Long Term Care Insurance, Annuities, and the Under-Insurance Puzzle*

John Ameriks — Vanguard
Joseph Briggs — New York University
Andrew Caplin — New York University
Matthew D. Shapiro — University of Michigan
Christopher Tonetti — Stanford GSB

January 15, 2015

Very Preliminary

Abstract

Life cycle models suggest high potential demand for improved long term care insurance (LTCI). Using such a state of the art model, we estimate that indeed older wealth holders' demand for improved LTCI would be high. Yet when we directly measure stated demand, we find it to be lower. The corresponding gap is even larger when we compare model-based and stated demands for actuarially fair annuities. Both findings suggest far lower interest in insurance of late in life spending risks than current models predict. Patterns in the gap between demand estimates suggest that current models of late in life savings may mis-specify inter-generational motives. The survey-based methods we develop to investigate model specification are broadly applicable.

*The views expressed herein are those of the authors and do not necessarily reflect the views of The Vanguard Group, Inc. or of Ipsos SA.

Acknowledgments

We gratefully acknowledge the support of the VRI provided by the National Institute on Aging grant P01-AG026571. We also acknowledge support for the VRI project from the Vanguard Group, Inc., as well as significant assistance from Ipsos SA and Vanguard's Client Insight team in managing the VRI surveys. We would like to thank Mi Luo, Minjoon Lee, and Ann Rodgers for truly outstanding research assistance. We are grateful for the help of Wandi Bruine de Bruine, Brooke McFall, Alycia Chen, Annette Bonner, and Wendy O'Connell for pivotal assistance in survey design and implementation.

1 Introduction

Standard life cycle models fail to predict wealth holders' slow spend down of assets in later life.[1] Recent research suggests that part of the explanation may lie in precautionary motives associated with high costs of private long term care. The resulting models suggest that demand would be high for improved long term care insurance. Such insurance may not only be of private value, but also of great public value, since provision of free care is placing ever-increasingly pressure on the public finances (Brown and Finkelstein (2008), Brown, Goda, and McGarry (2013). Unfortunately the insurance that is available in the market-place is far from ideal due to default risk, possible increases in future premia, high loads, a potentially adversarial claims process, etc.[2]

We use a state of the art model to estimate demand for improved long term care insurance among older wealth holders. These demand estimates derive from a new and uniquely suitable sample of wealth holders, the Vanguard Research Initiative (VRI).[3] Our survey-based method enable us to estimate model parameters for each respondent. We use these individual parameters to estimate demand for improved long term care insurance. Demand is estimated to be particularly high for those who expect longer stays in long term care facilities and who regard public long term care to be of particularly low quality relative to private care.

In addition to estimating demand for long term care insurance from our model, we make corresponding estimates directly from a survey-based measure of stated demand. While stated demands are also high, there is a gap. Directly elicited demands are significantly lower than are our model-based estimates.

One possible reason for low stated demand for improved insurance may be lack of respondent familiarity with the product on offer. We elicit demand for "Activities of Daily Living Insurance" (ADLI). This is an Arrow security that pays out automatically whenever the policy holder has difficulties with such activities as eating, dressing, bathing, walking across a room, etc. This clear product specification makes demand for ADLI easy to estimate. Yet, while steps were taken to test and shore up such

[1]Soto, Penner, and Smith (2009) find that the wealthiest 20% of the HRS report rising net worth until age 85, and Poterba, Venti, and Wise (2013) and Love, Palumbo, and Smith (2009) similarly showing that household wealth is relatively stable or increasing at later ages absent death or divorce.

[2]See section 2.

[3]See section 3 and Ameriks, Caplin, Lee, Shapiro, and Tonetti (2015) for detailed background information on this sample.

comprehension, the net effect may nevertheless be to artificially reduce stated demand.

That unfamiliarity may not be the whole story is revealed by considering an insurance product with which many in our sample are familiar: annuities.[4] When we use our model to estimate demand for actuarially fair annuities, we again find high such demand. Yet when we compare these estimates with stated demands, we find that the model overpredicts by an even greater margin. The vast majority of respondents express little to no interest in actuarially fair annuities despite the estimated model predicting high such demand.

In combination, our results indicate that there is an "under-insurance" puzzle. There appears to be far lower interest in insurance of late in life spending risks than current models predict. This lower than model-predicted level of interest in insurance among older asset holders raises the possibility our model is mis-specified. We investigate this possibility with particular reference to inter-generational altruism. While the form of such altruism has been richly modeled in the theoretical literature, the model we use in estimating demand follows the standard approach of summarizing such concerns with a "warm glow" bequest motive (De Nardi (2004)). Indeed we find that those who have in the past made transfers to their family have particularly low stated demand relative to model-based demand. This finding applies both to long term care insurance and to annuities. Hence modeling missing intergenerational motives may be important if we are to better understand potential demand for modified insurance products.

As the above makes clear, the methods that we introduce for testing the specification of life cycle models are survey-based. Key to the tests are "strategic survey questions" (SSQs) that liberate estimation of model parameters at the individual level (Ameriks, Caplin, Laufer, and Van Nieuwerburgh (2011), Ameriks, Briggs, Caplin, Shapiro, and Tonetti (2015)) use such questions in more aggregated form). These questions ask respondents to specify behavior in detailed scenarios that are particularly revealing of preference parameters.[5] It is precisely the combination of SSQs and direct stated demand questions that liberates our approach. The broad feasibility of corresponding measures may make our methods of wider interest.

Section 2 introduces the model that we estimate in the paper and provides background material on the long term care insurance and annuity markets. Section 3 introduces the VRI and the key data items on which our analysis rests. Section 4 provides evidence on the credibility of survey responses.

[4]Several respondents indicated that they were not only well aware of but also firmly set against annuities. Some even found it objectionable that we were so dogged in eliciting their interest in such products.

[5]See section 3 for design details.

Section 5 produces our individual parameter estimates. Section 6 derives model-based and stated preference estimates of demand for ADLI. Section 7 re-estimates both forms of demand for actuarially fair annuities. Section 8 demonstrates the impact of family transfers on the gap between demand estimates. Section 9 concludes.

2 Section 2 - Background

Model

State of the art models that explain the observed slow spend down of wealth in later life allow for both bequest motives and precautionary motives associated with high late in life health and long term care (LTC) expenses (see Kotlikoff (1988)). Existing estimates of the relative importance of these motives range widely. Ameriks, Caplin, Laufer, and Van Nieuwerburgh (2011), Kopecky and Koreshkova (2004), and Lockwood (2014) find LTC expenses to be significant drivers of savings, and De Nardi, French, and Jones (2010) finds medical expenses to be the primary driver of retirement savings. Yet Hubbard, Skinner, and Zeldes (1994) and Palumbo (1999) estimate the contribution of such expenses to late-in-life savings to be low. With regard to bequest motives, De Nardi (2004)'s finds a luxury bequest motive active for the richest individuals. Others, such as Hurd (1989), Lockwood (2014), De Nardi, French, and Jones (2010), Ameriks, Caplin, Laufer, and Van Nieuwerburgh (2011), and Hurd and Smith (2002) find them to be more broadly important for savings, with Lupton and Kopczuk (2007) identifying such a role even amongst those without children. Lockwood (2014) estimates a near linear bequest utility function which can by itself largely explain the high savings rates of the elderly.

A feature that is increasingly recognized as important in the literature concerns health state utility. Koijen, Van Nieuwerburgh, and Yogo (2015) estimate a lower marginal utility when in poor health. In a companion paper in which we use the VRI data set, we allow for a separate utility of wealth when in need of long term care (Ameriks, Briggs, Caplin, Shapiro, and Tonetti (2015)). We find precautionary motives associated with LTC to be significantly more important than bequest motives as drivers of late in life savings behavior. Savings motives driven by LTC are active for individuals with less than $50,000 in annual income and wealth less $400,000 (a large majority of the US population). By contrast, our estimated bequest utility parameters suggest that the corresponding motives contribute only modestly to late in life savings.

The estimates of Ameriks, Briggs, Caplin, Shapiro, and Tonetti (2015) are for a representative consumer. In the current paper we take advantage of the richness of the data in the VRI to estimate parameters of this model at the individual level. The model considers consumers who are heterogeneous over wealth, income age-profile, age, gender, initial health status ($s \in \{0, 1, 2, 3\}$), and preferences. The health and health cost state evolves according to a Markov process that is common amongst all agents. Consumers start at age 55 and live to be at most 108 years old. In each discrete period, consumers choose consumption, savings, expenditure on long term care, and whether to use government care. Each consumer has a perfectly foreseen deterministic income sequence and receives a risk free rate of return of $(1 + r)$ on his savings.

When in good or poor health ($s \in \{0, 1\}$), consumers value consumption according to standard CRRA preferences with parameter σ. Spending when a consumer needs LTC ($s = 2$) is valued differently,

$$U(e_{LTC}) = \frac{\theta_{LTC}}{1-\sigma} \left(e_{LTC} + \kappa_{LTC}\right)^{1-\sigma}.$$

Capturing the fact that LTC provision is essential for those in need and private long term care is expensive, there is a minimum level of expenditure needed to obtain private LTC, i.e., $e_{LTC} \geq \chi_{LTC}$. Finally upon death ($s = 3$), the agent receives no income and pays all mandatory health costs. Any remaining wealth is left as a bequest, b, which the consumer values with warm glow utility function,

$$v(b) = \frac{\theta_{beq}}{1-\sigma} \left(b + \kappa_{beq}\right)^{1-\sigma}.$$

Both ADL state and bequest preferences are governed by two key parameters, θ and κ; θ affects the marginal utility of an additional dollar spent and κ controls the degree to which the expenditure is seen as a luxury or a necessity. Increases in θ increase the marginal utility of a unit of expenditure, while increases in κ indicate that expenditure is more of a luxury. Negative κ can be interpreted as the expenditure being a necessity.

The consumer has the option to use a means-tested government provided care program. The cost of using government care is that a consumer forfeits all wealth.[6] If the consumer chooses to use government care when not in the ADL state ($s = 1$ or 2) the government provides a consumption floor, $c = C_f$. A consumer who needs LTC ($s = 2$) has access to public LTC services in the form of Medicaid. If the consumer needs care and uses government care, the government provides $e_{LTC} = LTC^{PC}$, the

[6]This aligns with public welfare only being accessible to individuals with sufficiently low resources.

level of which captures possible aversion to public care. There is no borrowing, and the retiree cannot leave a negative bequest.

The Long Term Care Insurance Market

The type of long-term care insurance product we describe in the VRI and use in our modeling is very different from prevailing forms of long-term care insurance available on the private market. Currently, the typical structure of LTC policies involves consumers paying periodic premiums in exchange for an insurer's promise to reimburse certain LTC-related expenses, under certain conditions, subject to certain (generally restrictive) limits. For example, Brown and Finkelstein (2011) define a typical purchased policy "as a policy that covers institutional and home care with a 60-day deductible, a four-year benefit period, and a $150 maximum daily benefit with a 5 percent per year escalation rate." They estimate that such a policy could potentially possibly cover about only two-thirds of the expected present discounted value of LTC expenses at age 65.

Beyond these basic limitations, there are several design features of existing, real-world LTC policies that may make them unattractive consumer point of view. For example, while most policies are "guaranteed renewable," LTC policy holders are subject to the important risk of an increase in required premium rates to maintain continuing coverage. If they cannot pay higher rates, they can lose their coverage. Insurers cannot raise premiums on individual LTC policies in isolation, but, subject to regulatory approval, they can increase (and in several well-publicized changes have increased) rates for groups or "classes" of policyholders to reflect errors in actuarial underwriting assumptions or other factors. In addition, policy benefit triggers, especially for tax-qualified LTC policies, can be restrictive. Stallard (2011) (as cited in Rubin, Crowe, Fisher, Ghaznaw, McCoach, Narva, Schaulewicz, Sullivan, and White (2014)) "finds that about half of [the elderly] disabled population does not meet the eligibility requirements for tax qualified LTC insurance policies due to not satisfying either HIPAA's ADL trigger definitions or its cognitive impairment trigger." Finally, LTC insurance may be subject to significantly higher cost loads than are typical for life annuities or other forms of insurance. Brown and Finkelstein (2011) estimate loads (costs) of 32 cents per dollar of hypothetical, actuarially fair benefits. For all of these reasons, we believe there to be quite significant differences between the hypothetical product described in our work and the real-world options generally available to consumers. [7]

The Annuity Market

Insurance contracts offering fixed nominal or, less commonly, fixed inflation-adjusted life annuities are currently available for purchase in private markets. Brown, Mitchell, Poterba, and Warshawsky (2001) describe many of the relevant institutional details of the immediate annuity market in the U.S. Current annuity products and providers can be found using a simple internet search for "retirement income," and indicative pricing of such contracts is available from services such as ImmediateAnnuities.com. Given the wide availability of annuity products, the reasons why they are so little used by retirees remain puzzling to many economists (the issue is well summarized in Warshaswksy (2013), Chapter 3)).

A natural explanation of low demand for annuities would be high price. Study of the typical cost of annuities available in the private market relative to hypothetical, actuarially fair versions was first undertaken by Friedman and Warshawsky (1988) and Friedman and Warshawsky (1990). Others have revisited and updated these estimates. Mitchell, Poterba, Warshawsky, and Brown (1999) report the ratio of actually available annuity payouts to hypothetical actuarially fair equivalents of roughly .85-.95. While such costs are not insignificant, there is general consensus that such loads would not significantly impact demand in a standard life-cycle framework. Other than pricing deviations , the only significant dimension of difference between the hypothetical annuity contract we describe in our modeling and questions and one available in the real world is that a completely risk free annuity is not attainable in the real world. We maintain that neither of these sets of issues represents a significant material difference between annuity contracts availably publicly and the hypothetical version we describe to panelists and use in our modeling.

[7] This calls into question the ability to use low purchases of such insurance to infer motives, as in * and *. This is a more widespread issue, since recovery of utility parameters from choice of insurance rests on a strong identifying assumptions relating both to the product and to how well informed are consumers.

3 Section 3 The VRI and the Survey Instruments

3.1 The Sample

This paper draws on the newly developed Vanguard Research Initiative (VRI). Respondents are Vanguard clients who agreed to participate in up to three surveys. The sample has been stratified across two of Vanguard's major lines of business—individual accounts and retirement accounts through employers (seeAmeriks, Caplin, Lee, Shapiro, and Tonetti (2015)). The survey protocol involves a number of elements to maintain participant engagement: periodic updates; an electronically delivered "Dillman letter" (email) prior to each survey; an email with the survey link; and up to three reminders.

Since the surveys involve innovative measurement, not only research economists and research psychologists, but also survey experts at Vanguard and IPSOS contributed critically to their design, as further detailed below. The resulting design involves key questions being subjected to cognitive interviews carried out at the Survey Research Center at the University of Michigan.[8] In addition, a set of initial respondents is designated as the pilot sample. A pilot version of each survey is employed with this sample to test all aspects of the design. As detailed below, the pilot includes a scripted electronic real-time chat with a subset of respondents using a pop-up interview with questions similar to those used in the cognitive interviews. The survey that the production sample receives reflects findings from the cognitive interviews, pilot survey responses, and the online chats from the pilot.

Respondents have now completed three surveys (Web link). VRI Survey 1 introduces novel methods for measuring household portfolios of assets and debts (see Ameriks, Caplin, Lee, Shapiro, and Tonetti (2015) for detailed analysis). The pilot was conducted in June 2013, followed in August 2013 by the production sample. Because surveys are conducted via the Internet, Respondents must possess a valid email address, and have logged onto Vanguard's website within the last six months. Additionally, we required a total account balance of at least $10,000. Respondents received an incentive for participation in each survey in the form of a sweepstakes for prizes such as an iPad, as well as a monetary payment for completing all three surveys.

We make essential use in this paper not only of the data from VRI Survey 1, but also from VRIs 2 and 3. VRI 2 has at is center the key SSQs and stated preference questions. It was piloted in October 2013 with the production version in January 2014. VRI Survey 3 gathers information on

[8] In these interviews, respondents are shown Internet survey instruments and given in-person interviews scripted by Wandi Bruine de Bruin and Alycia Chen to assess their comprehension: see section 4 for further details.

family structure as well as family transfers. The pilot was conducted in May 2014 and the production version in August 2014. The sample that we analyze in this paper consists of those who completed all three surveys, did not opt out of any SSQs, and are single.[9] Key statistics on the sample are in table 1. Ameriks, Caplin, Lee, Shapiro, and Tonetti (2015) show that the VRI sample is wealthier, more educated, more married, and healthier than the broad HRS population. However they show also that employer-based VRI panel members have wealth and demographic profiles that align reasonably with the correspondingly conditioned HRS.

