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Income-indemnity long-term care insurance: Selection, informal care, and precautionary savings

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ABSTRACT

We study the demand for income-indemnity long term care (LTC) insurance, a product that pays income in LTC states whether care services are used or not. We conduct an experimental survey where participants divide their (hypothetical) retirement savings between three products: a LTC income product, a life annuity and a liquid investment account. Objective measures of exposure to LTC risk indicate little to no selection effects for the LTC income product. However subjective measures of exposure to LTC risk show that the LTC income product is more attractive to participants who perceive a higher risk that they will need LTC. This could either indicate adverse selection due to private information or subjective mis-measurement by participants of their future LTC costs. We find stronger demand for the product among participants who plan to rely on family members for high-level care, evidence that the LTC income product complements high-level informal care. Access to the LTC income product materially affects annuitization choices for around half of participants. The LTC income product allows many people to reduce savings held to self-insure LTC risk and to purchase additional longevity insurance. Participants with lower LTC risk are more likely to do so.

Keywords: Long-term care insurance; aged care; informal care; retirement incomes; annuity experiment.

JEL Classifications: G22, I13, D14, J32

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1 Introduction

Retirees in many countries retain a large amount of savings until late in life (Ooijen et al., 2015; Poterba et al., 2017; Wu et al., 2015a). One important reason that people do not deplete their savings at older ages is that they anticipate the high private costs of long term care (LTC) (Ameriks et al., 2015b). Standard economic models propose long-term care insurance (LTCI) as a remedy that can free retirees to spend more of their precautionary savings (Ameriks et al., 2011). However, LTCI is not sold at all in many countries and even where it is available, few people buy it.[1]

Explanations for the low demand for LTCI include adverse selection (Sloan and Norton, 1997; Finkelstein and McGarry, 2006; Brown and Finkelstein, 2007; Webb, 2009), poor product design (Brown and Finkelstein, 2007), reliance on publicly provided care (Sloan and Norton, 1997; Brown and Finkelstein, 2008), reliance on unpaid carers (Pauly, 1990; Zweifel and Strüwe, 1998), self-insurance using home equity (Davidoff, 2010), (non-strategic) bequest motives (Pauly, 1990; Lockwood, 2014), limited awareness of LTC risk (Zhou-Richter et al., 2010), and state-dependent utility (Brown and Finkelstein, 2009). However these explanations come from studies of expense-reimbursement LTCI, which covers the costs of paid LTC services and is the typical product on offer.

We study the demand for income-indemnity LTCI, a product that pays a regular income whenever the insured person needs care, regardless of the care costs they actually incur. In many countries, people in declining health receive care from close family members who are usually not paid.[2] Even in Western countries where formal care arrangements are more common, the rate at which elderly people utilize residential care has decreased: government policies in the U.S., for example (Wiener et al., 2009), favor care of people in their own homes.[3] Care and support provided by family members may be unpaid but it is not costless. Carers carry substantial costs, such as loss of earnings from paid employment (Colombo et al., 2011). Therefore, an income-indemnity LTCI policy which allows compensation for informal care could better suit the needs of elderly people and their carers (Mommaerts, 2016). However we know little about demand for income-indemnity LTCI products since most studies of LTCI have relied on revealed preferences, focused on expense-reimbursement policies and often explored only one or two influences on demand. In this study we collect stated preferences in order to better understand demand for income-

[1] See, for example, Lloyd (2011) in the U.K. and Brown and Finkelstein (2007) in the U.S.

[2] See, for example, Pickard et al., 2007 in the U.K., Kaye et al., 2010 in the U.S., and Productivity Commission, 2011 in Australia.

[3] Likewise in Australia, recent reforms of public care systems also aim to help older people remain in their own homes for as long as possible as their care needs increase (see, for example, Department of Health and Ageing, Australian Government, 2012).

indemnity LTCI. This method allows us to investigate an extensive list of possible determinants of demand because we can collect the preferences of a representative sample of purchasers in a range of scenarios, and for a product that has not yet been marketed.

To study LTCI demand, we designed and fielded a large experimental survey of over 1,000 Australians close to retirement. Australia is an ideal setting for this experiment for a number of reasons. First, the publicly financed LTC system in Australia shares many features with other developed countries, especially the U.K.,[4] including the absence of a private LTCI market,[5] so our results have general application. Second, Australians, in contrast to Americans, are very unlikely to have experience of a private LTCI market. As such, they are more likely to accept the hypothetical scenarios in the survey rather than importing their own experiences of expense-reimbursement LTCI to their deliberations. Third, Australians are more familiar with retirement savings decisions than people in many other countries because almost all adults participate in the mandatory defined contribution (DC) retirement saving system.[6] Finally, because the minimum contribution rate into retirement accounts is 9.5% of earnings, even average workers in Australia accumulate substantial account balances (Clare, 2015). As a consequence, decisions about managing retirement wealth are consequential, relevant and imminent for participants in our experiment.

In the survey, we offer participants monetary incentives to learn about three products: a LTC income product; a life annuity; and a liquid investment account. Participants then make hypothetical allocations of their retirement savings to these products. The LTC income product requires a single premium paid at purchase, in exchange for income benefits when the purchaser is functionally disabled in the activities of daily living (ADL) or is diagnosed with dementia.[7] While the product does not provide full LTC expenditure coverage, it does provide disability-contingent income whether paid LTC services are used or not. The survey also collects an array of information about each participant, including demographics, health and illnesses, subjective expectations about the need for LTC, potential sources of care, and a variety of personal characteristics. The use of stated preference data allows us to overcome difficulties in analyzing revealed preference data, such as uncontrolled and complex institutional settings and market

[4]Both countries have a means-tested publicly financed LTC system. The system provides a lifetime stop-loss scheme on the amount of care fees (which does not include the accommodation costs for residential care) paid out-of-pocket, such that no one would pay more than the capped amount for costs of care during their lifetime. This stop-loss scheme was introduced in the aged-care reforms in Australia in 2012 and in the U.K. in 2013 (Department of Health and Ageing, Australian Government, 2012; U.K. Department of Health, 2013). See Appendix A for more details on the publicly financed LTC system in Australia.

[5]There is no private LTCI market in Australia. In the U.K., the last LTCI provider exited the market in 2010, with around 36,000 policies remaining in force (Lloyd, 2011).

[6]The second pillar of the Australian retirement income system, which is called the "Superannuation Guarantee", was introduced in 1992.

[7]Earlier studies called this product disability insurance or ADL insurance (Brown and Warshawsky, 2013; Ameriks et al., 2015a).

incompleteness, while maintaining implications for decisions in real life (Louviere et al., 2000).

Using data collected from the survey, we estimate demand for the LTC income product and explore its determinants. We find that over three quarters of survey participants would purchase the LTC income product, at a median annual income of $45,000 in LTC states. This result suggests that imperfections in existing LTCI policies can partly explain low LTCI coverage.

More importantly, we find that people who expect to receive high-level care (if required) from close family members have a stronger demand for the LTC income product than those who do not. While informal care is a substitute for expense-reimbursement LTCI (Pauly, 1990; Zweifel and Strüwe, 1998), it is a complement to income-indemnity LTCI. We argue that the complementarity exists either because informal care users value insurance benefits that allow flexibility and control, or because they are willing to make *inter vivos* transfers that exceed the costs of professional care. This conjecture is verified by the fact that LTC income insurance is not a complement to *low-level* informal care but is complementary to *high-level* informal care for women, who are more likely to have to call on help from people who are not their partners while men are more likely to rely on informal care from their partner. The finding of complementarity between high-level informal care and the LTC income product shows the potential for income-indemnity LTCI to raise coverage.

