment to FHSWL, Δ	Life expectancy at 70	
		De Nardi et al. (2010)	Adjusted FHSWL		De Nardi et al. (2010)	Adjusted FHSWL
1	17	7.6	7.7	6	12.8	13.0
2	15	8.4	8.4	5	13.8	13.6
3	13	9.3	9.3	3	14.7	14.8
4	11	10.5	10.3	2	15.7	15.4
5	9	11.3	11.3	0	16.7	16.8

Table A2: Adjustments to the Friedberg et al. (2014) (FHSWL) model of health transitions for females to match the life expectancy differences across sex and income groups documented by De Nardi, French and Jones (2010).

	Life expect	Exp fract of time from 65:				Prob ever in NH	Exp years in NH	Exp years in NH > 0	Prob leave NH alive	Prob leave NH ever NH
		He	HC	ALF	NH					
Males										
Original	16.8	0.95	0.02	0.01	0.02	0.43	0.39	0.90	0.35	0.82
Yearly transitions	17.3	0.95	0.02	0.01	0.02	0.20	0.38	1.92	0.11	0.56
By income quintile										
Bottom	9.8	0.81	0.03	0.04	0.12	0.45	1.19	2.65	0.22	0.48
Second	10.8	0.83	0.03	0.04	0.10	0.43	1.12	2.59	0.22	0.51
Third	11.9	0.84	0.04	0.03	0.09	0.41	1.05	2.56	0.22	0.53
Fourth	13.0	0.86	0.04	0.03	0.08	0.39	0.99	2.53	0.21	0.54
Top	14.2	0.87	0.04	0.03	0.07	0.37	0.94	2.52	0.21	0.55
Females										
Original	20.3	0.91	0.03	0.02	0.04	0.57	0.83	1.46	0.46	0.80
Yearly transitions	20.8	0.91	0.03	0.02	0.04	0.33	0.82	2.47	0.19	0.56
By income quintile										
Bottom	16.1	0.89	0.04	0.02	0.05	0.35	0.88	2.50	0.20	0.56
Second	16.8	0.89	0.04	0.02	0.05	0.35	0.86	2.49	0.19	0.56
Third	18.3	0.90	0.03	0.02	0.05	0.34	0.84	2.48	0.19	0.56
Fourth	19.1	0.90	0.03	0.02	0.04	0.34	0.83	2.48	0.19	0.56
Top	20.8	0.91	0.03	0.02	0.04	0.33	0.82	2.47	0.19	0.56

Table A3: Health transitions model statistics. “Original” corresponds to the Friedberg et al. (2014) (FHSWL) model of monthly health transitions. The other rows show simulated statistics from adjusted versions of the model. The adjustments are: switching from monthly to yearly transitions to economize on computation time and better match the frequency of the HRS data, using FHSWL’s female model for males in my sample to better reflect the long-term care risk facing single retirees, and adjusting the male and female models to match the heterogeneity in remaining life expectancy from age 70 documented by De Nardi, French and Jones (2010). The first column shows life expectancy at age 65. The next four columns show the expected fractions of time from age 65 on spent healthy, receiving home care, living in assisted living facilities, and living in nursing homes, respectively. I am grateful to Wenliang Hou and Tony Webb for providing me with the transition matrices from Friedberg et al. (2014).

Relative price of nursing home care	
Female	0.0604 (0.0669)
Age	-0.0000976 (0.00369)
2nd income quintile	0.0783 (0.0799)
3rd income quintile	0.0164 (0.0782)
4th income quintile	0.0958 (0.0849)
Top income quintile	0.115 (0.0812)
<i>N</i>	536

Table A4: Regression of the relative price of nursing home care using data from the NLTCs. Standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	(1)	(2)
	Log acute medical spending	Square of log acute medical spending
Age	0.0140* (0.00580)	0.183** (0.0592)
Female	0.376*** (0.111)	3.830*** (1.052)
Home care	0.391*** (0.0811)	4.311*** (0.907)
Nursing home	0.401** (0.150)	5.131*** (1.474)
2nd income quintile	0.614* (0.288)	4.937 (2.553)
3rd income quintile	0.654* (0.276)	4.878* (2.418)
4th income quintile	0.747** (0.265)	5.320* (2.324)
Top income quintile	0.802** (0.261)	5.980** (2.275)
<i>N</i>	4308	4308

Table A5: Acute medical spending regressions. The omitted dummy variables are “healthy” and “bottom income quintile.” The sample is my main sample of single retirees 65 and older. In order to take logs I first set the value of acute medical spending to the maximum of its value and \$1. Home care indicates whether the individual used home care since the last interview. Nursing home indicates whether the individual is living in a nursing home at the time of the interview. Standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Asset	Data source	Taxation	Return, 1998–2008 (%)		Portfolio share (%)
			Mean	Std. dev.	
Occupied housing	OFHEO, Baker et al. (2007)	0% on capital gains, 1%/yr property tax	7.9	3.2	54.8
Stocks	CRSP	0% on capital gains, 20% on div yield (assume 2% yield)	2.6	16.9	9.3
Bonds	AAA long bonds yield to maturity	20%	3.2	1.0	2.2
Liquid (CDs)	Treasury	20%	1.2	1.4	6.9
Unoccupied housing	OFHEO	0%	4.3	3.2	1.5
Debt	Baker et al. (2007)	20%	2.4	-	-16.9

Table A6: Data sources and assumptions underlying the calculations of the expected and realized rates of return on wealth. The mean returns are the geometric averages of annual real, after-tax returns. The portfolio shares are the average shares of net wealth held in each asset in 1998 by the sample of single retirees, weighted by HRS respondent-level weights. The assumption of zero taxation of capital gains comes from the assumption that a large fraction of retirees' capital gains are not realized (by asset sales) during the sample period. Additional details about the data sources can be found in Baker, Doctor and French (2007).