Wealth Levels	**Mean**	**10p**	**25p**	**50p**	**75p**	**90p**		
Full Sample	745,274	115,000	271,720	543191	1,012,263	1,587,400		
Employer Only	557,026	52,473	168,150	392,926	836,400	1,161,000		
Demographics	**Number**	**Education**		**Health**			**Gender**	
		No College	College or higher	Poor\Fair	Good	Very Good\Excellent	Male	Female
Full Sample	1087	25.7%	74.3%	5.2%	22.5%	72.2%	44.3 %	55.7%
Employer Only	162	37.7%	62.3%	4.3%	29.0%	66.7%	54.9%	45.1%

Table 1: **Characteristics of Final Sample:** This table presents the wealth distribution and demographic characteristics for our estimating sample. Individuals in this sample completed all three surveys and answered all necessary survey questions to produce all estimates needed in this paper. In addition, this table presents details from our employer subsample. This sample not only meets the above requirements, but also entered Vanguard through an employer sponsored plan

3.2 Stated Demand for Insurance

As indicated above, VRI Survey 2 includes stated preference questions on the demand for improved long term care insurance. The challenge in gathering this demand is that, by definition, it concerns a form of insurance that is not available in the market place. The demand questions were therefore preceded by a definition of the health state that is commonly regarded as provoking need for long term care. We define this in the survey as needing significant help with the activities of daily living (ADLs) such as "eating, dressing, bathing, walking across a room, and getting in or out of bed." To reinforce, we make this definition available in a hover button whenever *ADL appears. As detailed in section 4, we test subject comprehension of this definition prior to gathering information on demand

[9]Knowing ahead of time that they would be particularly suitable for early work that does not directly address family matters, singles were over-sampled (see Ameriks, Caplin, Lee, Shapiro, and Tonetti (2015).

for insurance.

When gathering demand information, we explicitly ask respondents to "make choices in hypothetical financial scenarios." In the specific case of ideal long term care insurance, the product is presented in the following frame.

> Please suppose that you are offered a hypothetical new form of insurance called ***ADL insurance** with the following features:
>
> - You pay a one-time, nonrefundable lump sum to purchase this insurance.
> - If you need help with activities of daily living (*ADLs), you will immediately receive a monthly cash benefit indexed for inflation.
> - For each ++$10,000++ you pay for this insurance, you will receive $Y per month indexed for inflation in any month in which you need help with *ADLs
> - The monthly cash benefit is set at the time of purchase and is not dependent on your actual expenses.
> - There is ++no restriction++ on the use of the insurance benefits. You are free to use benefits in any way you wish: to pay for a nursing home; a nurse to help at home; for some other form of help; or in literally any other way you would like.
> - An impartial third party who you trust will verify whether or not you need help with *ADLs immediately, impartially, and with complete accuracy.
> - The insurance is priced fairly based on your gender, age, and current health.
> - There is no risk that the insurance company will default or change the terms of the policy.

Note that typical risks associated with insurance products available in the market are removed. For example, we state explicitly that payouts are determined by an impartial third party to remove concerns about the receipt of money. We also provide an associated hover button whenever ADL Insurance is mentioned that refers to it as: "An insurance policy that pays benefits in any month in which the policy holder needs help with ADLs. The cash benefits are immediately available to the policyholder to be used for any purpose."

When gathering stated demand information, we price the product at the expected value of payouts conditional on age, gender, and current health based on our health transition model. This is reinforced by the qualitative statement that the pricing is actuarially fair. We price the product at monthly intervals because many nursing home stays and LTC provisions are short term. After all information is provided, demand is collected in two steps. We first ask respondents whether or not they would have any interest in purchasing ADLI were it available. If the answer is affirmative, we ask how large a monthly benefit they would purchase, while simultaneously reporting how much their purchase of any such benefit would cost up front. In the top right corner of the answer screen we present a link to a hover screen that presents the full specification of the product in case the respondent would like to review any features prior to reporting their demand. Responses to these questions are considered in section 6.

Our direct stated demand questions concerning actuarially fair annuities specify an annuity as paying a fixed amount of income for life. There is a corresponding hover button whenever the word annuity appears. The hypothetical annuities for which demand is elicited are described as having no risk of default, being perfectly indexed for inflation, and as being fairly priced based on gender, age, and current health. In identifying respondent demand, it is specified that they pay a one-time, nonrefundable lump sum to purchase the annuity. Responses are analyzed in section 7.

Strategic Survey Questions

SSQs place respondents in hypothetical choice scenarios that are significantly more detailed than those in standard stated preference questions. Since SSQs require respondents to comprehend and imagine complex scenarios, their design involved rich interaction with early respondents who were subjected to cognitive interviews and various respondents to the pilot who were themselves subjected to interviews structured by the psychologists on the research team. On their advice, we broke questions up and presented them in four parts to ease comprehension. We illustrate this four part process in the context of a particular SSQ related to LTC, starting with the introduction of the subject of interest and the scenario itself.

> "We are interested in how you trade off your desire for resources when you do and when you do not need help with activities of daily life (ADLs). This scenario is hypothetical and does not reflect a choice you are likely ever to face.
>
> Suppose you are 85 years old, live alone, rent your home, and pay all your own bills. You know with certainty that you will live for only 12 more months and that you will need help with *ADLs for the entire 12 months.
>
> You have ++$100,000++ that you need to split into Plan E and Plan F.

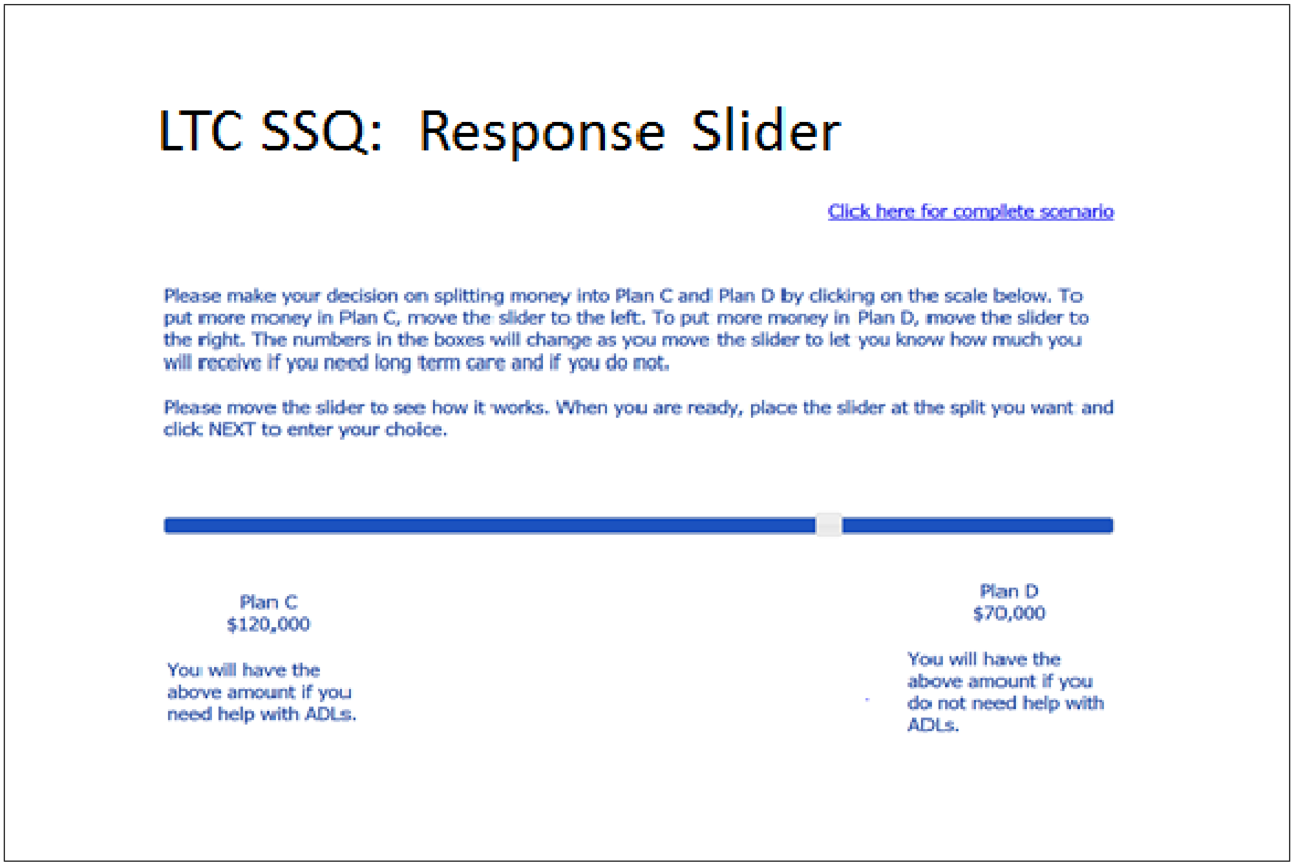
- Plan E is reserved for your spending. From Plan E, you will need to pay all of your expenses, including long-term care and any other wants, needs, and discretionary purchases.
- Plan F is an irrevocable bequest."

Immediately after the scenario is presented, respondents are provided with a summary of the rules that govern their choice. This recaps the previous screen but is presented in a bulleted, easy to read format. In addition, some features which were hinted at in the first screen, e.g., that there is no public care option and that determination of which plan pays out is made by an impartial third party, are stated explicitly. To further reinforce details of the scenario and measure comprehension, we ask the respondents to answer a sequence of comprehension questions. For all SSQ questions, these comprehension questions are introduced with:

> Again for research purposes, it is important to verify your understanding. We will now ask you a series of questions (each question no more than 2 times). At the end we will give you the correct information for any questions which you haven't answered correctly just to make sure that everything is clear.

When answering these questions the respondents do not have access to the screens describing the scenario, but have a chance to review the information before retrying any missed questions a second time. If they fail to answer questions correctly a second time, they are presented with the correct answers. The questions asked for this and the other SSQs verified the understanding of the ADL state, what the exact tradeoffs in that question were, which plan allocated resources to which state, what restrictions there are on the use of funds, the nature of the claims process, etc. All comprehension questions that were used in this instrument are in the Appendix. Because respondents who make errors review the scenario between their first and second attempt, they get to reinforce those aspects they failed to understand first time through before reporting their demand.

Having measured and reinforced understanding, we asked respondents to split their wealth between the two plans after again presenting them with the original scenario and including a link in the top right corner to the full scenario. The actual division of money involved a custom-designed interface that presents the trade off as clearly as possible. Specifically, we use an interactive slider that records the payoffs in different states of the world. This payoff changes as the slider is moved, allowing respondents to identify how their allocative choice is impacted by moving the slider. Text is included instructing the respondent how to allocate money, as well as what their allocation implies. The exact presentation can be seen in the frame below:



When the slider first appears, no allocative choice is visible. It is only when respondents themselves click on the slider that any allocation is shown. To further dampen possible anchoring and status quo bias, we ask respondents to move the slider at least once, which helps also to clarify the connection to the chosen allocation.

Having spent such a long time setting up the scenario and aiding comprehension, we stayed within the scenario and asked for additional allocative choices with distinct amounts of money. In the above question, answers were gathered not only concerning division of \$100,000, but also of \$150,000 and \$200,000.

In addition to this SSQ, we posed three other forms of SSQ. A brief summary of these SSQs is presented in table 2. The same strategy of providing a long educational process followed by investigation of detailed scenarios was followed for other SSQs, as detailed in the Appendix. A full list of test questions for all SSQs is in the Appendix, and the results of these tests are summarized in the next section.

As noted above, our SSQ design process incorporates several forms of feedback that provided us

	Question	Motives	Variations	Parameters
SSQ 1	Lottery over income	Ordinary consumption	2	σ
SSQ 2	Portfolio allocation between ordinary and ADL states	Ordinary consumption and ADL expenditure	3	σ, θ_{LTC}, κ_{LTC}
SSQ 3	Portfolio allocation between ADL and bequest states	ADL expenditure and bequest	3	σ, θ_{LTC}, κ_{LTC} θ_{beq}, κ_{beq}
SSQ 4	Indifference between public and private ADL care	ADL expenditure and bequest	1	σ, θ_{LTC}, κ_{LTC} θ_{beq}, κ_{beq} PC_{LTC}

Table 2: **Link between parameters and SSQs:** Here we provide a bit more information on each SSQ. The first column briefly summarizes the tradeoffs, while the second lists the number of times it was asked under various specifications. The third column lists the parameters that determine optimal responses in our model. More information and question text is provided in appendix B

with opportunities to improve the survey prior to fielding to the production sample. In addition to survey design feedback obtained as a result of cognitive interviews, we also gathered feedback from scripted "iModerate" pop-up interviews with a subset of the pilot sample. The iModerate chats provide feedback in free response form on issues that may trouble respondents. In addition to asking respondents for their overall reactions to the survey, we posed specific questions about each SSQ, with broadly encouraging and informative results. Aggregate versions of the iModerate style questions were posed after respondents had completed the production survey. Results are presented in the next section.

3.3 Transfer and Other

In the analysis that follows we make use of many data items in addition to those identified above. Specifically, from VRI 2 we use data on expectations of longevity and on future need for help with ADLs. We also use data indicative of prior insurance holdings, in particular LTC insurance. From VRI 3 we use data on family transfers (see section 8), as well as whether the respondent has children. We also use answers to a categorical question concerning the perceived quality of public long term care relative to a typical private nursing home, as well as beliefs about the cost of a year of care in a typical private nursing home in their community.

4 Credibility of Responses

Three forms of evidence are used to assess the credibility of the responses. First, we present results of key comprehension tests. Second, we report responses to the questions designed directly to assess how well the respondents felt they had understood and internalized the SSQs. Finally, we analyze the internal coherence of responses and their relationship to important correlates.

4.1 Comprehension tests

As indicated above, we included direct comprehension tests that respondents attempted at most twice. In the case of the ADLI questions, there were 6 such questions in total. More than 50% answered all questions correctly on their first attempt, with nearly 75% doing so after their second attempt, and more than 90% making one or fewer error after the second attempt. Analogous tests were presented for each set of SSQs, with performance presented in table 3. In practice comprehension may be even

	ADLI	SSQ 1	SSQ 2	SSQ 3	SSQ 4
Number of questions	5	6	9	3	2
All correct, 1^{st} try	57.9%	46.3%	18.6%	55.4%	77.3%
All correct, 2^{nd} try	81.9%	75.1%	55.5%	81.9%	94.1%
≤ 1 wrong, 2^{nd} try	94.4%	93.4%	80.8%	96.2%	99.5%

Table 3: **Responses to SSQ test Questions**: When introducing each survey instrument, we asked a series of test questions that examined respondents knowledge of and reinforced details of each scenario. Statistics on the number of correct responses are presented in the above table.

higher than the table indicates, since important aspects of the scenario are reiterated when respondents make their final decisions, which occurs after the tests have been completed.

4.2 Respondent Feedback and SSQ Design

As indicated above, broad questions on Respondent responses to the SSQs were placed at the very end of the production survey. As show in table 4, the results were broadly encouraging. We see that nearly 90% of respondents found the tradeoffs either very clear or somewhat clear. Furthermore, more than 80% indicated that they placed themselves in the hypothetical scenario either moderately or very well. There is also a significant and interesting difference, with evidence that it was harder to place oneself in the scenario when answering than it was to comprehend the question. This is precisely what one would expect, and is suggestive of how seriously respondents took their charge. Finally, more than 80% had given the underlying issues at least a little thought before taking the survey.

Patterns of slider movement provide additional evidence of deliberation in the survey responses. Given our use of a slider technology there may be a concern with possible anchoring effects if individuals settled immediately for their first chosen allocation. An analysis of click patterns shows that most respondents followed our suggestion and moved the slider before finalizing their allocative choice. In fact regressions show that initial clicks do little to predict final answers, further suggestive of deliberation.