Adverse selection can undermine private insurance markets, including the market for LTCI. If we use objective measures of LTC risk, we do not find adverse selection effects in stated preferences for the LTC income product. However, if we use subjective measures of LTC risk that may contain private information, such as participants' self-reported chances of needing residential care, we do find adverse selection. An alternative explanation for this result is that the subjective measures do *not* contain private information, and what we observe is stronger demand from people who perceive more LTC risk, in other words, a kind of advantageous selection.

We also examine the extent to which LTC income insurance can release precautionary savings to purchase longevity insurance. We do this by observing wealth reallocations between a life annuity product and the liquid investment account in the event that the LTC income product is no longer offered. Results show that more participants decreased their level of longevity insurance compared to those who increased it, in other words, people stated a preference for access to precautionary liquid wealth when they could not insure LTC risk. However, we also find that participants with lower LTC risk are those who are more likely to reduce annuity income in return for more liquid wealth. This implies that a "bundle" of longevity insurance and LTC income insurance might be needed to support longevity insurance purchases

by unhealthy individuals.

The remainder of the paper is structured as follows. In the next section, we describe the hypotheses tested in this paper. Section 3 describes the experimental survey. Section 4 presents econometric results focusing on selection effects and the effect of informal care on income-indemnity LTCI demand. Section 5 investigates the relationship between longevity insurance and LTC income insurance and the impact on precautionary savings. Section 6 concludes.

2 Hypotheses

This section introduces theory and results from earlier studies which inform our hypotheses about the demand for the LTC income product. In the survey we collect covariates for objective measures of exposure to LTC risk, subjective indicators of the exposure to LTC risk, awareness of LTC risk, availability of informal care, other sources of financing for LTC costs, measures of utility parameters, individual capability and knowledge about retirement financial products, retirement planning, and demographics and other controls.

2.1 Selection: Measures of exposure to LTC risk

2.1.1 Objective measures of exposure to LTC risk

Since the product pricing model in Section 3.1 assumes that prices are gender-specific, we define a binary variable *Female* that equals 1 for females and 0 for males, to control for differences in price. Other objective measures of exposure to LTC risk can help us identify selection effects. [8] First we construct a continuous variable *Age*.[9] We also describe the health status of survey participants using four *Health states*, as defined in Table 1. Following Brown and Warshawsky (2013) and Wu et al. (2016), the classification of health states is based on information about ADL limitations, history of major illness, and self-reported health status.

[8] There is mixed empirical evidence on selection effects in the private market for LTCI. On the one hand, Sloan and Norton (1997), Browne (2006), and Brown and Finkelstein (2007) find evidence of adverse selection in the LTCI market in the U.S.; on the other hand Finkelstein and McGarry (2006) and Webb (2009) show that the information asymmetry is multidimensional.

[9] As explained in Section 3.1, the price of the LTC income product offered in the survey does not depend on age. Therefore, we need to include age to examine if there is a selection effect, since it affects the price in a general pricing model.

Table 1: Classification of health states

The table explains the classification of health states (1 - 4). Heart problems refer to heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems. Lung disease refers to chronic lung diseases like chronic bronchitis and emphysema.

Health state	History of major illness	Self-reported health	Disability status
1	None	Good to Excellent	0 ADL
2	None	Poor to Fair	0 ADL
	None	All	1 ADL
3	Heart problems or diabetes, but not both	All	0-1 ADL
4	Heart problems and diabetes, or Lung Disease, or Stroke	All	0-1 ADL

To examine whether selection occurs based on other objective LTC risk measures, we also create binary variables *Smoker* and *Received care* which equal 1 for current smokers and those who have received care in the past five years,[10] respectively. Although both of these variables are not pricing factors for the LTC income product in our survey, we include them because they could be pricing factors for a typical LTCI policy.[11]

Most of these variables could be observed by a product provider thus selection based on these variables can be addressed by underwriting, if needed.[12] Using these variables, we test the following hypothesis:

Hypothesis 1 *Objective measures of exposure to LTC risk do not affect the demand for the LTC income product.*

2.1.2 Subjective indicators of exposure to LTC risk

A person may have private information about his or her LTC risk which may not be revealed by the objective measures. Therefore, we also include three variables which are subjective indicators of exposure to LTC risk. For the first and second subjective variables, we collected participants' self-assessed chances of needing homecare and residential care, respectively. The choices were 'lower than', 'about the average', or 'higher than' other people of their gender. From their answers, we code two ordinal variables *Chance of needing homecare* and *Chance of needing residential care*. We also collected subjective life expectancy

[10] To be eligible for the experimental survey, they should not need help with two or more ADL. Thus they could be people who need help with one ADL or those who have recovered from needing help with one or more ADL.

[11] For example, smokers pay more for their LTCI premiums in the U.S.

[12] Self-reported health is an exception. However, we include self-reported health in the classification of health states so that we can compare our results with Brown and Warshawsky (2013) and Wu et al. (2016).

reported by participants after being presented their cohort life expectancies.[13] We code the deviations as *Subjective life expectancy* where positive (negative) values indicate optimistic (pessimistic) expectations of survival.

Using these variables, we are able to evaluate selection effects based on subjective risk assessment. Therefore, we test the following hypothesis:

Hypothesis 2 *Subjective indicators of exposure to LTC risk do not affect the demand for the LTC income product.*

None of these three variables is observable by a product provider and selection based on any of them cannot be addressed by underwriting. However, we do not know the extent to which an *ex ante* selection based on these variables has an impact on *ex post* benefit payments.[14]

2.1.3 Awareness of LTC risk

Subjective indicators of exposure to LTC could also capture awareness of LTC risk, so we include variables to measure awareness. We include these variables because prior research has found that people are more willing to purchase LTCI after becoming better informed about LTC risk (Zhou-Richter et al., 2010). As well as informing all participants about LTC risk in the survey itself, we construct a categorical variable *Financial planning for LTC* that indicates preparedness for financing LTC. These are '*Do not know needs and costs of LTC*', '*Have set aside money*', and '*Expect to rely on government*'. We also include a binary variable *Care provider* for participants who had themselves provided care in the past five years.

Prior studies have found advantageous selection effects in the LTC market. After controlling for priced factors, those who buy more insurance tend to be relatively good risks. de Meza and Webb (2001) postulate that advantageous selection arises when individuals have private information about both their risk type and their risk aversion, where the more risk averse buy more insurance coverage and the more risk averse are also lower risks. Moreover, Finkelstein and McGarry (2006) show that people who undertake preventive health care, such as getting a flu shot or screening test, are both more likely to own LTC insurance and less likely to enter a nursing home, consistent with advantageous selection based on risk aversion. They find that the overall correlation between LTC insurance coverage and use of long-term

[13] Differing from the current life expectancy, the cohort life expectancy incorporates future mortality improvement. We compute the cohort life expectancies from the Australian Life Tables (Australian Government Actuary, 2009) using the 25-year improvement factors.

[14] A person with a subjective indicator of high LTC risk could in fact be a high risk or he or she may have higher risk perception, which may lead to better health behaviors and thus a low risk. Therefore, this is an empirical question. To answer this question, one needs to develop a pricing model for the LTC income product which incorporates these subjective indicators as well.

care is negative but insignificant.[15] We define a variable '*Have set aside money*' to identify people who are aware of LTC risk and change their behavior accordingly. We infer advantageous selection if those who are aware of LTC risk and save money to pay for care also have a stronger demand for the LTC income product.