4.3 Coherence

As Manski (2004) stresses, one necessary criterion for judging responses as meaningful is internal coherence. One indication of internal coherence derives from analyzing the pattern of correlations in survey responses. As indicated, these questions came in distinct blocks. When changing the allocation

Overall, how clear were the tradeoffs that the hypothetical scenarios asked you to consider?		**Overall, how well were you able to place yourself in the hypothetical scenarios and answer these questions?**		**How much thought had you given to the issues that the hypothetical scenarios highlighted before taking the survey?**	
Response	Percent	Response	Percent	Response	Percent
Very Clear	51.8	Very Well	23.1	A lot of thought	29.5
Somewhat Clear	39.7	Moderately Well	60.5	A little thought	52.1
Somewhat Unclear	7.4	Not very well	14.2	No thought	18.4
Very Unclear	1.1	Not very well at all	2.2		

Table 4: **Survey Comprehension Questions:** Each respondent was asked each of the three questions presented above. Response statistics are recorded for each.

within a scenario, one would expect a strong positive correlation in responses. Just such a pattern is present in the diagonal blocks of the correlation matrix presented in table 5. However there is no reason to expect such a strong correlation across SSQs aimed at very different motivations: this relative lack of correlation is again evident.

A second indication of coherence derives from exploring how individuals trade off leaving money as a bequest and having wealth when in the ADL state for different wealth levels. As noted above, all were asked to divide up not only $100,000, but also $150,000 and $200,000. One would of course expect the answers to be related. Indeed they are. Most respondents allocate almost all of their portfolio to the ADL state when wealth is $100,000, about 2/3 to the ADL state when wealth is $150,000, but only about half when wealth is $200,000, as illustrated in figure 1.

In addition to being internally coherent, individual responses to SSQs should align with behaviors outside the model. To identify relevant such patterns, we regress responses to the SSQs on related economic and demographic variables. In the particular scenario we have been detailing, the allocation to the ADL state is recorded as the response. Hence higher responses should indicate a higher preference for wealth in the ADL state relative to an end of life bequest. Regressions of these responses on standard demographic variables and other variables of particular relevance are presented in table 6.

Note that having children is a strong predictor of allocating less money to the ADL state, as might

	SSQ 1-1	SSQ 1-2	SSQ 2-1	SSQ 2-1	SSQ 2-3	SSQ 3-1	SSQ 3-2	SSQ 3-3	SSQ 4-1
SSQ 1-1	1 .00								
SSQ 1-2	0.44	1.00							
SSQ 2-1	-0.01	0.04	1.00						
SSQ 2-2	-0.04	-0.01	0.61	1.00					
SSQ 2-3	-0.08	0.07	0.55	0.56	1.00				
SSQ 3-1	-0.01	-0.08	-0.11	-0.04	-0.11	1.00			
SSQ 3-2	-0.06	-0.08	0.04	0.04	0.023	0.78	1.00		
SSQ 3-3	-0.08	-0.08	0.07	0.08	0.07	0.63	0.86	1.00	
SSQ 4-1	-0.03	-0.00	0.04	0.06	0.04	-0.11	-0.10	-0.08	1.00

Table 5: **Correlation Matrix of SSQ responses:** The correlation matrix for the SSQ responses are presented above. Responses are grouped by SSQ. Of key interest are the correlations between SSQs of the same type.

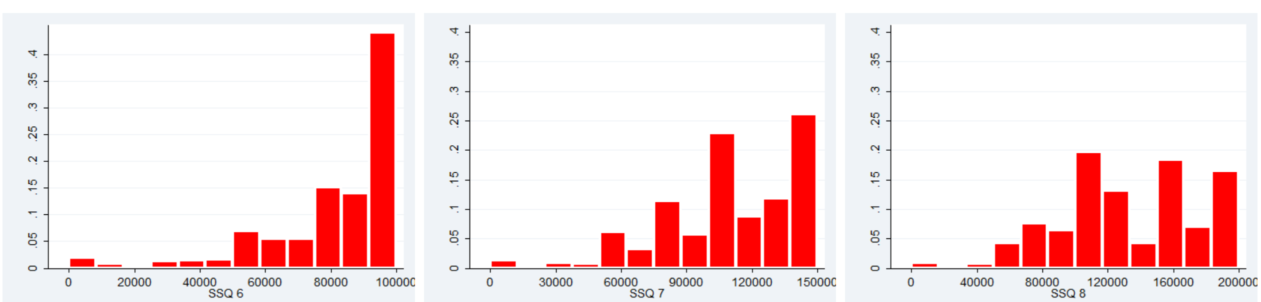


Figure 1: **SSQ 3 Response Distributions:** We ask SSQ 3, the SSQ presented in the section above, for wealth values of $100,000, $150,000, and $200,000. The response distributions are presented above in this order.

	SSQ6	SSQ7	SSQ8
Age	-55.733	-284.593	-386.798
	(0.70)	(0.09)	(0.06)
Gender	-2188.325	804.021	507.316
	(0.56)	(0.85)	(0.93)
$\mathbb{I}_{sick}$	458.376	938.313	4543.978
	(0.93)	(0.88)	(0.54)
Total Wealth	0.002	0.001	0.001
	(0.15)	(0.61)	(0.73)
Income Group	-69.569	2423.177	2198.164
	(0.95)	(0.05)	(0.16)
Income Group × Gender	565.370	-2041.065	-2425.774
	(0.70)	(0.23)	(0.26)
$\mathbb{I}_{child}$	-2767.862**	-3588.327***	-4091.390***
	(0.00)	(0.00)	(0.00)
Average ADL expense	0.040	0.055*	0.078*
	(0.06)	(0.03)	(0.01)

Table 6: **External Verification of SSQs 3:** This table presents the results from a tobit regression of SSQ 3 responses on the listed covariates.

be expected based on likely differences in underlying bequest motives. We also observe evidence that individuals who believe ADL costs are larger allocate more to the ADL state. Note that we observe little predictive power for state variables such as wealth, income, age, health, and gender. This may be because these variables were effectively neutralized in the SSQ.

Three other SSQs were asked that identify other model parameters. A brief description of these is provided in table 2, with their full presentation included in appendix B. We show in the appendix that fundamental internal and external consistency conditions are met for all questions.

5 Parameter Estimates

5.1 Estimation Strategy

In this section we estimate individual preference parameters using our SSQs. Our identification strategy relies upon assuming the utility functional forms that characterize each individuals' response to each SSQ. There are 9 different iterations of 4 SSQs, with the response to each SSQ characterized by the relevant utility functions and individual parameter sets θ_i. For each individual we assume a response process that permits a likelihood function, and then use the 9 SSQs to identify via MLE the parameter set that generated each individual's response set (denoted $\hat{Z}_i = [\hat{z}_k]_{k=1}^{9}$). Table 2 summarizes the SSQs and the relevant parameters and motives for each.

To derive our likelihood function, we denote the response to the k^{th} SSQ as $z_k(\theta)$ and assume each individual's response is reported with normally distributed response errors. Thus, we assume that the observed responses can be expressed as,

$$\hat{z}(\theta_i) = z_k(\theta_i) + \hat{\epsilon}_{k,i},$$

where $\epsilon_{k,i} \sim \mathbb{N}(0, \sigma_{k,i}^2)$. and $\hat{\epsilon}_{k,i}$ denotes the realization of individual i's response error to SSQ k. To ensure identification of the six preference parameters at an individual level from 9 questions, we must restrict the error variances to be functions of no more than three free parameters. This is achieved by specifying $\sigma_{k,i}^2$ to be a function of a question specific and an individual specific component. Specifically, we assume that the standard deviation of the response error to question k is linear in the maximum feasible response W_k and individual scaling factor $\bar{\sigma_i}$, so that $\sigma_{k,i} = \bar{\sigma_i} \times W_k$. The idiosyncratic component accounts for differences in the precision with which individuals report answers. The question specific component takes into account the different scales of the nine SSQs and thus normalizes the error standard deviation according to the feasible response size. Note that W_k is naturally defined in each question by the budget constraint, except in SSQ 9. In this question, we windsorize the raw survey responses at the 95^{th} percentile and assign $W_9 = 500000$ as the maximum response in the cleaned data. In appendix C we show that our estimation procedure is robust to alternative specifications of response errors.

Our specification permits us to express the likelihood of observing a response to each question as a function of $[\theta_i, \bar{\sigma}_i]$ as,

$$\mathcal{L}_k(\theta_i, \bar{\sigma}_i|\hat{z}_{k,i}) = \begin{cases} F_{\sigma_{k,i}^2}(-z_k(\theta_i)) & if \quad \hat{z}_{k,i} = 0; \\ f_{\sigma_{k,i}^2}(\hat{z}_{k,i} - z_k(\theta_i)) & if \quad 0 < \hat{z}_{k,i} < W_k; \\ 1 - F_{\sigma_{k,i}^2}(W_k - z_k(\theta_i)) & if \quad \hat{z}_{k,i} = W_k; \end{cases}$$

where the boundary cases take into account error truncation due to the budget constraint, and $F_{\sigma_{k,i}^2}$ and

$f_{\sigma^2_{k,i}}$ denote the normal CDF and PDF with variance $\sigma^2_{k,i}$ respectively. We further assume independence of survey response errors to obtain a multiplicatively separable likelihood function for the full response set $\hat{Z}_i$ as,

$$\mathcal{L}(\theta, \bar{\sigma}|\hat{Z}_i) = \prod_{k=1}^{9} \mathcal{L}_k(\theta, \bar{\sigma}|\hat{z}_{k,i}).$$

We use MLE to estimate individual parameter sets as,

$$[\hat{\theta}_i, \hat{\bar{\sigma}}_i] = \arg\max \mathcal{L}(\theta, \bar{\sigma}|\hat{Z}_i).$$

Formal derivation of $\mathcal{L}_k$ for each SSQ k is presented in appendix C. We briefly demonstrate the identification argument for the third SSQ that was presented in Section 3. As shown in table 2 σ, θ_{LTC}, and κ_{LTC} determine responses to SSQs 1 and 2, and identification of these parameters rests largely on these questions. The third SSQ is largely relied upon to identify θ_{beq} and κ_{beq}. The text of this SSQ asks individuals to solve the following optimization problem:

$$\max_{z_{3,LTC}, z_{3,beq}} \frac{\theta_{LTC}(z_{3,LTC} + k_{LTC})^{1-\sigma}}{1-\sigma} + \frac{\theta_{beq}(z_{3,beq} + k_{beq})^{1-\sigma}}{1-\sigma}$$

$$s.t. \quad z_{3,LTC} + z_{3,beq} \le W.$$

Given this formulation, the optimal allocation rule is given by,

$$z_{3,LTC} = \begin{cases} 0 & if \ \beta\theta_{beq}(W + k_{beq})^{-\nu} - \theta_{LTC} \left(k_{LTC}\right)^{-\nu} \alpha > 0 \\ W & if \ \theta_{LTC} \left(\alpha W + k_{LTC}\right)^{-\nu} \alpha - \beta\theta_{beq}(k_{beq})^{-\nu} > 0 \\ \frac{\left(\frac{\beta\theta_{beq}}{\alpha\theta_{LTC}}\right)^{-1/\nu}(W+k_{beq})-k_{LTC}}{\left(\alpha+\left(\frac{\beta\theta_{beq}}{\alpha\theta_{LTC}}\right)^{-1/\nu}\right)} & otherwise. \end{cases}$$

Conditional on knowing σ, θ_{LTC}, and κ_{LTC}, we observe that the interior response is linear in wealth, and thus θ_{beq} and k_{beq} are identified by two interior responses at different wealth levels. Because we repeat this question at 3 different wealth levels and these parameters also impact the response to SSQ 4, we have an over-identified response set that we can use to identify these parameters. Identification of other parameters from the remaining SSQs follow a similar argument. Using these responses, we are

	σ	θ_{LTC}	k_{LTC}	θ_{beq}	k_{beq}	PC_{LTC}
10%	2.04	.00	-82.44	.00	37.23	.40
25%	3.02	.05	-50.65	.04	11.70	9.00
50%	4.52	2.14	-9.45	17.89	125.72	31.93
75%	6.74	99.45	46.23	108.33	362.64	64.10
90%	10.11	1000	148.81	1000	781.45	149.20
Ameriks, Briggs, Caplin, Shapiro, and Tonetti (2015)	5.85	1.57	-45.65	0.59	7.88	39.46
Median Standard Errors	.13	.98	10.71	1.37	18.44	.35

Table 7: **Estimated Parameter Distributions:** The marginal distributions of each parameter are presented in the table above. Note that each line represents the percentile of each marginal distribution and does not take into account the correlation between parameters. The next line presents the parameters estimated from a similar model with a representative agent, and the final line presents the median standard error estimate for each parameter.

able to identify all relevant structural model parameters.[10]

5.2 Parameter Estimates

For those single individuals with full SSQ response sets, we summarize in table 7 the marginal distributions at the 10th/25th/50th/75th/90th percentiles and compare them to the estimates found in Ameriks, Briggs, Caplin, Shapiro, and Tonetti (2015). Given the difference in estimation procedures (Ameriks, Briggs, Caplin, Shapiro, and Tonetti (2015) estimates a single population parameter set and utilizes wealth holdings as an additional source of identification) and that in table 7 we are not accounting for the correlation between estimated parameters, we should not expect to replicate this parameter set. We do observe however that the qualitative patterns of our estimates align fairly well. Furthermore, for all parameters the estimates in this previous study are contained in the $25^{th} - 75^{th}$ percentile of our estimated distribution. Our median marginal estimates suggest a relative risk aversion parameter $\sigma = 4.52$, LTC expenditure as a necessity $\kappa_{LTC} < 0$ with low marginal valuations ($\theta_{LTC} \approx 1$), bequests as a luxury ($\kappa_{beq} > 0$) with a high marginal valuation ($\theta_{beq} > 1$), and a public long term care dollar equivalent of $\$32,000$ (PC_{LTC}).

Our parameter sets are reasonably well identified. The individual component of the response error ($\bar{\sigma}$) is estimated to be between 0 and .2 for over 95% of our population. This implies that when individuals have $100,000 to allocate, the standard deviation of response error is between 0 and $20,000

[10] C_F and β are not identified by any of our SSQs, and thus are calibrated to standard values from the literature

for 95% of our population, with a median value of $8,000. Furthermore, in table 7 we present median estimated standard errors for each of the preference parameters. These are perhaps surprisingly small given that we are identifying all parameters from only 9 questions. The precision of our estimates reflects the design of the SSQ survey instruments to ensure identification.

In section 4 we showed that SSQ responses are predicted by covariates that reflect higher bequest and LTC motives. Unsurprisingly, these differences in answer patterns cause meaningful variation in parameter estimates. For example, individuals with children are estimated to have stronger bequest motives and individuals that report higher subjective opinions of the quality of public care are estimated to assign a higher monetary equivalent to the public care option.

6 ADLI Demand

6.1 Model-Based Calculation

Using the parameter estimates presented above and each individual's specific state variables, we calculate the model-implied demand for insurance products. Our model solves each individual's decision problem conditional on age, gender, health, wealth, income, and preference parameter set. ADLI as we have defined it is modeled as a state contingent security that pays out whenever an individual is in the ADL health state ($s = 2$). When an individual purchases this product, they pay $\$y_{ADL,i} \times p(X_i)$ at current age t wealth to receive income $y_{ADL,i}$ in each year that they need assistance with ADLs for the remainder of life. The demand is thus determined by preference over future consumption streams as determined by preference parameter set θ_i, the set of state variables X_i that determine the expected value of these future consumption streams, and the price $p(X_i)$ that individuals must pay to purchase an additional unit of consumption. The pricing function is determined so that the product is actuarially fair given an individual's gender, age, health state, and access to a risk free outside asset promising 1% annual return. Here, actuarially fair is defined such that the agent selling this product makes zero expected profit. For formal expression of the demand implied by the model we refer the reader to appendix A.

6.2 Model-Based ADLI Demand

When we calculate ADLI demand for each individual in our sample, we find that 37.23% of respondents have no interest whatever. For those who have interest, the resulting demand is presented in figure 2.

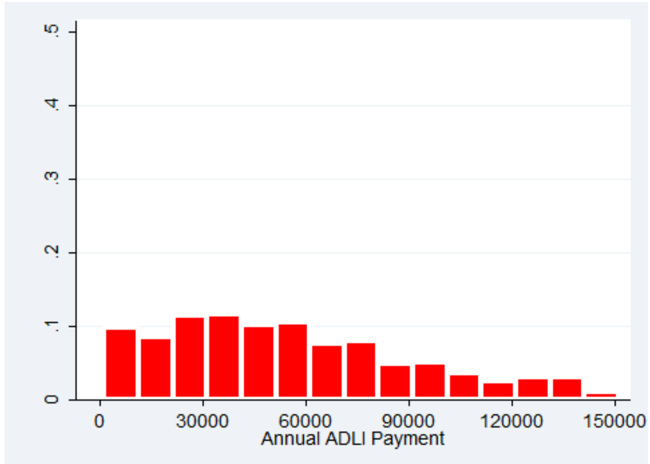


Figure 2: **ADLI Income demand for individuals with positive demand:** This figure presents the level of ADLI income demanded for our those individuals that our model estimates to have positive demand. We omit the 32.1% of individuals for whom demand is zero.