Using these variables collectively, we test the following hypothesis:

Hypothesis 3 *Better awareness of LTC risk is associated with stronger demand for the LTC income product.*

2.2 Substitutes: informal care and financing arrangements

2.2.1 Substitute for formal care provision: informal care

The availability of informal care is particularly important to the demand for LTCI. Empirical studies show that in many countries most people who need care rely on unpaid care from close family members (e.g., Kaye et al., 2010; Productivity Commission, 2011), and informal care substitutes paid formal care (both home care (Pezzin et al., 1996) and nursing home care (Charles and Sevak, 2005)). Pauly (1990) and Zweifel and Strüwe (1998) show theoretically that not purchasing (expense-reimbursement) LTCI may be optimal for individuals if family members can provide care.

However, this may not be the case for the demand for the LTC income product analyzed here for two reasons. First, informal care users may be more attracted by the flexibility and control offered by LTC-contingent income since the benefits can serve many purposes (e.g., for expenditures related to lower (home) productivity such as gardening or preparing meals, alterations to their houses, *inter vivos* transfers for informal care). People who have a strong preference to stay in their own home rather than move to a residential care facility may accept higher monetary costs than those who move to residential care.[16] Second and more importantly, the amount of *inter vivos* transfers that potential informal care users will pay to be cared for by their family may exceed the costs of professional care, as they might cover compensation for the emotional demands of their care as well as the time and money.[17] Expense-reimbursement LTCI that does not cover the costs of informal care is less attractive than income-indemnity

[15] Advantageous selection effects are also observed in Australian health insurance Buchmueller et al. (2008).

[16] Using data from a large survey, National Seniors Productive Ageing Centre (2013) find that two-thirds of Australian aged over 50 intend to stay in their current home as they age, compared with moving into retirement village or a residential care facility. In addition, this proportion increases with age.

[17] On the monetary side, care and support provided by family members cost money and time. Colombo et al. (2011) find that informal care giving is associated with a higher probability of both dropping out of the labor force and switching to part-time work in the U.K. and Australia. On the emotional side, providing care is emotionally demanding and people do not want to be a burden on their families (Hewitson et al., 2011).

LTCI to people who place high value on flexible in-home care or care by family members.

Furthermore, the reasons that people who value flexible care from familiar carers find income indemnity LTCI attractive are stronger for high-level care, than for low-level care. Flexibility and control are likely to be less important when the amount of LTC-contingent income required is small (i.e., in the case of low-level care) and anyway low level care is usually delivered at home and often by family members.[18]

Males and females are likely to have a different role in providing informal care and they are likely to receive care from different sources. Accordingly, we expect to see differences in the impact of availability of informal care between genders. Married males usually have a shorter remaining life expectancy than their spouse or partner, who will likely be their primary source of informal care. However, females usually have a longer remaining life expectancy than their spouse or partner and may have to rely on their children for high-level care at the end of life. Therefore, men are likely to make *intra-household*[19] transfers for high-level care to their spouses, while women are likely to make *inter vivos* transfers to their children. To the extent that the LTC income product complements the need for *inter vivos* transfers, the demand for the LTC income product is thus likely to be stronger for females than males.

On these grounds, we hypothesize that:

Hypothesis 4a *Availability of a family member providing low-level informal care is a substitute for the LTC income product, thereby reducing demand.*

Hypothesis 4b *The LTC income product complements the availability of a family member providing high-level informal care, thereby increasing demand.*

Hypothesis 4c *The complementary relationship between availability of high-level informal care and the demand for the LTC income product is stronger for females than males.*

To test these hypotheses, we asked participants to nominate potential sources of care (multiple sources allowed), if they were to need help with ADL. More importantly, to distinguish the level of informal care, we asked this question for low-level (some) and high-level (extensive) help with ADLs, respectively. Using this information, we construct two categorical variables, namely *Source of some care* and *Source of extensive care* for low-level and hight-level care, respectively. For each of these, there are three categories

[18]The preference to receive care at home is weaker due to the fact that low-level care is often required at relatively younger ages (National Seniors Productive Ageing Centre, 2013). Using the variables *Source of some care* and *Source of extensive care* constructed to measure the availability of informal care, we find only around 12% of participants reported that they would like to move into a residential facility for low-level care, with 70% nominating informal care as one of the sources of low-level care. For high-level care, these numbers are 32% and 50%.

[19]This is because many couples pool their assets, which is particular the case in Australia where the means tests of the public pension assess the pooled assets of couples.

describing the potential reliance and availability of informal care, namely *Informal care only*, *Informal care and other sources*, and *No informal care*. Informal care refers to care provided by close family members including their partner and children, while other sources of care are mainly formal care services provided by professional care givers either in the home or in a residential facility.

In addition to the self-reported potential sources of care, we include two objective measures of the potential to receive informal care. These are a binary variable *Non-partnered* coded as 1 for not living as a couple and a continuous variable *Number of children* to measure the marginal effect of having one more child.

2.2.2 Substitute for LTC costs financing arrangements

Even in the case where informal care is not available, buying LTCI is not the only way to finance the costs of LTC. Costs of LTC can also be financed using home equity (Davidoff, 2010), since the home becomes liquid wealth when moving into residential care facilities. Using data collected on home ownership, we create a binary variable *Non-homeowner* coded as 1 for non-homeowners and 0 for homeowners. Using this variable, we test the following hypothesis:

Hypothesis 5a *Home ownership provides self-insurance for LTC risk, thereby reducing the demand for the LTC income product.*

In addition, the demand for the LTC income product may be crowded out by publicly financed care (Sloan and Norton, 1997; Brown and Finkelstein, 2008). To control for the effect of publicly financed care, we asked participants whether they would '*Expect to rely on government*' for receiving care. This was coded as part of the categorical variable *Financial planning for LTC*. Using this variable, we test the following hypothesis:

Hypothesis 5b *The demand for the LTC income product is lower for those who expect to rely on the government for LTC.*

2.3 Precautionary savings

Elderly people face the risk of living long as well as the risk of needing LTC. Previous studies offer mixed evidence of the effects of LTC risk and health cost risk on the demand for longevity insurance (life annuities). We explore the relation between LTC and longevity insurance by collecting participants' stated preferences for life annuities when LTC income insurance is not available.

Participants may adjust by purchasing more life annuities to insure against LTC risk. Such a strategy can be optimal if people expect that LTC risk will be high late in retirement (Davidoff et al., 2005; Pang and Warshawsky, 2010; Peijnenburg et al., 2015). By annuitizing more, people can use the increasing-with-age mortality credits to save out of their life annuity and build a buffer against future LTC risk. For these people, LTCI is a substitute for a life annuity (Davidoff, 2009).

Participants may also decrease annuitization and instead hold more liquid wealth to self-insure against LTC risk (Turra and Mitchell, 2008; Reichling and Smetters, 2015; Wu et al., 2016). For these people, LTCI is a complement to a life annuity (Ameriks et al., 2011; Ameriks et al., 2015b).

Hypothesis 6a *A proportion of participants will use longevity insurance as a substitute for LTC income insurance in the absence of the latter. They will increase their demand for longevity insurance when the LTC income product is unavailable.*

Hypothesis 6b *A proportion of participants will use the release of precautionary savings (liquid wealth) enabled by LTC income insurance coverage to increase their longevity insurance. They will decrease their demand for longevity insurance when the LTC income product is unavailable.*

3 The experimental survey

We designed an experimental survey with three main objectives in mind. First, to assess whether the LTC income product attracts demand from high- or low-risk purchasers. Second, to explore the connection between preferences for informal care and demand for the LTC income product, and third, to better understand the connection between LTC income product, longevity risk insurance and liquid precautionary savings.

Table 2: Categorization of wealth groups

The table reports four wealth groups based on participants' self-reported net wealth, and corresponding assigned hypothetical retirement savings in the experiment. Net wealth is total assets less total liabilities, excluding the family home and its mortgage.