The largest category comprises those who demand between \$0 and \$100000 of income in any year in which they need assistance with ADLs, although a non-trivial number demand significantly more.

Heterogeneity in estimated ADLI demands in our sample derives in large part from differences in preferences. Table 8 presents the mean and median parameter sets for individuals that our model estimates do and do not wish to purchase ADLI. Note first that respondents we estimate to purchase ADLI are significantly more risk averse than those that who do not. This is unsurprising given the incentive risk aversion creates to purchase insurance. We find also that individuals who purchase ADLI have a much stronger preference for consumption when in the ADL state. In fact, these individuals have a median (mean) κ_{LTC} of -16.25 (-20.06) compared to 7.31 (32.94), meaning that individuals we estimate to purchase ADLI are more likely to view ADL state consumption as a necessity. Furthermore, the marginal utility multiplier θ_{LTC} is significantly larger for those that purchase ADLI, with a median (mean) value 4.66 (236.82) as opposed to .53 (131.68). Purchasers also unambiguously assign a lower valuation to a free government care option, PC_{LTC}, as would be expected.

Effects of the bequest motives on ADLI purchases are theoretically ambiguous. On one hand, bequests decrease desire for insurance as bequests increase the value of liquid wealth at the end of life. However, ADLI also insures the estate against being depleted in the ADL state, so this product also partly insures bequests. Our estimates support the second motive as being dominant, as individuals that are estimated to purchase ADLI have larger bequest motives. When comparing median (mean) κ_{beq} for those that we estimate do and do not purchase ADLI, the lower values (75.98 (162.70) as

		ADL Insurance Demand					
		σ	θ_{LTC}	k_{LTC}	θ_{beq}	k_{beq}	PC_{LTC}
Don't Buy	Mean	4.25	131.68	32.94	312.79	319.08	58.85
	Median	3.69	.53	7.31	11.33	236.19	39.99
Buy	Mean	5.73	236.82	-20.06	393.71	162.70	44.98
	Median	4.95	4.66	-16.25	24.93	75.98	25.02

Table 8: **Parameter sets and ADLI purchase:** This table presents parameter sets for those which our model does and does not predict will purchase ADLI.

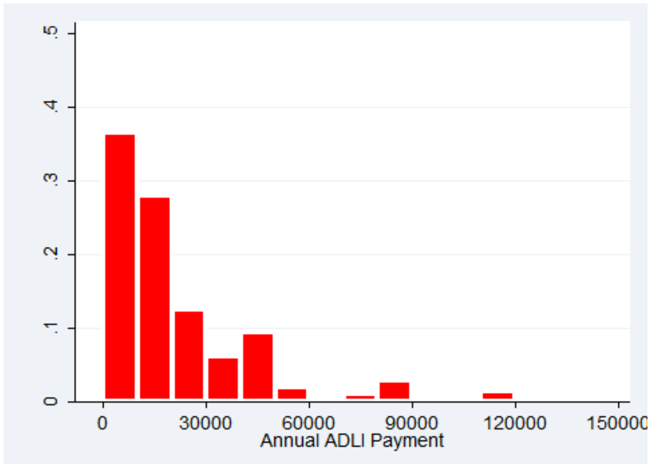


Figure 3: **Surveyed ADLI Demand only positive:** This figure presents the level of stated ADLI income demanded for our those individuals that indicated positive demand. We omit the 71.2% of individuals for whom stated demand is zero.

opposed to 236.19(319.08)) suggest that individuals that do purchase ADLI view bequests as less of a luxury good. In addition, we find that θ_{beq} is larger for those that purchase ADLI (24.93 (393.71)) than those that do not (11.33 (312.79)), implying a higher marginal valuation.

6.3 Stated ADLI Demand

Our second measure of ADLI demand is derived from the survey instrument described in section 3.2. As described therein, respondents are first asked whether they would like to purchase any amount of this product, to which 29.2% answer affirmatively. They are then asked how much they would purchase, generating the demand distribution presented in table 10. Note that 40% of respondents reporting positive demand indicate a desire to purchase more than \$20,000, while the 95^{th} percentile of the demand distribution is \$42,000.

In table 9 we examine how surveyed demands are predicted by demographic and economic charac-

	$\mathbb{I}_{ADLI>0}$	Annual ADLI Income
Age	-0.003	-94.783
	(0.56)	(0.23)
Gender	0.381*	9272.527***
	(0.01)	(0.00)
$\mathbb{I}_{sick}$	-0.331	-2686.371
	(0.14)	(0.39)
Total Wealth	-0.000	0.001
	(0.97)	(0.32)
Income Group	0.035	162.262
	(0.43)	(0.80)
Income Group × Gender	-0.092	-958.859
	(0.13)	(0.28)
Average ADL expense	0.000	0.030
	(0.69)	(0.08)
Positive Opinion of Public LTC	-0.099	-2497.851**
	(0.09)	(0.00)
$P(ADL\ state\ >\ 3\ year)$	0.004*	39.663
	(0.01)	(0.10)

Table 9: **Validation of Surveyed ADL demand measurement:** This table presents the results of a probit regression of the ADLI purchase decision on specified covariates, and a tobit regression on the level of ADLI income demanded.

teristics as well as preference indicators. We present results of a probit regression of the decision to buy and a tobit regression on the amount purchased. If a variable indicates a higher preference for wealth in ADL state, it should have a significant, positive coefficient in one or both of these regressions.

In the first column, we conduct a probit estimation of the purchase decision as a function of other survey measures. Here we find that respondents who report higher probabilities of experiencing extended time in the ADL state are more likely to purchase. This suggests that the prices quoted to these individuals may be more than actuarially fair, and hints at adverse selection in ADLI purchases. There is also evidence that individuals who indicate a more favorable opinion of publicly provided LTC have less of a desire to purchase. We see this more strongly when examining the level of purchases in the second column, as such individuals purchase $2500 less. Few demographic variables (other than male) are significant, likely reflecting actuarially fair pricing.

	ADLI							
	mean	p5	p10	p25	p50	p75	p90	p95
Simulated Demand	41717	0	0	0	23754	64739	111259	146271
Surveyed Demand	7179	0	0	0	0	6000	24000	42000
Simulated-Ideal	34489	-20579	-7449	1000	17581	59047	105503	134107

Table 10: **Distribution of Differences ADLI:** This table presents the distribution of each of our ADLI demand measures. The top line presents the simulated demand distribution, and the middle line presents the surveyed demand distribution. The bottom line presents the distribution of the differences between the simulated and stated demand. Note that this is different from the difference of the distributions.

6.4 Comparison of Estimates

The above section suggests that that our model over-predicts the demand for ADL insurance, for both the purchase decision and the level purchased. With regard to whether or not to purchase, one potential reason for the large gap is that pre-existing LTC insurance holdings may have caused individuals that would otherwise desire ADLI not to demand any more. When we include those individuals with prior LTC coverage amongst those that would purchase ADLI, we find that 43.5% of respondent either already own LTC insurance or report positive demand in the survey.

Our overestimation of ADLI demand is more pronounced on the intensive margin. We look at the distribution of differences in table 10. Here we observe a median demand difference of $17500 and a mean difference of $35000, further demonstrating that the model significantly over-predicts the level of demand. Note that the third row measures percentiles of difference, not differences of percentiles, so that we should not expect it to be the difference of top two rows. While the median difference is positive, note that in more than 10% of cases the stated demand for ADLI exceeds model-estimated demand.

7 Annuity Demand

Since ADLI is a product that does not exist in practice, part of the explanation for the large difference between demand measurements may be respondent unfamiliarity. In this section we repeat the previous exercises for actuarially fair annuities. As detailed in section 2, the annuity market is more developed than the market for LTC insurance products, and most individuals in our sample are familiar with

	Annuity							
	mean	p5	p10	p25	p50	p75	p90	p95
Simulated Demand	47257	1586	05003	13922	33035	65447	104660	141135
Surveyed Demand	3485	0	0	0	0	0	10000	20000
Simulated-Ideal	44188	0	2461	12128	29977	62669	102012	129637

Table 11: **Distribution of Differences Annuity:** This table presents the distribution of each of our Annuity demand measures. The top line presents the simulated demand distribution, and the middle line presents the surveyed demand distribution. The bottom line presents the distribution of the differences between the simulated and stated demand.

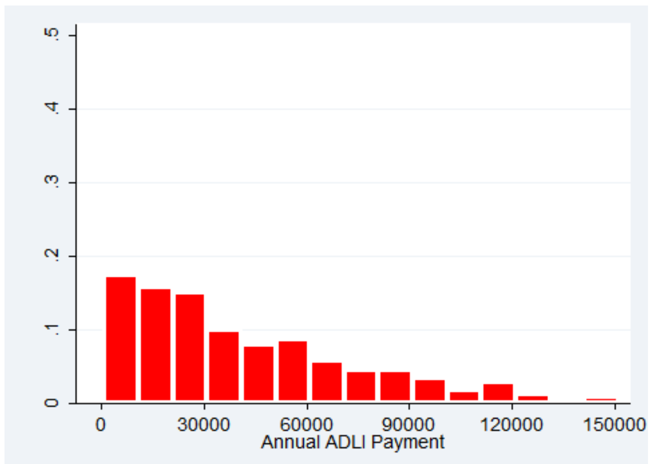


Figure 4: **Annuity Demand - Model:** This figure presents the annuity demand from the model for the 96.1% of individuals that our model predicted to have positive demand.

them.

Just as with ADLI, we use our model to calculate the implied annuity demands for our sample. Strikingly, all but 4% of respondents are estimated to purchase a strictly positive amount of an actuarially fair, risk free annuity. Moreover, the expenditure on optimally chosen annuities is high, as shown graphically in figure 4.

We also collect stated annuity demand measures, the distribution of which is presented in table 11. We find little interest in this product. Only 22.9% of respondents indicated they would purchase any of this product. The lack of interest is also exhibited in low-level of demand for annuity income. The 95th percentile of annuity demand is only $20,000. However, when we regress this demand on demographic correlates[11], there are two highly significant findings. First, those with longer life expectancy are significantly more likely to have strictly positive demand than are those with lower life expectancy. As

[11] The results of this estimation are presented in appendix E

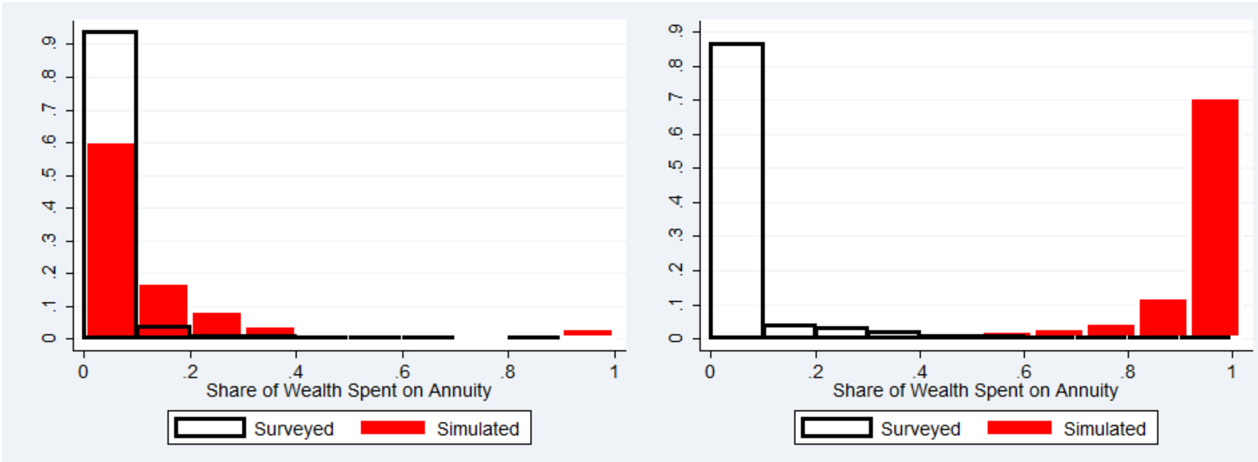


Figure 5: **Share of Wealth used to Purchase Insurance:** The above figures present the amount of wealth spent on the relevant insurance product divided by total wealth. Panel A presents this ratio for ADLI, while Panel B presents the same results for the annuity.

for ADLI, this points to possible adverse selection in the market for annuities. With respect to the extensive margin, among those who state a willingness to purchase, the quantity purchased increases strongly with wealth, which is as would be expected.

While the qualitative properties of stated annuity demand are not surprising, the quantitative findings indicate a dramatic difference with estimated demands. Table 11 presents the demand distributions for both estimated and stated demands as well as the distribution of these differences. The table shows for actuarially fair annuities, the gap between what the model predicts individuals would demand and what individuals state that they would purchase is massive. We observe that on average the model over-predicts annuity demand by more than $44,000 with a median over-prediction of almost $30,000. This is even larger than the difference in demands we observed for ADLI, and suggests that our model over-estimation of demand can not be accounted for by respondents unfamiliarity to products.

8 The Under-Insurance Puzzle, Model Specification, and Transfers

Our results strongly suggest that interest in insurance among older wealth holders is well below the level that current state of the art models suggest. To illustrate the puzzle in starkest form, figure 5 converts our findings from the last two sections as the share of wealth allocated to ADLI and annuities for both our surveyed and modeled measurements. In panel A of figure 5, we plot the distribution of the proportion of financial wealth that respondents are estimated to allocate to ADLI. We find that in both our survey and simulation individuals allocate fairly low shares of wealth to ADLI, although the modeled measurement clearly predicts a higher wealth share.

Powerful as is the gap between estimates for ADLI, it is far more dramatic for the case of actuarially fair annuities, as plotted in panel B of figure 5. As illustrated, the model implies that a very large proportion of wealth should optimally be annuitized. Stated demands in sharp contrast indicate very low interest: below 10% of wealth for almost the entire population. This figure illustrates the annuity puzzle in dramatic form, yet for a non-standard population. As Ameriks, Briggs, Caplin, Shapiro, and Tonetti (2015) show, precautionary motives related to long term care can explain lack of interest in annuities, but only for those singles either with wealth below \$400,000 and retirement income below about \$50,000. While this may cover the majority of the U.S. population, it does not cover the majority of the VRI panel. Respondents have generally high wealth as well as relatively high current and anticipated future income. They appear to have enough such resources to be able to self insure against even relatively high long term care costs out of the income from their annuity. Given that their bequest motives are relatively low, at least in terms of the model as currently specified, it is optimal to annuitize the bulk of their wealth.

In appendix D we present the same measurements when we restrict our sample to those with employer sponsored Vanguard plans. These individuals are less wealthy and more representative of the general population, as displayed in table 1. In this analysis, we find that all qualitative results hold for this sample, further suggesting that the low demand for insurance is pervasive.

One possible explanation for our findings of high modeled interest in annuities and LTCI relative to stated measures is that we may have under-estimated bequest motives in our model. With a sufficiently strong bequest motive, as estimated in Lockwood (2014), an individual would have little interest either in ADLI or in actuarially fair annuities due to a preference for liquid end of life wealth. However it is difficult to reconcile this parameter set with the response distributions we observe in SSQ 3. In particular, an individual with the Lockwood parameter set would allocate almost all wealth to the bequest state. However, we observe in figure 1 that respondents clearly indicated a strong preference for consumption in the LTC state rather than for an end of life bequest. Thus, explaining the lack of insurance product demand through a strong end of life bequest motive is not compatible with their survey responses.

The blatant conflict between model predicted and stated demand for insurance raises important questions concerning model specification. When contemplating possible reasons for lower than model-predicted interest in insurance, one natural candidate is possible mis-specification of bequest motives. As Abel and Warshawsky (1987) point out, models rationalizing bequests come in a wide variety of flavors. One alternative to the industry-standard warm glow formulation of De Nardi (2004) that we employ is intergenerational altruism whereby parents obtain utility indirectly from their descendants' utility (Barro (1974), Becker (1974), Barro and Becker (1988)). A third alternative is a strategic bequest motive of the form introduced by Bernheim, Shleifer, and Summers (1985), whereby parents use possible intergenerational transfers to incentivize behaviors in their offspring.