Net wealth	Wealth group	Hypothetical retirement savings
Less than $100,000	1	$50,000
$100,000 to less than $250,000	2	$175,000
$250,000 to less than $500,000	3	$375,000
$500,000 or higher	4	$1,000,000

We sampled 1,008 Australians aged 55-64 in October 2015 from a large panel of over 180,000 Australians maintained by the web panel Lightspeed GMI.[20] We excluded from the sample people who had dementia or needed help with two or more activities of daily living (ADL) because these conditions make them immediately eligible for LTC-contingent income, and hence disqualified from a purchase. We put eligible participants into eight (2×4) experimental groups based on gender (2 groups) and their net wealth excluding the family home (4 groups) as shown in Table 2. We maintained a roughly even distribution of participants across wealth groups.

Table 3: Demographics

The table compares demographic characteristics of survey participants with Australian Census population data. The survey samples 1,008 Australians aged 55-64, who do not have dementia or who need help with two or more activities of daily living. The population data is for ages 55-64 years and from the Australian Bureau of Statistics 2011 Census of Population and Housing.

Variable	Population %	Sample %	Variable	Population %	Sample %
Gender			High school completion		
Male	49.4	51.4	Year 12	40.5	63.2
Female	50.6	48.6	Year 11	9.8	8.6
Age			Year 10	31.1	22.8
55	10.9	9.6	Year 9	9.3	3.8
56	10.6	9.1	Year 8 or less	8.2	1.5
57	10.2	10.1	Did not go to school	1.1	0.1
58	10.2	9.8			
59	9.9	11.4	Tertiary qualification		
60	9.8	9.7	Post graduate	4.1	7.4
61	9.7	10.2	Graduate Diploma/Certificate	2.5	9.3
62	9.4	9.6	Bachelor Degree	12.5	16.0
63	9.4	10.9	Vocational Diploma	9.9	18.0
64	9.9	9.4	Vocational Certificate	20.1	23.7
Marital status			None of the above	50.9	25.6
Never married	8.1	10.9			
Widowed	4.3	3.4			
Divorced/Separated	20.7	18.4	Personal income		
Married/De facto	66.9	67.4	Negative or no income	7.6	7.6
Work status			$1 to $20,799	28.8	24.8
Employed (FT)	37.3	27.0	$20,800 to $41,599	24.3	25.2
Employed (PT)	23.1	20.6	$41,600 to $64,999	18.4	20.7
Unemployed	2.4	5.8	$65,000 to $103,999	13.4	16.0
Not in labor force	37.2	46.6	$104,000 or more	7.6	5.7

Table 3 compares the demographic characteristics of the sample with Australian Bureau of Statistics

[20]Appendix A provides a brief explanation of the publicly financed LTC system in Australia.

Census data. Overall the sample matches the Australian population aged 55-64, with the exception that the sample is better educated and have higher personal income on average, possibly because we select participants with at least a minimum net wealth and with access to the internet.

The web panel provider recruited participants by email invitation. Participants were paid $4 if they completed the survey, with a chance to earn bonus earnings of up to $3. We paid bonus earnings to encourage participants to pay attention to information that described the three products in the choice task: the bonus depended on participants' answers to a quiz that tested how much information they could recall. Ideally, we would offer an incentive payment to participants that was compatible with the hypothetical allocations of their retirement savings made in the experimental tasks. However an incentive payment that is compatible with the trade-off between LTCI coverage and liquidity is a complicated multi-period payment that continues over the whole of retirement. In addition, the stakes of the real choices the experiment mimics are extremely high, and even if we could design a risk-contingent multi-period payment stream, it would be relatively small, and unlikely to influence stated preferences significantly (Noussair et al., 2013). So as an alternative we encourage participants to learn about the products and complete the survey.

The online survey consisted of five parts and collected an array of information about each participant.[21] The median time participants took to complete the survey was 30 minutes. The first part collected demographic data (age, country of birth, years of living in Australia, marital status, health, and wealth) and screened out ineligible participants. The second part included the experimental tasks and concluded with a recall quiz on the key features of the three products offered. The third part comprised questions measuring risk attitudes (in general and in a financial context), level of patience and preferences for spending in different health conditions. The fourth part asked questions about subjective longevity, smoking, bequests, experience of providing care, purchase of private health insurance, availability of informal care and planning for financing care. The final part collected data on personal characteristics, including education, employment status, household income, financial literacy (Lusardi and Mitchell, 2009), numeracy (Lipkus et al., 2001), knowledge of and past experience with various retirement income and insurance products, and retirement planning.[22] Online Appendix B describes how we construct the covariates from these survey questions.

[21] The dynamic version of the survey is available at: `http://survey.confirmit.com/wix3/p3074038853.aspx`. A full set of screenshots from the survey including the wording of all questions and instructions is available in Online Appendix A at `http://www.cepar.edu.au/media/167402/online-appendices-for-income-indemnity-long-term-care-insurance.pdf`.

[22] Many of the questions in this part are drawn from Bateman et al. (2016).

3.1 Financial products and experimental instructions

3.1.1 Financial products and pricing

In the experiment, participants compare three financial products. The first product is an LTC income product that provides a fixed regular income for the period of time the insured needs care. The trigger for the benefit is either having dementia and/or needing help with at least two ADL from (i) eating, (ii) bathing, (iii) dressing, (iv) toileting, and (v) getting into or out of bed. Hence the product does not guarantee to cover total formal care expenditure related to LTC, as the costs of care may exceed the benefits. Benefits can be used at the receiver's discretion to pay for professional care, for care provided by family members, or for other expenses. The second product is an immediate life annuity that provides a fixed inflation-indexed lifetime income. The third product is a liquid investment account where withdrawals can be made at any time.

We anticipated that everyday people might find it hard to understand these products, so we conducted two focus groups in November 2014 and March 2015 to inform the design of the experimental tasks and the words used to describe the products. We found that Australians understood the labels 'Aged care income', 'Lifetime annual income', and 'Account-based pension' best.[23] Within the survey, we check participants' inattention and confusion: we insert Instructional Manipulation Checks[24] (IMC) (Oppenheimer et al., 2009); and we ask participants to assess the clarity of the survey over six levels, ranging from 'completely clear' to 'completely confusing'. Over half of the participants reported that the survey was 'completely clear' or 'mostly clear', while only five percent found the survey 'mostly confusing' or 'completely confusing'.

We price the life annuity and the LTC income product at actuarially fair value based on gender, using a risk-free real interest rate of 3%. Both the mortality probabilities and health transition probabilities for pricing the life annuity and the LTC income product are estimated by Brown and Warshawsky (2013). Using data from the Health and Retirement Study (HRS) 1998 (Wave 4) to 2008 (Wave 9), Brown and Warshawsky (2013) estimate the transition probabilities of a continuous-time Markov Chain of eleven health states including death.[25] We use the first four states to describe the *current* health of survey

[23]Long-term care is referred as 'aged care' in Australia. As not all annuity products provide longevity insurance in Australia (such as term annuities), the life annuity is labeled as 'Lifetime annual income'. 'Account-based pension' is the most popular decumulation product for DC pension plans (i.e., the superannuation funds) in Australia, which is a liquid investment account that allows an individual to make asset allocation decisions and withdraw a lump sum.

[24]We repeated questions about dementia and ADL limitations at two places of the survey. A participant failed an IMC if either 1) the answers provided in an IMC were not consistent with his or her previous answers or 2) the participant failed to recognize that these questions had appeared before. Under this criteria, nine percent of participants failed the IMCs.