Unfortunately, while crucial for policy questions such as the optimal estate tax, it is notoriously hard to separate distinct bequest motivations in behavioral data (Piketty and Saez (2013)). The reason that warm glow motives dominate the applied literature is that they are straight forward to operationalize. By contrast, operationalizing an altruistic motive or dynamic transfer decision requires modeling not only the parent's optimization problem, but also the recipient's. Given the computational complexity of existing late in life savings models, introducing a second optimization problem into the model's state space is prohibitive. Even if computational constraints were removed, identifying the altruistic motive in such a model would require a panel of matched parent/recipients that does not currently exist.

In this section we consider various forms of inter-vivos transfer to see if they might partly explain the gap between our demand estimates. In much current theoretical work, inter-vivos transfers and bequests are treated as the same, with life's unfolding dynamics telescoped into a single period (Farhi and Werning (2010), Farhi and Werning (2013); Piketty and Saez (2013); Kopczuk (2001); Kopczuk (2013)). In reality there are important distinctions between inter-vivos giving and bequests, not only in theory, but also in practice (see Altonji, Hayashi, and Kotlikoff (1997) and McGarry (1999)). In particular, inter-vivos transfers may allow parents to meet specific evolving needs of liquidity constrained offspring. As such, these transfers may be of particular value when these needs are high. This might help explain the somewhat lumpy nature of observed transfers (Light and McGarry (2003)).

As described briefly in section 3, in VRI Survey 3 we measure the total amount of financial wealth that individuals have transferred to their descendants in the last three years. We find that 67.6% of individuals report having transferred wealth to descendants during this time frame, with a mean (median) transfer level of $18,900 ($8,600). Furthermore, 25% of respondents indicating positive transfers report having transferred more than $29,500, and 10% report having transferred more than $60,000. These

	ADLI diff	Annuity diff
Transfers	0.402**	.191**
	(.004)	(.002)
$\mathbb{I}_{Transfer>20k}$	14656*	2712.9
	(.023)	(.34)
$\mathbb{I}_{child}$	1310	1451.43
	(0.82)	(.57)

Table 12: **Other motives:** This table presents the coefficient on each indicated variable from implementing the fixed effect regression in appendix C. In each case, we omit presenting the coefficients on the included fixed effects, but note that in all cases the fixed effects are jointly significant at the 1% level.

numbers suggest that transfer of wealth to descendants is both common and the amount transferred potentially large.

While deep exploration of the transfer data and corresponding modeling is beyond the scope of this paper, what we can do at this stage is to explore the possibility that transfer motives are at least in part responsible for the difference between model implied and stated demands. We do this separately for ADLI and for actuarially fair annuities. Intuitively, if an element of the model is mis-specified, then it will affect the level of model predicted demand relative to the true demand. Specifically, omitted (overstated) risks/precautionary motives should cause larger (smaller) difference between modeled and stated demands. When regressing indicators of such motives on the difference we would expect a significant positive (negative) coefficient. The econometric model that we estimate is presented in appendix C, and is designed to control for variation in demands both due to state variables and preferences.

We are particularly interested in the role of intergenerational transfers in predicting differences in demand, and present results related to these in table 12. Here we observe that for ADLI demand, both the level and an indicator of having made a transfer larger than $20k are predictive of a larger gap. For annuities we observe very much the same qualitative patterns, with the level of transfers again significantly predicting the demand difference. We observe no effect when examining how having children per se predicts the differences in demand. This suggests suggests that an unmodeled motive or risk related specifically to intergenerational transfers contributes to the large difference in our demand measurements.

We regard the analysis of this section as comprising a specification test for the broad class of current models of late in life spending. No version of this model that is responsive to respondent preferences is consistent with the very low stated demand for actuarially fair annuities and for long term care insurance. While the findings of this section suggest that family transfers may explain a portion of this gap, their contribution remains to be quantified. While it is conceivable that appropriately including these motives will explain much of the identified gap, there is also a chance that additional model elements remain to be uncovered. Methods analogous to those used in this section may aid in the identification of such additional elements.

9 Conclusion

Our results suggest far lower interest in insurance of late in life spending risks than current models predict. Patterns in the gap between demand estimates suggest that current models of late in life savings may mis-specify inter-generational motives. The survey-based methods we develop to investigate model specification may be of broader interest.

References

Abel, A. B., and M. Warshawsky (1987): "Specification of the joy of giving: Insights from altruism," *NBER*.

Altonji, J., F. Hayashi, and L. Kotlikoff (1997): "Parental Altruism and Inter Vivos Transfers: Theory and Evidence," *Journal of Political Economy*, 105, n6.

Ameriks, J., J. Briggs, A. Caplin, M. Shapiro, and C. Tonetti (2015): "Long Term Care Utility and Late in Life Saving," *Vanguard Research Initiative Working Paper*.

Ameriks, J., A. Caplin, S. Laufer, and S. Van Nieuwerburgh (2011): "The Joy of Giving or Assisted Living? Using Strategic Surveys to Separate Public Care Aversion from Bequest Motives," *Journal of Finance*, 66(2), 519–561.

Ameriks, J., A. Caplin, M. Lee, M. Shapiro, and C. Tonetti (2015): "The Wealth of Wealthholders," *Vanguard Research Initiative Working Paper*.

Barro, R., and G. Becker (1988): "A Reformulation of the Economic Theory of Fertility," *Quarterly Journal of Economics*.

Barro, R. J. (1974): "Are government bonds net wealth?," *The Journal of Political Economy*, pp. 1095–1117.

Becker, G. S. (1974): "A Theory of Social Interactions," *Journal of Political Economy*, 82(61).

Bernheim, B. D., A. Shleifer, and L. H. Summers (1985): "The strategic bequest motive," *The Journal of Political Economy*, pp. 1045–1076.

Brown, J. R. ., G. S. Goda, and K. McGarry (2013): "State-Dependent Utility and Insurance Purchase Decisions," *working paper*.

Brown, J. R., and A. Finkelstein (2008): "The Interaction of Public and Private Insurance: Medicaid and the Long-Term Care Insurance Market," *The American Economic Review*, pp. 1083–1102.

——— (2011): "Insuring Long-Term Care in the United States," *The Journal of Economic Perspectives*, pp. 119–141.

Brown, J. R., O. S. Mitchell, J. M. Poterba, and M. J. Warshawsky (2001): *The role of annuity markets in financing retirement*. MIT Press.

De Nardi, M. (2004): "Wealth inequality and intergenerational links," *Review of Economic Studies*, 07, 743–768.

De Nardi, M., E. French, and J. Jones (2010): "Differential mortality, uncertainmedical Expenses, and the Saving of elderly singles," *Journal of Political Economy*, 118, 49–75.

Farhi, E., and I. Werning (2010): "Progressive estate taxation," *The Quarterly Journal of Economics*, 125(2), 635–673.

——— (2013): "Insurance and taxation over the life cycle," *The Review of Economic Studies*, 80(2), 596–635.

Friedman, B., and M. Warshawsky (1990): "The cost of annuities: Implications for saving behavior and bequests," *The Quarterly Journal of Economics*, 105(1), 135–54.

Friedman, B. M., and M. Warshawsky (1988): "Annuity prices and saving behavior in the United States," in *Pensions in the US Economy*, pp. 53–84. University of Chicago Press.

Hubbard, R. G., J. Skinner, and S. P. Zeldes (1994): "Expanding the life-cycle model: Precautionary saving and public policy," *The American Economic Review*, pp. 174–179.

Hurd, M., and J. Smith (2002): "Expected bequests and their distribution," *RAND Working Paper*, NA, NA.

Hurd, M. D. (1989): "Mortality risk and bequests," *Econometrica: Journal of the Econometric Society*, pp. 779–813.

Koijen, R. S. J., S. Van Nieuwerburgh, and M. Yogo (2015): "Health and Mortality Delta: Assessing the Welfare Cost of Household Insurance Choice," *Journal of Finance*, forthcoming.

Kopczuk, W. (2001): "Optimal estate taxation in the steady state," *University of Michigan*.

——— (2013): "Incentive effects of inheritances and optimal estate taxation," Discussion paper, National Bureau of Economic Research.

Kopecky, W., and T. Koreshkova (2004): "The impact of medical and nursing home expenses and social insurance policies on savings and inequality," *American Economic Journal: Macroeconomics*, NA, NA.

Kotlikoff, L. J. (1988): "Intergenerational Transfers and Savings," *Journal of Economic Perspectives*, 2(2), 41–58.

Light, A., and K. McGarry (2003): "Why parents play favorites: Explanations for unequal bequests," Discussion paper, National Bureau of Economic Research.

Lockwood, L. (2014): "Bequest Motives and the Choice to Self-Insure Late-Life Risks," *working paper*.

Love, D. A., M. G. Palumbo, and P. A. Smith (2009): "The trajectory of wealth in retirement," *Journal of Public Economics*, 93(1), 191–208.

Lupton, J., and W. Kopczuk (2007): "To Leave or Not To Leave: The Distribution of Bequest Motive," *Review of Economic Studies*, 74(1), 207–235.

Manski, C. F. (2004): "Measuring expectations," *Econometrica*, 72(5), 1329–1376.

McGarry, K. (1999): "Inter vivos transfers and intended bequests," *Journal of Public Economics*, 73(3), 321–351.

Mitchell, O., J. Poterba, M. Warshawsky, and J. Brown (1999): "New Evidence on The Money's Worth of Individual Annuities," *American Economic Review*, 89(5), 1299–1318.

Palumbo, M. (1999): "Uncertain medical expenses and precautionary saving near the end of the life cycle," *Review of Economic Studies*, 66, 395–421.

Piketty, T., and E. Saez (2013): "A theory of optimal inheritance taxation," *Econometrica*, 81(5), 1851–1886.

Poterba, J. M., S. F. Venti, and D. A. Wise (2013): "Health, education, and the post-retirement evolution of household assets," Discussion paper, National Bureau of Economic Research.

Rubin, L., K. Crowe, A. Fisher, O. Ghaznaw, R. McCoach, R. Narva, D. Schaulewicz, T. Sullivan, and T. White (2014): "The Economic Need for LTC Insurance, the History of LTC Regulation & Taxation and the Development of LTC Product Design Features," in *N/A*. The Society of Actuaries.

Soto, M., R. Penner, and K. Smith (2009): "How Seniors Change Their Asset Holdings During Retirement," *Available at SSRN 1553268*.

Stallard, E. (2011): "Estimates of the incidence, prevalence, duration, intensity, and cost of chronic disability among the US elderly," *North American Actuarial Journal*, 15(1), 32–58.

A Model Appendix

This section has a richer presentation of the model as presented in Ameriks, Briggs, Caplin, Shapiro, and Tonetti (2015), how insurance demands are defined, and existence of insurance demand.

A.1 Extended Model Presentation

Consumers Consumers are heterogeneous over wealth ($a \in [0, \infty)$), income age-profile ($y \in \{y_1, y_2, \ldots, y_5\}$), age ($t \in \{55, 56, ..., 100\}$), gender ($g \in \{m, f\}$), health status ($s \in \{0, 1, 2, 3\}$), and health cost ($h \sim H(t, s)$ with support $\Omega_H(t, s)$). Time is discrete and the life-cycle horizon is finite. Consumers start at age t_0 and live to be at most T-1 years old, where in our parametrization t_0 corresponds with age 55 and T corresponds with age 108. Each period, consumers choose consumption ($c \in [0, \infty)$), savings (a'), expenditure on long term care, ($e_{LTC} \in [\chi, \infty)$), and whether to use government care ($G \in \{0, 1\}$). Each consumer has a perfectly foreseen deterministic income sequence and receives a risk free rate of return of $(1 + r)$ on his savings. The only uncertainty a retiree has is over health/death.

Government The consumer always has the option to use a means-tested government provided care program. The cost of using government care is that a consumers wealth is set to zero, while the benefit is that the government provides predetermined levels of expenditure, which depend on the health status of the retiree as described below. $G = 1$ if the consumer chooses to use government care and $G = 0$ if the consumer chooses not to use government care.

Health and Death There are four health states: $s = 0$ represents good health, $s = 1$ represents poor health, $s = 2$ represents the need for long term care (LTC), and $s = 3$ represents death. The health state evolves according to a Markov process, where the probability matrix, $\pi(s'|t, s)$ is age and health state dependent. h is a stochastic health expenditure that must be paid—essentially a negative wealth shock.

Each period the consumer is not in good health he has to pay a health cost, h, where, $h \sim H(t, s)$ and H is the CDF of the health cost random variable with support $\Omega_H(t, s)$.

If a consumer chooses to use government care when he does not need long term care (i.e., when $s = 0, 1$), then the government provides a consumption floor, $c = \omega_G$, that is designed to represent welfare.

A consumer needs long term care if he needs help with the activities of daily living (ADLs), such as bathing, eating, dressing, walking across a room, or getting in or out of bed. Thus, state 2 is interchangeably referred to as the LTC or ADL state. If a consumer needs LTC ($s = 2$), then he must either purchase private long term care or use government care. Capturing the fact that LTC provision is essential for those in need and private long term care is expensive, there is a minimum level of expenditure needed to obtain private LTC, i.e., $e_{LTC} \geq \chi$ for those not using government care.[12] Treatment of government provided care is related to the institution of Medicaid. If the consumer needs LTC and uses government care, the government provides $e_{LTC} = \psi_G$. The value ψ_G is a measure of the consumers public care aversion, since that parameter essentially determines the utility of a retiree who needs LTC and chooses to use government care.

In addition to affecting health costs and survival probabilities, health status affects preferences. There is a health-dependent utility function, such that spending when a consumer needs LTC ($s = 2$) is valued differently than spending when a consumer does not need LTC.

$$U(e_{LTC}) = \theta_{LTC} \ \frac{(e_{LTC} + \kappa_{LTC})^{1-\sigma}}{1-\sigma}. \tag{1}$$

Upon death ($s = 3$), the agent receives no income and pays all mandatory health costs. Any remaining wealth is left as a bequest, b, which the consumer values with warm glow utility function

$$v(b) = \theta_{beq} \ \frac{(b + \kappa_{beq})^{1-\sigma}}{1-\sigma}. \tag{2}$$

Utility Functions. When an individual is healthy or sick, his utility is given by a power utility function of consumption. Bequests are valued using the industry standard warm glow utility function developed in De Nardi (2004). When an individual needs long term care, utility is given by a similar formula, which treats LTC and bequests symmetrically in theory, allowing differences in preferences to be determined empirically through estimated parameter differences. Two key parameters are θ and κ; θ affects the marginal utility of an additional dollar spent and κ controls the degree to which an expenditure is valued as a luxury good or a necessity, in the sense that it provides a utility floor.

[12] We are taking the stand that all empirical heterogeneity in LTC expenditure is from voluntary additional spending, as opposed to heterogeneous necessary expenditure. In future survey work, we are collecting information on the subjective expectations of the cost of LTC.

Increases in θ increase the marginal utility of a unit of expenditure, while increases in κ indicate the expenditure is valued as more of a luxury good. Negative κ can be interpreted as the expenditure being a necessity.

The Consumer Problem The consumer takes r as given and chooses a', c, e_{LTC}, and G to maximize utility. The consumer problem, written recursively, is

$$V(a,y,t,s,h,g) = \max_{a',c,e_{LTC},G} \mathbb{I}_{s\neq 3}\ (1-G)\ \left\{U_s(c,e_{LTC}) + \beta E[V(a',y,t+1,s',h')]\right\}$$

$$+\ \mathbb{I}_{s\neq 3}\ G\ \left\{U_s(\omega_G,\psi_G) + \beta E[V(0,y,t+1,s',h')]\right\} + \mathbb{I}_{s=3}\{v(b)\}$$

s.t.

$$a' = (1-G)[(1+r)a + y(t) - c - e_{LTC} - h]$$

$$a' \geq 0$$

$$e_{LTC} \geq \chi \ \text{ if } \ (G=0\ \wedge\ s=2)$$

$$e_{LTC} = \psi_G \ \text{ if } \ (G=1\ \wedge\ s=2)$$

$$c = \omega_G \ \text{ if } \ (G=1\ \wedge\ (s=0\ \vee\ s=1))$$

$$b = \max\{(1+r)a - h'\ ,\ 0\}$$

$$U_s(c,e_{LTC}) = \mathbb{I}_{s\in\{0,1\}}\ \frac{c^{1-\sigma}}{1-\sigma} + \mathbb{I}_{s=2}\ \theta_{LTC}\frac{(e_{LTC}+\kappa_{LTC})^{1-\sigma}}{1-\sigma}$$

$$v(b) = \frac{\theta_{beq}}{1-\sigma}\ (b+\kappa_{beq})^{1-\sigma}$$

The value function has three components, corresponding to the utility plus expected continuation value of a living individual who does not use government care, that of one who does choose to use government care, and the warm glow bequest utility of the newly deceased retiree. Note that a retiree using government care has expenditure levels set to predetermined public care levels and zero next period wealth. The budget constraint shows that wealth next period is equal to zero if government care is used, and equal to the return on savings plus income minus expenditures on consumption and LTC minus health costs. The retiree can not borrow, private expenditure on LTC must be at least χ, and a retiree can not leave a negative bequest.[13]

[13] Technically, there is a fifth health state that is reached (with certainty) only in the period after death and is the absorbing state, so that the consumer only receives the value of a bequest in the first period of death.

A.2 Insurance Demands

Both insurance products we consider are state contingent income streams. When an individual purchases this product, they face a tradeoff of paying \$$y_{Ins,i} \times p(X_i)$ at current age t wealth to receive income $y_{Ins,i}$ in each year the relevant states are realized for the remainder of life. The demand is thus determined by preference over future consumption streams as determined by preference parameter set θ_i, the set of state variables X_i that determine the expected value of these future consumption streams, and the price $p(X_i)$ that individuals must pay to purchase an additional unit of consumption. The pricing function is determined so that the product is actuarially fair given an individuals gender, age, health state, and access to a risk free outside asset promising 1% annual return. Here, actuarially fair is defined such that the agency selling this product makes zero profit in expected value. Note, that because all health transitions are determined exogenously and there is no private information regarding individual mortality or health transition probabilities, there does not exist any moral hazard or adverse selection problems that complicate this pricing.

We thus represent ADL insurance demand as a mapping

$$D : \Theta \times \mathbb{X} \to \mathbb{R}$$
$$D(\hat{\theta}_i, X_i) = y_{Ins,i}$$

where Θ is the feasible parameter space and $\mathbb{X}$ is the feasible set of individual characteristics. Note that because the pricing function $p(X_i)$ is exogenously given, all pricing is summarized by state variable X_i and prices do not need to enter as a formal argument in D. Practically, an agent's demand function is calculated as

$$D(\hat{\theta}_i, X_i) = \arg\max_{y_{Ins}} V^{\hat{\theta}_i}(a - p(X_i)y_{Ins}\ ,\ y + y_{Ins} \times \mathbb{I}_{s\in S}, t, s, h, g)$$
$$s.t. \quad 0 \leq y_{Ins} \leq \frac{a}{p(X_i)}$$

where $V^{\hat{\theta}_i}$ is the value function parametrized with preference set $\hat{\theta}_i$, $a - p(X_i)y_{Ins}$ is the agents wealth minus any ADLI payment, and $y + y_{Ins}\mathbb{I}_{s\in S}$ is defined to be the agents lifetime income profile augmented with insurance amount y_{Ins} whenever the relevant state ($s \in S$) is realized. To calculate $D(\theta_i, X_i)$, we must solve the consumers' life-cycle consumption/savings problem over a grid of y_{Ins}, and interpolate to obtain the y_{Ins} that maximizes the value function. Because the value function is concave and monotonically increasing in both wealth and income profile,the optimal insurance demand is generically unique in the compact feasible demand space and characterized by the following relationship

$$p(X_i) = \frac{V_2^{\hat{\theta}_i}(a - p(X_i)y_{Ins}\ ,\ y + y_{Ins}\mathbb{I}_{s=2}, t, s, h, g)}{V_1^{\hat{\theta}_i}(a - p(X_i)y_{Ins}\ ,\ y + y_{Ins}\mathbb{I}_{s=2}, t, s, h, g)}.$$

where $V_1^{\hat{\theta}_i}$ denotes the marginal value of wealth and $V_2^{\hat{\theta}_i}$ denotes the marginal value of income

B Other SSQs: Questions, Responses, and Validations

Our preference parameter estimation relies upon answers to 4 SSQs. SSQ 3 was presented in the text of the paper. In this appendix, we present the text of the remaining SSQs, the FOC conditions that characterize responses, and regression tables that show responses correlate with other behavioral measures and thus provide external validation.

B.1 SSQ 1

Presentation

> The next section asks you to think about your **willingness to take financial risk**.
>
> We will ask you to imagine a situation. We will ask you questions about the situation. We will then ask you about choices that you would make. Even if it is hard to imagine yourself in this situation, please try your best. Finally we will ask you how changes in the situation affect your choices.
>
> We are interested in your preferences between having a set amount of guaranteed money and taking a risk that might increase or decrease the amount of money you have available to spend.
>
> Suppose you are 80 years old. Suppose, further, that for the next year:
>
> - You live alone, rent your home, and pay all your own bills.
> - You are in good health and will remain in good health.
> - You will have no medical bills or other unexpected expenses.

- You do not work.

You must decide between two plans for the amount you will have available to spend next year.

- Plan A guarantees that you will have $100,000 for spending next year.
- Plan B will possibly provide you with more money, but is less certain. There is a 50% chance Plan B would double your money, leaving you with $200,000, and a 50% chance that it would cut it by a third, leaving you with $67,000.

The plan you choose will determine how much you have to spend for the next year. This choice affects your finances only for next year, not for any years after that. At the end of next year you will again be offered the same choice with another $100,000.

The rules are as follows:

- You have no other assets or income, and so this is the only money you have available for all your spending next year from either Plan A or Plan B.
- Any money that is not spent at the end of next year cannot be saved for the future.
- You cannot give any money away or leave it to others in your will.
- If you need anything next year, you have to pay for it. No one else can buy anything for you.

The respondents are then asked a series of test questions. We present two here:

Again, for research purposes, it is important to verify your understanding. We will now ask you a few questions (each question no more than 2 times). After these questions, we will give you the correct information for any questions which you haven't answered correctly, just to make sure that everything is clear.

1. In the situation just described, if you choose Plan A, next year you will have
    - $100,000
    - $200,000

- $67,000
- Either $200,000 or $67,000, with a 50% chance of each

2. In the situation just described, if you want to buy anything, do you have money aside from what you have in either Plan A or Plan B?

   - Yes
   - No

The respondents then were given the following screen and asked to record their decision

Now we will ask you to choose between the two plans. As a reminder, suppose you are 80 years old. Suppose, further, that for the next year:

- You live alone, rent your home, and pay all your own bills.
- You are in good health and will remain in good health.
- You will have no medical bills or other unexpected expenses.
- You do not work.

You must decide between two plans for the amount you will have available to spend next year.

- Plan A guarantees that you will have the $100,000 for spending next year.
- Plan B will possibly provide you with more money, but is less certain. There is a 50% chance Plan B would double your money, leaving you with $200,000, and a 50% chance that it would cut it by a third, leaving you with $67,000.

Would you choose Plan A or Plan B?

The respondents were then given a series of questions until they had chosen plan A once and plan B once, or were in an extreme case where they would choose plan A if they were only required to risk 10% of income and plan B if they were required to risk 75% of income. These bounds and branching logic mirrored BJKS. They were then asked some variant the following and indicated their willingness to risk income using the the slider technology.

> You have indicated that:
>
> - You would choose Plan A when choosing between two plans, the first of which guarantees \$100,000 is available as spending next year and the second of which offers a 50% chance that your money would double to \$200,000 and a 50% chance that it would be cut by 33% to \$67,000.
> - You would choose Plan B when choosing between two plans, the first of which guarantees \$100,000 is available as spending next year and the second of which offers a 50% chance that your money would double to \$200,000 and a 50% chance that it would be cut by 20% to \$80,000.
>
> What is the largest percent of your money that you would be willing to risk and still choose Plan B?

This was then repeated for wealth value of \$50,000.

Mathematical Derivation and FOC's This question assumes standard CRRA utility functions, and asks for the indifference point at which an individual is willing to risk doubling their next years income against losing a significant amount of their lifetime wealth. Assuming the probability of doubling their income is $\pi = .5$ and the probability of losing a fraction of their income is $\pi = .5$, the question thus asks for the values of λ for which

$$U(W) \leq \pi U(2W) + (1-\pi)U((1-\lambda)W)$$

Of particular interest to us is the $\lambda^{\star}$ at which the above holds with equality.

$$U(W) = \pi U(2W) + (1-\pi)U((1-\lambda^{\star})W)$$

Assuming that

$$U(W) = \frac{1}{1-\nu}(W)^{1-\nu}$$

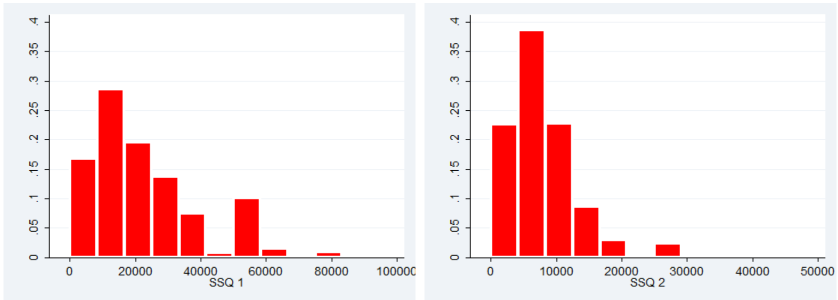


Figure 6: **SSQ 1 distribution:** The above indicates the SSQ responses indicate the amount of wealth an individual would be willing to risk for a 50/50 chance of income doubling. Responses are presented for wealth \$100,000 and \$50,000 respectively.

then we obtain

$$\begin{aligned}
\frac{1}{1-\nu}(W)^{1-\nu} &= \pi\frac{1}{1-\nu}(2W)^{1-\nu} + (1-\pi)\frac{1}{1-\nu}((1-\lambda^{\star})W)^{1-\nu} \\
(W)^{1-\nu} &= \pi(2W)^{1-\nu} + (1-\pi)((1-\lambda^{\star})W)^{1-\nu} \\
(W)^{1-\nu} - \pi(2W)^{1-\nu} &= (1-\pi)((1-\lambda^{\star})W)^{1-\nu} \\
\frac{(W)^{1-\nu} - \pi(2W)^{1-\nu}}{(1-\pi)} &= ((1-\lambda^{\star})W)^{1-\nu} \\
\left(\frac{(W)^{1-\nu} - \pi(2W)^{1-\nu}}{(1-\pi)}\right)^{\frac{1}{1-\nu}} &= W - W\lambda^{\star} \\
W\lambda^{\star} = W - \left(\frac{(W)^{1-\nu} - \pi(2W)^{1-\nu}}{(1-\pi)}\right)^{\frac{1}{1-\nu}} & \\
\lambda^{\star} = 1 - \left(\frac{1-\pi 2^{1-\nu}}{(1-\pi)}\right)^{\frac{1}{1-\nu}} &
\end{aligned}$$

Verification In figure 6 we present the distribution of responses to this SSQ.

Next we regress the response to SSQ 1 on the respondents ownership of equity. We observe in table 13 some evidence respondents that do not own equity indicate that they would be less willing to risk future income for a chance at doubling income. Such individuals would be considered more risk averse.

B.2 SSQ 2

Presentation

> The next section asks you to think about **long term car**. Again, we will ask you to imagine a situation and describe the rules that apply. We will ask you questions about the situation. We

	SSQ1	SSQ2
age	25.498	-17.010
	(0.70)	(0.53)
Gender	4688.073*	1624.817*
	(0.02)	(0.04)
$\mathbb{I}_{sick}$	3145.602	-489.349
	(0.23)	(0.65)
Total Wealth	-0.000	0.000
	(0.78)	(0.58)
Income Group	-115.133	-228.671
	(0.83)	(0.30)
Income Group × Gender	-266.580	-162.184
	(0.73)	(0.60)
No Risky Assets	-2785.870	-3041.527*
	(0.42)	(0.03)

Table 13: **SSQ 1:** The above table presents a tobit estimation of SSQ 1 on the listed covariates.

will then ask you about choices that you would make. Even if it is hard to imagine yourself in this situation, please try your best. Finally we will ask you how changes in the situation affect your choices.

We are interested in how you trade off your desire for resources when you do and when you do not need help with activities of daily life (*ADLs). This scenario is hypothetical and does not reflect a choice you are likely ever to face.

Suppose you are still 80 years old, live alone, rent your home, and pay all your own bills. Now, suppose that there is a chance that you will need help with *ADLs in the next year. If you need help with *ADLs you will need long-term care.

- There is a **25%** chance that you**will** need help with ADLs for all of next year.
- There is a**75%** chance that you**will not** need any help at all with ADLs for all of next year.

You have**$100,000** to divide between two plans for the next year. This choice will affect your finances for next year alone. At the end of next year you will be offered the same choice with another $100,000 for the following year.

- Plan C is hypothetical *ADL insurance that gives you money if you **do** need help with *ADLs.
  - For every $1 you put in Plan C, you will get**$4** to spend if you need help with *ADLs.
  - From that money, you will need to pay all your expenses including long-term care at home or in a nursing home and any other wants, needs, and discretionary purchases.
- Plan D gives you money only if you**do not** need help with ADLs.
  - For every $1 you put in Plan D, you will get **$1** to spend if you**do not** need help with *ADLs.
  - From that money, you will need to pay for all of your wants, needs, and discretionary purchases.

Here are the rules for this scenario.

- You can only spend money from Plan C or Plan D next year. You do not have any other money.
- If you want to be able to spend whether or not you need help with ADLs, you need to put money into both plans.
- If you need help with *ADLs, all money in Plan D is lost.
- If you do not need help with ADLs, all money in Plan C is lost.
- Any money that is not spent at the end of next year cannot be saved for the future, be given away, or be left as a bequest
- You must make your choice before you know whether you need help with *ADLs. Once you make your choice, you cannot change how you split your money.
- Regardless of whether or not you need help with *ADLs, your hospital, doctor bills, and medications are completely paid by insurance.
- Other than Plan C, you have no other resources available to help with your long-term care. **You** have to pay for any long-term care you may need from Plan C.

- There is**no public-care option or Medicaid** if you do not have enough money to pay for a nursing home or other long-term care.
- An impartial third party that you trust will verify whether or not you need help with *ADLs immediately, impartially, and with complete accuracy.

The respondents are then asked a series of test questions. We present two here:

Again, for research purposes, it is important to verify your understanding. We will now ask you a few questions (each question no more than 2 times). After these questions, we will give you the correct information for any questions which you haven't answered correctly, just to make sure that everything is clear.

1. In the hypothetical scenario money in Plan D is available
   - Only if you do not need help with ADL
   - Only if you do need help with ADLs
   - Whether or not you need help with ADLs
   - Neither if you need help with ADLs or do not
2. If you cannot take care of yourself next year, can anyone take care of you for free?
   - Yes
   - No

We then presented again a shortened version of the scenario

Again, suppose you are 80 years old, live alone, rent your home, and pay all your own bills.

- There is a **25%** chance that you **will** need help with ADLs for all of next year.
- There is a **75%** chance that you **will not** need any help at all with ADLs for all of next year.

You have **$100,000** to divide between two plans for the next year.

- Plan C is hypothetical *ADL insurance that gives you money if you **do** need help with *ADLs. For every $1 you put in Plan C, you will get **$4** to spend if you need help with *ADLs.
- Plan D gives you money only if you **do not** need help with ADLs. For every $1 you put in Plan D, you will get **$1** to spend if you**do not** need help with *ADLs.

The next page will ask about your choices.

They are then given the following screen where they can record their optimal portfolio allocation using the slider response technology.

Please make your decision on splitting money into Plan C and Plan D by clicking on the scale below. To put more money in Plan C, move the slider to the right. To put more money in Plan D, move the slider to the left. The numbers in the box will change as you move the slider to let you know how much you will receive if you need long term care and if you do not.

Please move the slider to see how it works. When you are ready, place the slider at the split you want and click NEXT to enter your choice.