[25]This actuarial health transition model is similar to the one developed by Robinson (1996), which is widely-used in the literature (Brown and Finkelstein, 2007, 2008) as well as by insurance companies, regulators, and government agencies.

participants (see Table 1).[26] The rest seven states (with more than one limitations in ADL or death) together with the first four describe how participants' health evolves in the future. The health transitions probabilities are (gender- and) age-dependent. We use these estimated health transition probabilities to price the life annuity and the LTC income product.[27] Because the hypothetical scenario in the experiment asks people to make the decisions as if they were aged 65, everyone of the same gender faces the same price for the LTC income product.[28]

3.1.2 Experimental instructions and policy context

The experimental task starts with introductory information about how people can meet retirement expenses, including the estimated average chance and costs of LTC in Australia (Productivity Commission, 2011).[29] We then ask participants to compare their chances of needing in-home care and residential care against an average person of their gender. After that, we describe the three products in the experiment, illustrate the prices, and explain the opportunity for bonus earnings for correct answers in a recall quiz.[30] Finally we describe the setting for their decision: a simple situation where everyone is paid a flat rate public pension, is not subject to taxation, and can be confident that the insurers will not default.[31]

3.2 Experimental tasks

The experimental task presents the hypothetical scenario to participants and then, first asks them to apportion their wealth between the products in four settings (Q1-Q4), second asks three best/worse choice questions (Q5-Q7), and third asks two additional questions to collect complementary information (Q8-Q9). The experimental task concludes with a recall quiz.

Participants read this text before answering the questions: "*We are now going to present you with*

[26] As explained above, people with two or more limitations in ADL are excluded from the survey.

[27] We are aware of that the health transitions are estimated from the U.S. data while the survey is distributed among Australians. This is because there is no available Australian data to estimate a similar multi-state health transition model in retirement. For comparison, Brown and Finkelstein (2008) estimate that the probability of ever using long-term care for an aged 65 American male (female) is 40 (54), while the probability of requiring aged care for an aged 65 Australian male (female) is 48 (68) according to Productivity Commission (2011).

[28] The LTC income product is not priced according to a purchaser's current health, because the differences in actuarially fair prices across health states are small (Brown and Warshawsky, 2013).

[29] We use the term 'aged care' in the survey rather than 'long-term care' because it is better understood by Australians. To control for the effects of public support on aged care which are subject to complex means testing rules, we also abstract from the means testing rules and only present the unsubsidized costs of care to participants.

[30] We summarize the important features of the products in a table which also pops-up during the task if participants put their cursor on the product names.

[31] The public pension in Australia is the Age Pension which is means-tested and covers around 75% of Australians over the eligibility age 65 (Harmer, 2008). We label the public pension in the experiment as 'Age Pension' but also tell participants explicitly both in the instructions and in the experiment questions that the amount of income from the public pension is constant and will not change with the choices they made.

a series of hypothetical scenarios and ask you to make decisions about the allocation of your retirement savings to the various retirement income product options we have shown you. Ignoring your own financial circumstances for the moment, we want you to imagine you are 65 years old, about to retire, and own your own home."

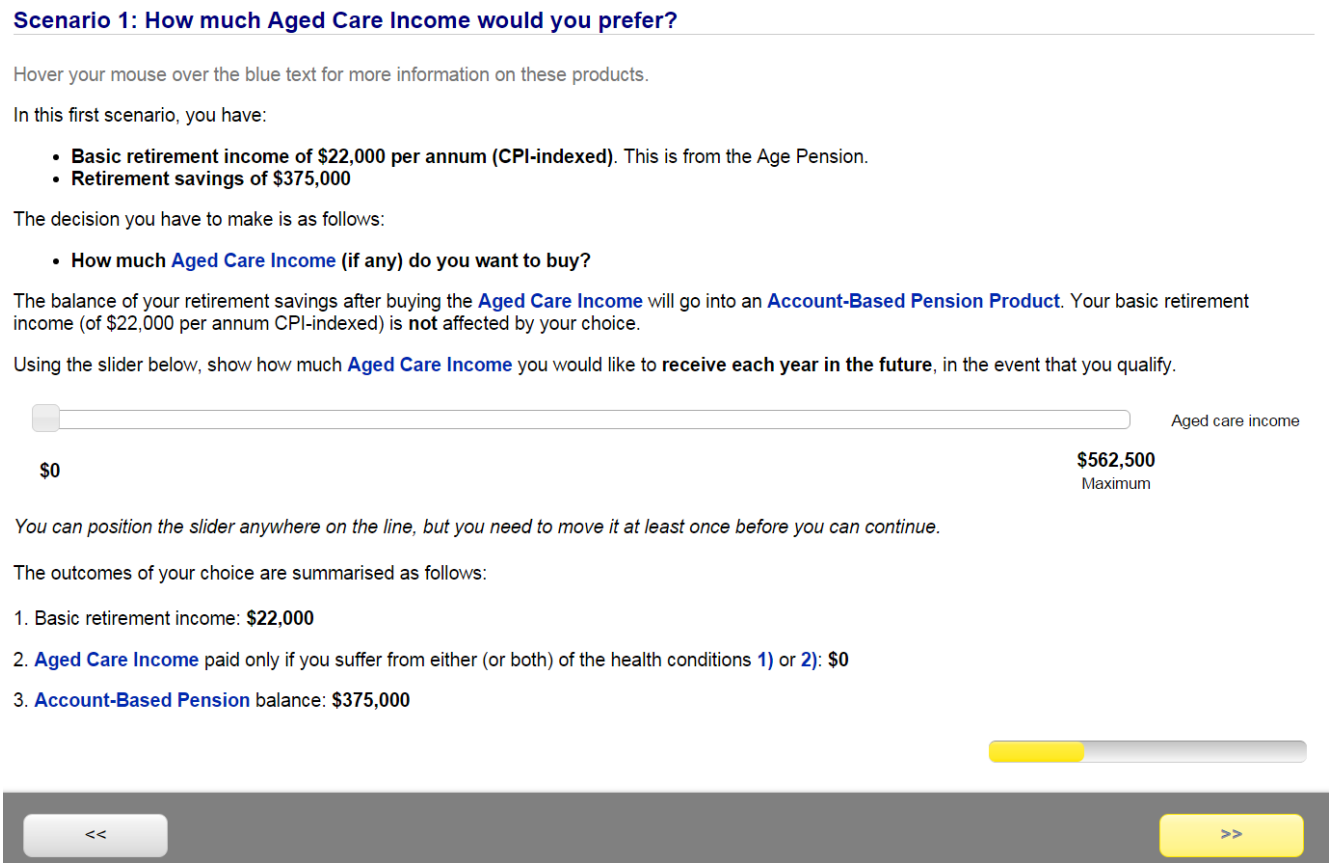

Figure 1: Allocation question for a male in wealth group 3

Q1-Q4 measure participants' demand for LTC income at fixed and increasing levels of lifetime income. Q1 asks participants how much LTC income they would like to buy with their (hypothetical) retirement savings, given that they also receive an inflation-linked lifetime income of $22,000 per annum from the public pension (Basic retirement income). What retirement savings they do not spend on LTC income remains in a liquid investment account.[32] Participants make their choices by moving a slider. As they move the slider, participants can see changes in their LTC-contingent (Aged Care) income and related changes in their liquid wealth (i.e., the Account-Based Pension balance). Figure 1 shows the first question of the experimental task with a screen shot for a male in wealth group 3. Q2-Q4 repeat this decision but at increasing levels of lifetime income. That is, we increase lifetime income by adding an immediate

[32]We endow each participants with one of four amounts of (hypothetical) retirement savings according to their wealth group as Table 2 shows.

annuity to the public pension of amounts 25%, 50%, and 75% respectively of participants' retirement savings.

In the next three choice questions (Q5-Q7), we ask participants to choose the option that they considered to be the best and the worst from three alternatives. The three alternatives in Q5 are the outcomes that the participant selected in questions Q2-Q4 (under partial annuitization). Q6 then takes the best choice from Q5 together with the participant's choice from Q1 (zero annuitization) and a third option that assumes full annuitization (i.e., no LTC income or savings in the investment account) and asks participants to select the best and worst from these three options. Q5 and Q6 together thus elicit a participant's most preferred allocation to the three products.

Q7 measures how access to long-term care insurance affects demand for life annuities. In Q7 we tell participants that the LTC income product is no longer available. We show participants three options: first, their most preferred allocation (from Q6), but where the money they spent on LTC income is refunded to their investment account, with the level of lifetime income remaining the same; second, option 1 with 25 percentage points higher annuitization; and third, option 1 with 25 percentage points lower annuitization.

Q8 and Q9 collect complementary information: how participants would finance any purchases of LTCI they might make in the future (Q8); and whether they prefer income-indemnity benefits (labeled as fixed payments) or expense-reimbursement benefits (labeled as reimbursement) (Q9). The experimental task concludes with a recall quiz on the key features of the three products.

3.3 Descriptive statistics

This section reports descriptive statistics of experimental choices and participants' characteristics.

3.3.1 LTC income product allocations

Figure 2 illustrates the cumulative distributions of the percentage of liquid retirement savings allocated to the LTC income product in Q1-Q4. Around 85% of participants indicate they would purchase the LTC income product over all levels of annuitization. As the level of annuitization increases from 0% to 75%, the percentage of remaining savings allocated to the LTC income product generally increases, suggesting that participants want a nominal amount of LTC-contingent income.

Table 4 reports the distribution of LTC contingent income participants choose. The median LTC-contingent income levels are similar to actual costs of LTC in Australia; median income decreases from

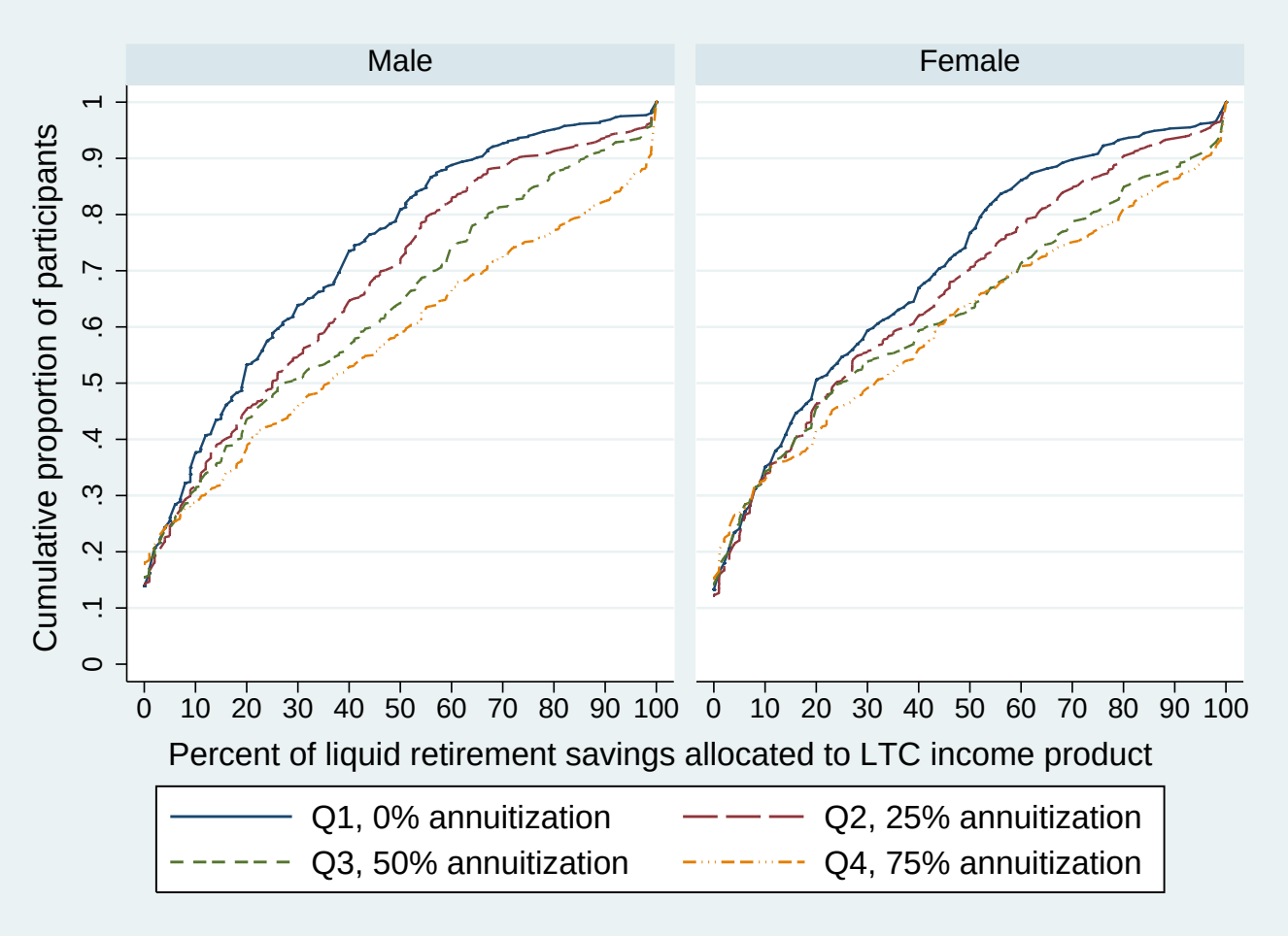

Figure 2: Cumulative distribution of percentage of liquid retirement savings allocated to the LTC income product at pre-determined levels of annuitization. Data used in the calculations is from Q1-Q4 in the survey.

$50,700 ($35,300) at 0% level of annuitization to $18,800 ($11,800) at 75% level of annuitization for males (females).[33] The extremely large values at high percentiles are typically observed in stated preferences (Ameriks et al., 2011). These either reflect true preferences for those who believed they would transit into LTC states soon, or are reporting errors due to misunderstanding of the experimental tasks or product features.

Table 4: Percentiles of annual LTC-contingent income (in $000)

The table reports selected percentiles, mean, and standard deviations of annual LTC-contingent income at pre-determined levels of annuitization for both genders. Data is from Q1-Q4 in the survey.

	Males				Females			
	Annuitization				Annuitization			
Percentiles	0%	25%	50%	75%	0%	25%	50%	75%
1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15%	0.8	1.2	0.0	0.0	1.3	1.2	0.3	0.0
25%	18.0	17.7	7.9	4.5	10.5	9.0	5.0	2.0
50%	50.7	50.4	34.7	18.8	35.3	30.2	22.5	11.8
75%	150.0	135.0	105.0	65.6	100.0	89.3	70.0	41.2
90%	435.0	382.5	292.5	142.5	243.8	215.2	150.0	84.2
95%	750.0	585.0	465.0	266.3	500.0	330.0	305.0	142.5
99%	1230.0	1001.3	735.0	375.0	950.0	660.0	495.0	250.0
Mean	150.0	125.6	97.3	55.0	96.1	78.6	59.2	31.0
Standard deviation	254.9	196.3	153.1	83.2	164.8	125.6	96.5	49.6
N	518	518	518	518	490	490	490	490

Although the majority of participants trade-off liquidity and LTCI coverage as annuitization increases, we also observe two other types of decisions. Around 17% of participants chose a fixed nominal LTC-contingent income, even at the expense of exhausting their liquid savings and around 14% of participants purchased little LTC-contingent income regardless of the level of annuitization.