This question is then repeated with wealth of $50,000 and probability .25 (multiplier 4) of needing help with ADLs, and with $100,000 and probability .5 (multiplier 2) of needing help with ADLs

Mathematical Derivation and FOC's

$$\max \pi_1 \frac{(x_{i,1})^{1-\nu}}{1-\nu} + (1-\pi_1)\frac{\theta_{LTC}(x_{i,2}+k_{LTC})^{1-\nu}}{1-\nu}$$

$$st. p_1 x_{i,1} + p_2 x_{i,2} \leq W$$

$$x_{i,2} \geq 0$$

We can write out the Lagrangian as:

$$L = \pi_1 \frac{(\frac{W-p_2 x_{i,2}}{p_1})^{1-\nu}}{1-\nu} + (1-\pi_1)\frac{\theta_{LTC}(x_{i,2}+k_{LTC})^{1-\nu}}{1-\nu} + \lambda(x_{i,2})$$

Taking FOC's yields:

$$\pi_1 \left(\frac{W - p_2 x_{i,2}}{p_1}\right)^{-\nu} \left(\frac{p_2}{p_1}\right) = (1-\pi_1)\theta_{LTC}(x_{i,2} + k_{LTC})^{-\nu} + \lambda$$
$$0 = \lambda x_{i,2}$$

Solving for the allocation yields the following system if $x_{i,2}>0$. Then $\lambda = 0$:

$$(W - p_2 x_{i,2}) \left(\frac{\pi_1 p_2}{p_1(1-\pi_1)\theta_{LTC}}\right)^{\frac{-1}{\nu}} = p_1(x_{i,2} + k_{LTC})$$
$$W \left(\frac{\pi_1 p_2}{p_1(1-\pi_1)\theta_{LTC}}\right)^{\frac{-1}{\nu}} - k_{LTC} p_1 = p_1 x_{i,2} + p_2 x_{i,2} \left(\frac{\pi_1 p_2}{p_1(1-\pi_1)\theta_{LTC}}\right)^{\frac{-1}{\nu}}$$
$$x_{i,2} = \frac{W \left(\frac{\pi_1 p_2}{p_1(1-\pi_1)\theta_{LTC}}\right)^{\frac{-1}{\nu}} - k_{LTC} p_1}{p_1 + p_2 \left(\frac{\pi_1 p_2}{p_1(1-\pi_1)\theta_{LTC}}\right)^{\frac{-1}{\nu}}}$$

Finally, if $x_{i,2} = 0$ then we find that

$$\pi_1 \left(\frac{W}{p_1}\right)^{-\nu} \left(\frac{p_2}{p_1}\right) = (1-\pi_1)\theta_{LTC}(k_{LTC})^{-\nu} + \lambda$$
$$\lambda = \pi_1 \left(\frac{W}{p_1}\right)^{-\nu} \left(\frac{p_2}{p_1}\right) - (1-\pi_1)\theta_{LTC}(k_{LTC})^{-\nu} > 0$$

Thus, the optimal policy rule dictates that

$$x_{i,2} = \begin{cases} 0 & if\ \pi_1 \left(\frac{W}{p_1}\right)^{-\nu} \left(\frac{p_2}{p_1}\right) - (1-\pi_1)\theta_{LTC}(k_{LTC})^{-\nu} > 0 \\ \frac{W\left(\frac{\pi_1 p_2}{p_1(1-\pi_1)\theta_{LTC}}\right)^{\frac{-1}{\nu}} - k_{LTC} p_1}{p_1 + p_2\left(\frac{\pi_1 p_2}{p_1(1-\pi_1)\theta_{LTC}}\right)^{\frac{-1}{\nu}}} & otherwise \end{cases}$$

Verification In figure 7 we present the distribution of responses to this SSQ.

Next we regress the response to SSQ 4 on the respondents ownership of LTC insurance. We observe in table 14 some evidence respondents assign more wealth to plan C in SSQ 2, indicating a greater preference for wealth when in need of help with ADLs.

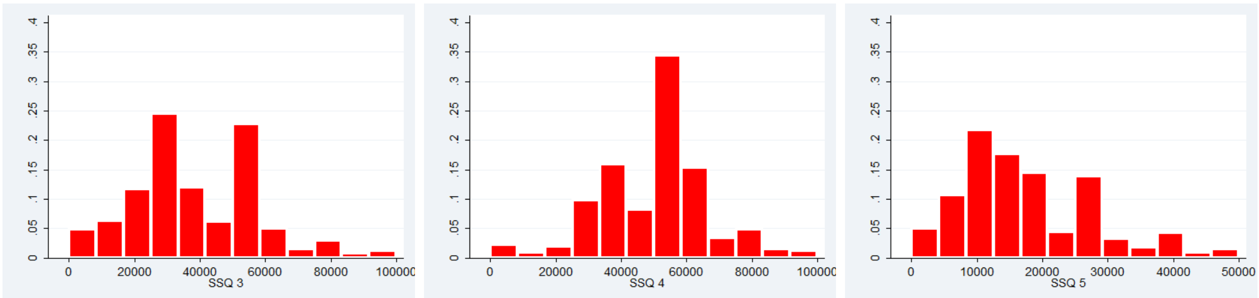


Figure 7: **SSQ 2 distribution:** The above figures present the response distributions to SSQ2. Responses indicate the allocation to the ADL state, with wealth \$100,000 and $\pi = .25$,\$100,000 and $\pi = .5$, and \$50,000 and $\pi = .25$ respectively.

	SSQ1	SSQ2	SSQ3
Age	323.0747 ***	164.6257***	188.5319***
	(.000)	(.010)	(.000)
Gender	640.3033	2276.085	2281.926
	(.762)	(.218)	(.052)
$\mathbb{I}_{sick}$	3037.052	-579.1218	-3016.98*
	(.285)	(.815	(.055)
Total Wealth	-.0012401	-.0004135	-.0003979
	(.180)	(.607)	(.438)
Income Group	-1127.711	-206.842	-142.0448
	(.061	(.693)	(.670)
Income Group × Gender	-400.8133	-1385.507	-462.4333
	(.628	(.055)	(.313)
Prior LTCI Ownership	1877.882	1784.253	1684.273 *
	(.198)	(.160)	(.037)

Table 14: **SSQ 2:** The above table presents a tobit estimation of SSQ 2 on the listed covariates.

B.3 SSQ 4

Presentation

Suppose you are 85 years old, live alone, rent your home, and pay all your own bills. You know with certainty that you will live only 12 more months, and that you will need help with *ADLs for the entire 12 months.

The final scenario is identical to the previous scenario **except you are entitled to an option of a publicly-funded nursing home**. You can now legally leave **all** your assets as bequests and live in a publicly-funded nursing home for a year.

In this scenario, you have **$100,000** and must decide between either Plan G or Plan H.

- Plan G puts **all** of your $100,000 in an irrevocable bequest, and you will live in a publicly-funded nursing home.
- Plan H allows you to split your $100,000 between spending and bequests, and you are not eligible to live in a publicly funded nursing home.
  - From Plan H, you must designate whether to leave an irrevocable bequest, and if so, how much.
  - From Plan H funds you do not designate as a bequest, you will need to pay all your expenses, including long-term care and any other wants, needs, and discretionary purchases.

Here are the rules for this scenario.

- You have no money other than the $100,000.
- Once you make your choice, you cannot change it.
- You have full insurance that covers all of your hospital, doctor, and medication costs, but you have no private long-term care insurance.
  - If you choose Plan G, you are entitled to care in a publicly-funded nursing home.
  - If you choose Plan H, you will need to pay for all long-term care expenses.

- If you choose Plan H, you must choose the size of your bequest from the $100,000. The size of the bequest will be determined at the start of the year, but not available to recipients until the end of the year.
- The publicly-funded nursing home has similar range of quality and choice as nursing homes provided by the current Medicaid program.
- No one—including friends or family—can take care of you for free. Long-term care must be purchased at market rates.
- If you choose Plan G, you can legally leave all your $100,000 as a bequest.
- Your bequest is not subject to any taxation under both Plan G and Plan H.

The respondents are then asked a series of test questions. We present two here:

Again, for research purposes, it is important to verify your understanding. We will now ask you a few questions (each question no more than 2 times). After these questions, we will give you the correct information for any questions which you haven't answered correctly, just to make sure that everything is clear.

1. Will public care be available to you for even part of the year if you put any money in Plan G?
    - Yes
    - No
2. If you put no money in Plan H, hence choosing to use public care, will all the money you place in Plan G still be left as a bequest?
    - Yes
    - No

We then presented again a shortened version of the scenario and asked for their decision

Again, suppose you are 85 years old, live alone, rent your home, and pay all your own bills. You know with certainty that you will live only 12 more months, and that you will need help with *ADLs for the entire 12 months. In this scenario, you have **$100,000**and must decide between either Plan G or Plan H.

- Plan G puts **all** of your $100,000 in an irrevocable bequest, and you will live in a publicly-funded nursing home.
- Plan H allows you to split your $100,000 between spending and bequests, and you are not eligible to live in a publicly funded nursing home.
  - From Plan H, you must designate whether to leave an irrevocable bequest, and if so, how much.
  - From Plan H funds you do not designate as a bequest, you will need to pay all your expenses, including long-term care and any other wants, needs, and discretionary purchases.

Given the $100,000 available to you, would you put money in Plan G and live in a publicly-funded nursing home, or would you instead put all $100,000 in Plan H and fund your own care?

- Use Plan G that uses public care and leaves all money as a bequest.
- Use Plan H that divides my money between paying for my own care and a bequest.

Respondents were then asked the same question, exactly as presented in the above frame, at either the $20,000 or $1,000,000 level. Depending upon their response, they were then asked to provide an indifference point using the slider technology.

You have indicated that you would use Plan G (thus using public care and leaving all of your money as a bequest) if you had $20,000, but would use Plan H (thus funding both your own private LTC and bequest) if you had $100,000. What is the maximum amount of wealth for which you would still use Plan G (thus using public care and leaving all of your money as a bequest)?

Mathematical Derivation and FOC's In this question we are asking for the indifference point between paying for private LTC and utilizing Medicaid provided government aid. An agent is given an option of paying for private LTC or utilizing public care and leaving his entire wealth as a bequest. We then elicit the wealth level at which a person is indifferent between utilizing publicly funded long term care and consuming the allocations derived in the previous SSQ.

$$u_{LTC}(PC_{LTC}) + \beta v(W) \leq u_{LTC}(x_{i,1}) + \beta v(x_{i,2})$$
$$u_{LTC}(PC_{LTC}) + \beta v(W) = u_{LTC}(x_{i,1}) + \beta v(W - x_{i,1})$$

Note that the agent will never choose to consume $x_{i,1} < PC_{LTC}$ since in this case the LHS is unambiguously less than the right. Thus, the optimal decision $x_{i,1}$ follows

$$x_{i,1} = \begin{cases} W & if\ \theta_{LTC}\left(\alpha W + k_{LTC}\right)^{-\nu}\alpha - \beta\theta_{bequest}(k_{bequest})^{-\nu} > 0 \\ \frac{\left(\frac{\beta\theta_{bequest}}{\alpha\theta_{LTC}}\right)^{-1/\nu}(W + k_{bequest}) - k_{LTC}}{\left(\alpha + \left(\frac{\beta\theta_{bequest}}{\alpha\theta_{LTC}}\right)^{-1/\nu}\right)} & otherwise \end{cases}$$

We argue that the indifference condition is satisfied uniquely. Take W=0. Clearly the LHS is bigger. Now, take W>0. Note that for sufficiently large W, $x_{i,1} < W$ since since for $W \to \infty$ the condition can't hold (it must be less than 0).

Now, take the limit as $W \to \infty$. Then if the LHS were to remain bigger, we would see

$$u_{LTC}(PC_{LTC}) - \beta v(W) > u_{LTC}(x_{i,1}) + \beta v(x_{i,2})$$
$$u_{LTC}(PC_{LTC}) - u_{LTC}(x_{i,1}) > \beta v(x_{i,2}) - \beta v(W)$$

However, since the RHS converges to 0 ($W \to \infty$ implies $x_{i,2} \to \infty$),and $x_{i,1} > PC_{LTC}$ for sufficiently large W, we find that

$$0 > \lim_{W\to\infty} u_{LTC}(PC_{LTC}) - u_{LTC}(x_{i,1}) > \lim_{W\to\infty} \beta v(x_{i,2}) - \beta v(W) = 0$$

which is a contradiction.

Now, writing out the indifference point (assuming interior)

$$\begin{aligned} u_{LTC}(PC_{LTC}) + \beta v(W) &= u_{LTC}(x_{i,1}) + \beta v(W - x_{i,1}) \\ u_{LTC}(PC_{LTC}) + \beta v(W) &= u_{LTC}\left(\frac{\left(\frac{\beta\theta_{bequest}}{\alpha\theta_{LTC}}\right)^{-1/\nu}(W + k_{bequest}) - k_{LTC}}{\left(\alpha + \left(\frac{\beta\theta_{bequest}}{\alpha\theta_{LTC}}\right)^{-1/\nu}\right)}\right) + v\left(W - \frac{\left(\frac{\beta\theta_{bequest}}{\alpha\theta_{LTC}}\right)^{-1/\nu}(W + k_{bequest}) - k_{LTC}}{\left(\alpha + \left(\frac{\beta\theta_{bequest}}{\alpha\theta_{LTC}}\right)^{-1/\nu}\right)}\right) \end{aligned}$$

There does not exist an analytical expression for the $W^\star$ which solves this expression, but we can solve this numerically.

Now, writing out the indifference point if $x_{i,1} = W$ we obtain

$$u_{LTC}(PC_{LTC}) + \beta v(W) \quad = \quad u_{LTC}(W) + \beta v(0)$$

which again must be solved numerically. Thus, we can express the solution to this problem as

$$W^\star \ solves \begin{cases} u_{LTC}(PC_{LTC}) + \beta v(W) = u_{LTC}(W) + \beta v(0) & if \ \theta_{LTC}\left(\alpha W + k_{LTC}\right)^{-\nu}\alpha - \beta\theta_{bequest}(k_{bequest})^{-\nu} > 0 \\ u_{LTC}(PC_{LTC}) + \beta v(W) = u_{LTC}\left(\frac{\left(\frac{\beta\theta_{bequest}}{\alpha\theta_{LTC}}\right)^{-1/\nu}(W + k_{bequest}) - k_{LTC}}{\left(\alpha + \left(\frac{\beta\theta_{bequest}}{\alpha\theta_{LTC}}\right)^{-1/\nu}\right)}\right) & \\ +\beta v\left(W - \frac{\left(\frac{\beta\theta_{bequest}}{\alpha\theta_{LTC}}\right)^{-1/\nu}(W + k_{bequest}) - k_{LTC}}{\left(\alpha + \left(\frac{\beta\theta_{bequest}}{\alpha\theta_{LTC}}\right)^{-1/\nu}\right)}\right) & otherwise \end{cases}$$

Verification In figure 8 we present the distribution of responses to this SSQ.

Next we regress the response to SSQ 4 on the respondents opinion of government care. Specifically, the variable is an indicator of whether the respondent indicates a more favorable view of publicly provided LTC than the median respondent. We observe in table 15 that such respondents assign a

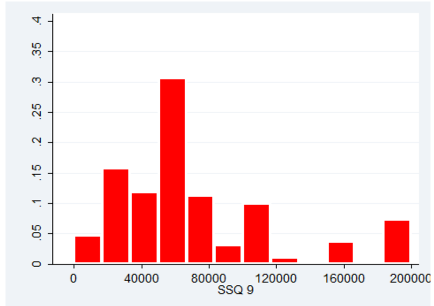


Figure 8: **SSQ 4 response distribution:** The above presents the distribution of responses to SSQ4. Here a response indicates the indifference point between self funding ADL expense and utilizing government care.

higher indifference point to SSQ 4, signifying that they are more willing to take public care at lower wealth levels.

C Estimation Appendix

C.1 Estimation of Preference Parameters

As detailed in the text, we estimate preference parameters using MLE under the assumption of additively separable errors on optimal responses. Each of the optimal responses, denoted $z_k(\theta)$, for each FOC are presented above or int he text.