3.3.2 Optimal allocations

Conventional life-cycle models predict that when markets are complete, retirees should insure both longevity risk and LTC risk, and preserve savings for intentional bequests (e.g., Ameriks et al., 2011). However, participants in this experiment have several reasons to preserve liquid wealth. First, they may need to cover very high care costs that exceed LTC income. Second, they may have to cover large unin-

[33] Although females are more likely to need LTC (Brown and Finkelstein, 2007), the higher median amount of LTC-contingent income for males (while having similar percentage of retirement savings allocated to the LTC income product as shown in Figure 2) is probably a result of fair pricing, which makes the LTC income product 33% less expensive for males than females.

surable expenses such as a car purchase. It may in fact be optimal for some participants to purchase no LTC care or longevity insurance.

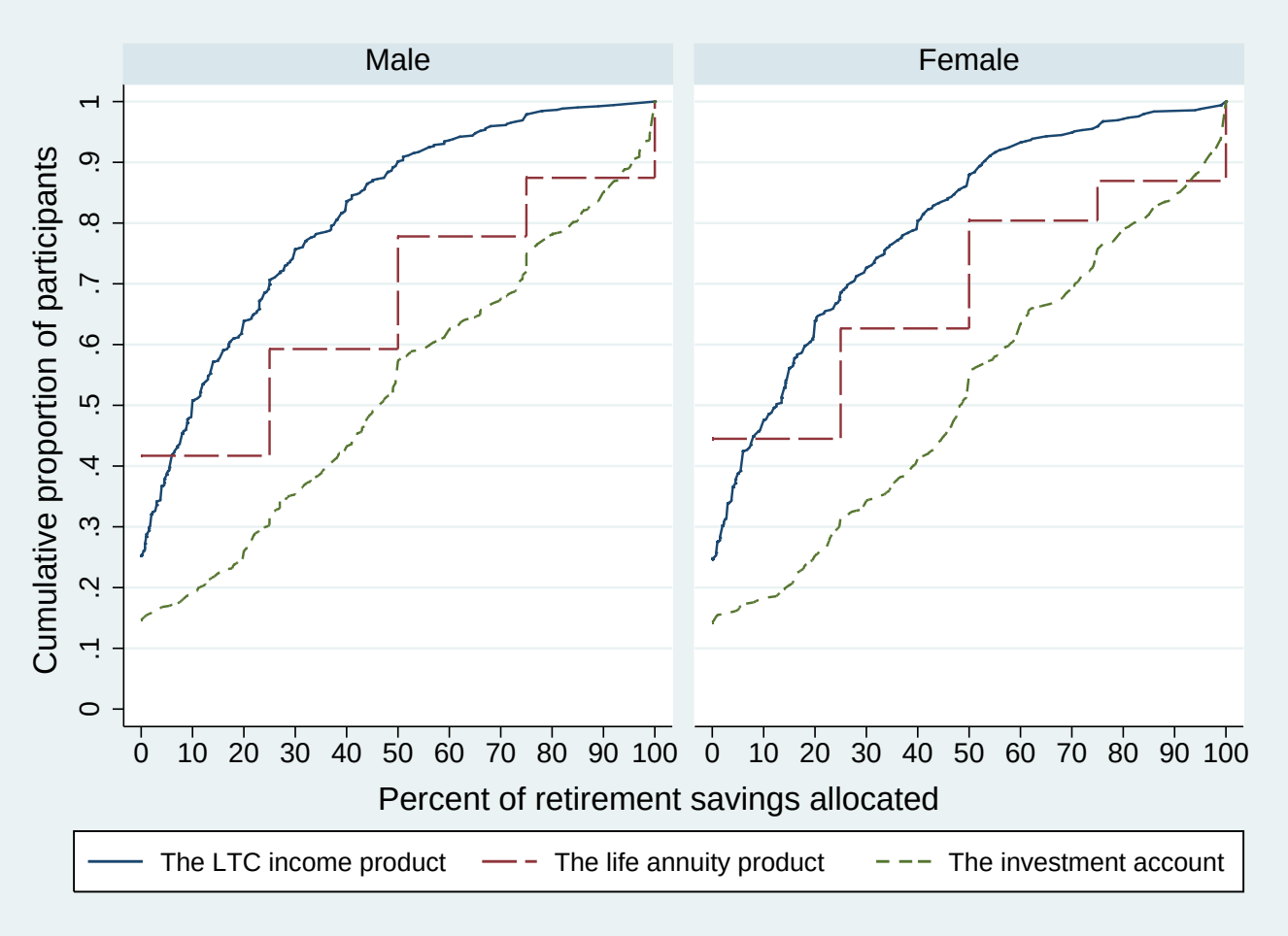

Figure 3: Cumulative distribution for allocation of retirement savings. The figure shows the cumulative distribution of percentage of retirement savings allocated to the LTC income product (continuous from 0% to 100%), the life annuity product (discrete from 0% to 100% at an interval of 25%), and the investment account (continuous from 0% to 100%). Data used in the calculations is from Q6 in the survey.

Figure 3 reports the cumulative distribution of allocations of retirement savings to the LTC income product, the life annuity, and the investment account respectively. Around 75% of participants spend at least some of their savings on LTC income.[34] The median annual LTC-contingent income chosen is around $45,000. These results put stated demand for LTC income well above the actual demand in real markets (Ameriks et al., 2015a). We also find that over 40% of participants do not purchase the life annuity product at all and about 20% allocated less than 10% of their retirement savings to the investment account.

[34]Note that this number is lower than the 85% reported in Section 3.3.1 (Figure 2), as just over 10% of participants choose full annuitization in Q6.

Table 5: Percentiles of the ratio of LTC-contingent income over survival-contingent income

The table reports selected percentiles, mean, and standard deviations of the ratio of LTC-contingent income over survival-contingent income for different wealth groups. The amount of survival-contingent income includes both the income from life annuities (chosen by the participant) and the public pension income (given as fixed). The ratio is calculated using data from Q6 of the survey. Wealth groups are classified as in Table 2.

	Males					Females				
	Wealth group					Wealth group				
Percentiles	1	2	3	4	All	1	2	3	4	All
1%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25%	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0
50%	0.7	1.4	1.6	2.0	1.3	0.5	0.9	1.7	1.1	0.9
75%	1.4	2.8	4.1	6.8	3.0	1.1	2.1	3.5	5.0	2.1
90%	2.0	4.9	13.0	25.1	8.0	1.6	3.3	7.8	9.1	5.3
95%	2.3	7.1	14.4	35.5	14.1	1.9	4.4	11.1	23.6	8.4
99%	3.0	11.9	22.8	62.7	44.9	2.3	7.5	15.8	37.9	24.0
Mean	0.8	2.1	3.5	6.8	3.4	0.7	1.3	2.8	4.0	2.1
Standard deviation	0.8	2.4	4.9	12.1	7.4	0.6	1.6	3.5	7.4	4.2
N	136	133	96	153	518.0	141	121	115	113	490

We also calculate the ratio of LTC-contingent income to survival-contingent income for all participants and report selected percentiles in Table 5.[35] We find that over three quarters of participants choose a ratio below three. The LTC to survival contingent income ratio generally increases with wealth because the fixed public pension is a large component of the allocations of participants with low wealth but a declining share of the allocations of wealthier participants. We note that the average stated-preference ratios (2.1 for males and 1.3 for females with wealth of $375K) conform to predictions of the calibrated life-cycle model in a related paper(see Wu et al., 2016).[36]