As noted in the text, we assume that the observed responses can be expressed as,

$$\hat{z}(\theta_i) = z_k(\theta_i) + \hat{\epsilon}_{k,i},$$

where $\epsilon_{k,i} \sim \mathbb{N}(0, \sigma^2_{k,i})$. and $\hat{\epsilon}_{k,i}$ denotes the realization of individual i's response error to SSQ k. To ensure identification of the six preference parameters at an individual level from 9 questions, we must restrict the error variances to be a parametric function of no more than three free parameters. This is achieved by specifying $\sigma^2_{k,i}$ to be a function of a question specific and an individual specific component. Specifically, we assume that the standard deviation of the response error to question k is linear in the maximum feasible response W_k and individual scaling factor $\bar{\sigma}_i$, so that $\sigma_{k,i} = \bar{\sigma}_i \times W_k$. The idiosyncratic component accounts for differences in the precision of which individuals report answers. The question specific component takes into account the different scales of the nine SSQs and thus normalizes the error standard deviation according to the feasible response size. Note that W_k is

	SSQ 9
age	-194.463
	(0.70)
Gender	19992.003
	(0.17)
$\mathbb{I}_{sick}$	-8312.349
	(0.68)
Total Wealth	0.004
	(0.53)
Income Group	-3384.263
	(0.41)
Income Group × Gender	-2373.870
	(0.68)
Positive opinion of Public LTC	11605.485*
	(0.03)

Table 15: **SSQ 4:** The above table presents a tobit estimation of SSQ 4 on the listed covariates.

naturally defined in each question by the budget constraint, except in SSQ 9. In this question, we windsorize the raw survey responses at the 95^{th} percentile and assign $W_9 = 500000$ as the maximum response in the cleaned data.

Our specification permits us to express the likelihood of observing a response to each question as a function of $[\theta_i, \bar{\sigma}_i]$ as,

$$\mathcal{L}_k(\theta_i, \bar{\sigma}_i | \hat{z}_{k,i}) = \begin{cases} F_{\sigma^2_{k,i}}(-z_k(\theta_i)) & if \ \ \hat{z}_{k,i} = 0; \\ f_{\sigma^2_{k,i}}(\hat{z}_{k,i} - z_k(\theta_i)) & if \ \ 0 < \hat{z}_{k,i} < W_k; \\ 1 - F_{\sigma^2_{k,i}}(W_k - z_k(\theta_i)) & if \ \ \hat{z}_{k,i} = W_k; \end{cases}$$

where the boundary cases take into account error truncation due to the budget constraint, and $F_{\sigma^2_{k,i}}$ and $f_{\sigma^2_{k,i}}$ denote the normal CDF and PDF with variance $\sigma^2_{k,i}$ respectively. We further assume independence of survey response errors to obtain a multiplicatively separable likelihood function for the full response set $\hat{Z}_i$ as,

$$\mathcal{L}(\theta, \bar{\sigma} | \hat{Z}_i) = \prod_{k=1}^{9} \mathcal{L}_k(\theta, \bar{\sigma} | \hat{z}_{k,i}).$$

We use MLE to estimate individual parameter sets as,

$$[\hat{\theta}_i, \hat{\bar{\sigma}}_i] = \arg\max \mathcal{L}(\theta, \bar{\sigma}|\hat{Z}_i).$$

Under the above specification, standard asymptotics follow. Specifically, we obtain that for each individual if we denote $\Theta_i = (\theta_i, \bar{\sigma}_i)$ then

$$\sqrt{n}\left(\hat{\Theta}_i - \Theta_{0,i}\right) \to \mathcal{N}(0, I_i^{-1})$$

where $n = 9$ denotes the 9 questions for each respondent, and I is the Fisher information matrix. In practice, we calculate the Hessian of our objective function numerically as $\hat{H}_i$ and set $\hat{I}_i = \hat{H}_i$ when calculating the standard errors presented in table 7

C.2 Estimation of Model Misspecification

As stated in section 4, ADL insurance demand as predicted by the model can be expressed as $D(\theta, x)$. Suppose in addition that the demand function of the measured by our stated preference survey instrument can be expressed as a function of the same state variables, denoted $S(\theta, x)$. Defining a function $H(\theta_i, x_i)$ and its corresponding observation

$$H(\theta_i, x_i) = D(\theta_i, x_i) - S(\theta_i, x_i)$$
$$\hat{H}(\theta_i, x_i) = D(\theta_i, x_i) - S(\theta_i, x_i) + \hat{\epsilon}_i$$

We propose that this difference can be expressed as a function G of state variables x, preference parameters θ, and other, undetermined state variables z. Finally, we suppose that the function $G(x, \theta, z)$ is additively separable in (x, θ) and z. Therefore, we can express H and its observational equivalent (with added mean zero term) as

$$\begin{aligned} H(\theta, x) &= G(x, \theta, z) \\ H(\theta, x) &= f(x, \theta) + g(z) \qquad (3) \\ \hat{H}(\theta, x) &= f(x, \theta) + g(z) + \hat{\epsilon}_i \end{aligned}$$

This expression of $\hat{H}$ will serve as the key representation for the remainder of our analysis, with our goal being to identify $f(x, \theta)$ and $g(z)$. Suppose that our modeled demand function $D(\theta, x)$ was a true representation of the real world data generating process $S(\theta, x)$. In this case our modeled and directly measured demand would coincide exactly, and we would find $H(\theta, x) = 0$. Of course, in practice it is not practical that our model exactly replicates the DGP, even if all relevant variables are included. Suppose that all relevant variables for determining demand are included, but the model is mis-specified in some way. In this case, $g(z) = 0$ and

$$\begin{aligned} H(\theta, x) &= f(x, \theta) \neq 0 \\ \mathbb{E}[\hat{H}(\theta, x)] &= f(x, \theta) + \mathbb{E}[\hat{\epsilon}_i] \\ &= f(x, \theta) \neq 0 \end{aligned}$$

As a separate exercise, suppose that our model correctly accounts for all modeled variables, but we omit state variables that affect demand measures. In this case, $f(x, \theta) = 0$, but $g(z) \neq 0$. Thus,

$$\begin{aligned} H(\theta, x) &= g(z)) \neq 0 \\ \mathbb{E}[\hat{H}(\theta, x)] &= g(z) + \mathbb{E}[\hat{\epsilon}_i] \\ &= g(z) \neq 0. \end{aligned}$$

Finally, note that our assumption that $H(\theta, x)$ is additively separable in $f(x, \theta)$ and $g(z)$ excludes any interaction between included state variables and omitted state variables in modeling the demand difference. This assumption is made primarily for tractability, as will be demonstrated when we implement our estimation strategy below. However, we view these interactions as secondary effects in most reasonable cases. Given our primary objective of identifying the presence of omitted state variables $g(z)$, we view this omission as a reasonable identifying assumption. There are very few cases we can imagine where an omitted state variable only affects demand measurements through its interaction with other state variables.

As stated above, we are interested in estimating

$$\hat{H}(\theta, x) = f(x, \theta) + g(z) + \hat{\epsilon}_i. \tag{4}$$

This is complicated due to our inability to specify a parametric form for $f(x,\theta)$ and $g(z)$. Given that our model (and likely, the underling DGP) is non-linear and non-monotonic in state variables, it is unlikely that $f(x,\theta)$ can be captured through a linear specification, even when including interactions between variables. To prevent making a restrictive parametric assumption regarding these interactions, we choose to model $f(x,\theta)$ through a set of indicator variables. Specifically, we partition the space (Θ, X) space by $P = \{P_k\}_{k=1}^K$ and define a vector $C_i \ni \{C_{i,k} = 1 \iff (x_i, \theta_i) \in P_k\}$. Note that some elements (Θ, X) are continuous, which requires us to discretize these continuous states into reasonable size bins. We thus omit any interaction between θ and x, to prevent the size of our partition from growing prohibitively large. We thus partition Θ into $P^\theta = \{P_k^\theta\}_{k=1}^K$ and define a vector $C_i^\theta \ni \{C_{i,k}^\theta = 1 \iff \theta_i \in P_k^\theta\}$, while conducting a similar partition for X. We then approximate

$$f(x,\theta) = \beta^\theta C^\theta + \beta^x C^x.$$

Substituting this into equation 4 we obtain

$$\hat{H}(\theta_i, x_i) = \beta^\theta C_i^\theta + \beta^x C_i^x + g(z_i) + \hat{\epsilon}_i.$$

and assuming a linear specification of $g(z_i)$ yields

$$\hat{H}(\theta_i, x_i) = \beta^\theta C_i^\theta + \beta^x C_i^x + \Gamma z_i + \hat{\epsilon}_i. \tag{5}$$

This will be the equation we estimate.

Equation 5 yields a simple interpretation. If the model is properly specified relative to the DGP, then we should obtain that $\beta^\theta = \beta^x = \Gamma = 0$. Thus, we are able to test for proper specification by examining the estimated coefficients, under the null hypothesis

$$H_0: \qquad \beta^\theta = 0; \beta^x = 0; \Gamma = 0 \tag{6}$$

Rejection of the null hypothesis for β^θ or β^x suggests that the existing state variables included in our structural model are not incorporated in a way that full reflects their impact on demand. Of primary interest to us is Γ however. A positive (negative) coefficient on Γ indicates that the variables in z cause the model to overpredict (underpredict) demand. It is thus reasonable to expect any variables that

	σ	θ_{LTC}	k_{LTC}	θ_{beq}	k_{beq}	PC_{LTC}
10%	1.95	.00	-95.15	.00	-57.21	1.11
25%	2.76	.01	-62.16	.00	-8.60	6.98
50%	3.89	1.03	-11.65	2.78	87.74	26.76
75%	6.16	26.16	32.24	999.53	336.78	56.59
90%	9.27	1000	123.58	1000	733.49	166.97
Ameriks, et.al 2014	5.85	1.57	-45.65	0.59	7.88	39.46
Median Standard Errors						

Table 16: **Parameter distribution, Employer Sample:** This table presents the marginal distribution of parameter estimates for our employer sample.

reflect missing risks or savings motives that are not included in our model to be estimated to have a significant positive coefficient.

To implement this estimation, we must first construct our partitions P^{θ} and P^{x}. P^{x} is constructed according to the discrete value of all state variables except wealth. Because wealth is continuous, we discretize it according to \$50,000 bins up to \$1,000,000, and \$200,000 bins thereafter. P^{θ} is a partition of continuous state variables. We discretize this by sorting individuals into partitions according to whether each parameter is above or below the population median.

D Robustness

In this section, we present evidence regarding SSQs, estimated preference parameters, modeled insurance product demands, and stated insurance products demands for our employer sub-sample. This sumbsample is drawn from individuals that are Vanguard clients through participation in an employer sponsored retirement plan. As such, these individuals did not self-select into the Vanguard client base. In addition, these individuals are not as wealthy as our larger sample, and thus are likely more representative of the broader population. Although we observe clear differences in our results when restricted to this sample, all results presented in the body of the paper remain unchanged qualitatively.

First, in figure 9 we present all SSQ response distributions. Here we see that the responses generally mirror those of the larger sample.

In table 16 we present the parameter estimates for this sample. The parameter distributions are remarkably similar to the larger sample, and give no reason to question our baseline results.

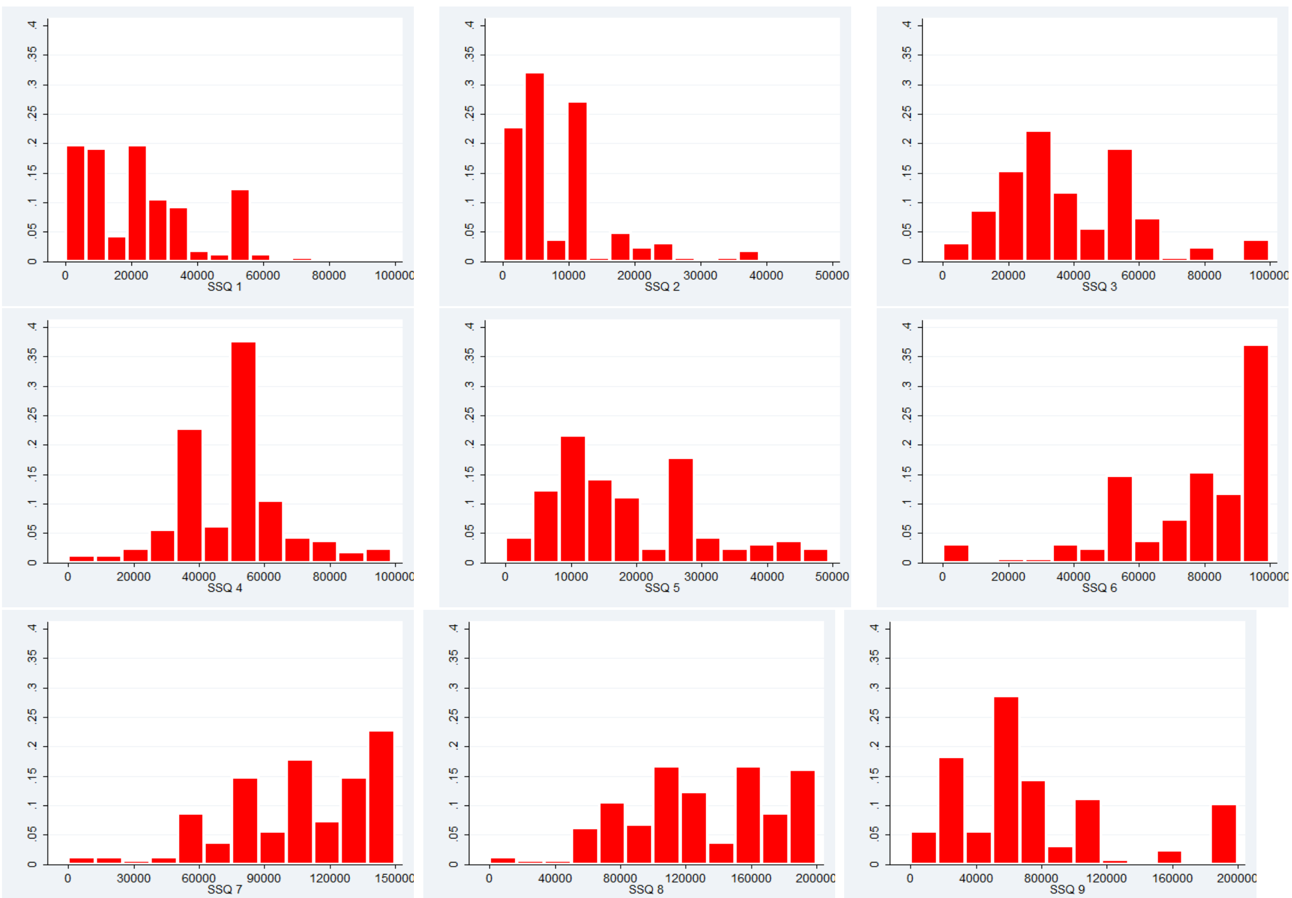


Figure 9: **SSQ distributions, Employer Sample:** This figure presents the SSQ distribution for respondents that are members of our employer sample.

	ADLI							
	mean	p5	p10	p25	p50	p75	p90	p95
Simulated Demand	31581	0	0	0	12,076	54,370	90,184	103,212
Surveyed Demand	7179	0	0	0	0	7,200	30,000	48,000
Simulated-Ideal	21,660	-35,000	-13,400	0	8,015	44,871	79,170	92,332
	Annuity							
	mean	p5	p10	p25	p50	p75	p90	p95
Simulated Demand	28,996	0	1310	7130	20,408	41,586	64,989	83,368
Surveyed Demand	7,179	0	0	0	0	220	12,800	25,000
Simulated-Ideal	24,135	-8,771	0	2,546	16019	39,017	62,669	83,368

Table 17: **Insurance Product Demands:** Above we present the insurance product demand estimate distributions and the distribution of differences for both annuities and ADLI, restricted to our employer sample.

Finally in table 17 we present product demands for all insurance products for our sample. We observe again that the model significantly overpredicts demand for both products. We do observe slightly lower simulated product demands, reflecting the lower wealth holdings of the employer sample. However, we observe that for both products the stated demand is far lower than model implied demand, with a more greatly right skewed distribution for annuities.

E Other Empirical Results

In table 18 we present our demand validation exercise for annuities and find that higher than expected longevity significantly predicts stated purchase of the ideal innuiy products.

	IA_buy	Annual_Annuity_inc
Age	-0.010	-63.346
	(0.07)	(0.08)
Gender	0.236	538.035
	(0.14)	(0.60)
$\mathbb{I}_{sick}$	0.284	440.971
	(0.16)	(0.76)
Total Wealth	0.000	0.001**
	(0.97)	(0.32)
Income Group	0.035	162.262
	(0.51)	(0.90)
Income Group × Gender	-0.024	326.014
	(0.69)	(0.42)
$\mathbb{I}_{Longevity}$	0.257**	563.286
	(0.00)	(0.34)

Table 18: **Surveyed ADL Demand:** This able shows how ADLI demand is predicted by various co-variates. Our measure of longevity is whether an individual expects above or below median probability of living for 10-20 years, conditional on current age.