3.3.3 Participants characteristics

Table 6 provides summary statistics of covariates used in estimation. In terms of participants' subjective assessment of longevity risk, participants on average are pessimistic about their survival prospects. The average deviation of subjective life expectancy relative to cohort life expectancy is negative (-3.186), in

[35] $L_i = \frac{INC_i^{LTC}}{INC_i^S}$, where INC_i^{LTC} represents the annual amount of LTC-contingent income chosen by subject i in Q6 and INC_i^S represents the annual amount of survival-contingent income chosen by subject i in Q6. The amount of survival-contingent income includes both the income from life annuities (chosen by the participant) and the public pension income (given as fixed)

[36] Wu et al. (2016) use the same classification of health states to estimate that the optimal ratio of LTC-contingent income over survival-contingent income is about 2 (1) for males (females) in health state 1 and with a total retirement wealth of $500,000 (including the expected present value of annuity income as well as liquid wealth). The corresponding group in the survey is wealth group 2. Individuals in this group have $375,000 retirement savings with a flat public pension of $22,000 per year, which is roughly amounting to a total retirement wealth of $500,000.

line with Wu et al. (2015b). However they are more likely to be optimistic than pessimistic about their probability of needing home or residential care: around 40% rate their chances of needing care as below average, compared with fewer than 8% who rate their chances as above average. The small numbers of participants who reported a higher-than-average chance of needing residential care are consistent with the unrealistic optimism about health problems found in other studies (Weinstein, 1982, 1987), and with optimism about survival when the question is asked using comparative judgment i.e, relative to the average person (Beshears et al., 2014).

Table 6: Summary statistics of covariates

Variable:	Mean	Standard deviation	Variable type
Objective measures of exposure to LTC risk			
Female	0.486	0.500	Binary
Age	59.539	2.838	Continuous in years
Health state			Categorical
1	0.597		Proportion in this group
2	0.090		Proportion in this group
3	0.196		Proportion in this group
4	0.116		Proportion in this group
Current smoker	0.157	0.364	Binary
Received care	0.062	0.240	Binary
Subjective indicators of exposure to LTC risk			
Subjective life expectancy	-3.186	8.946	Continuous in years
Chance of needing homecare			Categorical
Lower than the average	0.365		Proportion in this group
Equal to the average	0.559		Proportion in this group
Higher than the average	0.076		Proportion in this group
Chance of needing residential care			Categorical
Lower than the average	0.410		Proportion in this group
Equal to the average	0.530		Proportion in this group
Higher than the average	0.061		Proportion in this group
Awareness of LTC risk			
Financial planning for LTC			Categorical
Have set aside money but may need help	0.508		Proportion in this group
Expect to rely on government	0.083		Proportion in this group
Do not know needs and costs	0.409		Proportion in this group
Care provider	0.262	0.440	Binary
Availability of informal care and home ownership			
Source of some (low) care			Categorical
Informal care only	0.376		Proportion in this group
Informal care and other sources	0.328		Proportion in this group
No informal care	0.296		Proportion in this group
Source of extensive (high) care			Categorical
Informal care only	0.219		Proportion in this group
Informal care and other sources	0.282		Proportion in this group
No informal care	0.499		Proportion in this group
Non-parternered	0.326	0.469	Binary
Number of children	1.961	1.465	Continuous
Non-homeowner	0.191	0.394	Binary
Measures of utility parameters			
Willingness to take risk (WTR)	3.975	2.594	Continuous on a 0-10 scale
Patience	6.360	2.427	Continuous on a 0-10 scale
Utility in bad health	4.253	2.181	Continuous on a 0-10 scale
Chance of $100K bequest	52.589	42.451	Percentage points
Prefer reimbursement	0.421	0.494	Binary
Individual capability and knowledge about retirement financial products			
No. of mistakes in Financial literacy	0.648	0.836	Continuous a 0-3 scale
No. of mistakes in Numeracy	1.298	1.091	Continuous a 0-3 scale
Earnings from recall quiz	3.119	1.705	Continuous in dollars
General product knowledge	8.495	1.870	Continuous on a 0-10 scale
Knowledge on life annuity	2.167	1.576	Continuous on a 0-5 scale
Knowledge on LTCI	1.217	1.587	Continuous on a 0-5 scale
No private health insurance	0.382	0.486	Binary
Retirement planning			

continued on next page

Table 6 – continued

Variable:	Mean	Standard deviation	Variable type
Intent to retire before 65	0.493	0.500	Binary
Financial planning for retirement	0.782	0.413	Binary
Retirement spending change	-17.005	24.292	Percentage points
Demographics and other controls			
Not in Australia	0.243	0.429	Binary
Bachelor or above	0.327	0.469	Binary
Work status			Categorical
Full time			Proportion in this group
Part time	0.206	0.405	Proportion in this group
Unemployed/not in labour force	0.384	0.487	Proportion in this group
Retired	0.140	0.347	Proportion in this group
Hoursehold gross income	73.672	55.188	Continuous in thousand dollars/Year
Wealth group			Categorical
1	0.275		Proportion in this group
2	0.252		Proportion in this group
3	0.209		Proportion in this group
4	0.264		Proportion in this group

4 Selection and informal care effects

In this section, we use data obtained from Q1-Q4 in the experimental survey to estimate econometric models to help us understand who demands LTC income insurance. First, we are interested in whether the LTC insurance is purchased mainly by people who are more likely to need to claim the benefit, that is whether there are selection effects. Second, we are interested in whether people expect to use the LTC insurance benefits to fund informal as well as formal care. Whether a market for LTC income insurance can exist depends on the answers to these two questions.

Our analysis in this section starts with a brief explanation of the econometric framework. Using the estimation results, we study the influence of LTC risk factors and the availability of informal care on the product demand in Section 4.1 and Section 4.2, respectively.[37] Section 4.3 investigates whether the observed effects are due to differences in preference for income type products in general (using the LTC income product as substitute for longevity income); or reflect differences in income differential preferences between the healthy and LTC state.

Using data from Q1-Q4, we estimate two random effects models. The first model analyzes the decision to purchase the LTC income product or not, using a random-effects probit specification:

$$Z^{\star}_{ij} = X_i'\beta + \delta A + \nu_i + \epsilon_{i,j}, \qquad \text{for } i = 1, 2, \ldots, N \text{ and } j = 1, 2, 3, 4 \tag{1}$$

[37] Appendix B provides a brief discussion on the effects of other covariates.

with

$$Z_{ij} = \begin{cases} 1, & \text{if } Z_{ij}^{\star} > 0, \\ 0, & \text{otherwise,} \end{cases}$$

where $Z_{ij}^{\star}$ is a latent variable that can be interpreted as the utility gain of purchasing the LTC income product compared with not purchasing it; Z_{ij} is the observed binary variable that equals 1 if subject i purchased the LTC income product in question j (i.e., Q1-Q4) and 0 otherwise; X_i is a vector of covariates for subject i with the coefficient vector β; A is a (4×1) vector, where the j^{th} element equals 1 for question j and 0 otherwise; δ is the corresponding coefficient vector for A; ν_i captures the unobservable effects for subject i and is assumed to be i.i.d. normally distributed with mean zero and variance σ_{ν}^2; the residual ϵ_{ij} for subject i in question j is assumed to be independent of ν_i and i.i.d. normally distributed with mean zero and σ_{ϵ}^2. The conditional probability of purchasing the LTC income product product for subject i in question j is thus given by:

$$\Pr(Z_{ij} = 1 | X_i, A, \nu_i) = \Phi\left(\frac{X_i'\beta + \delta A + \nu_i}{\sigma_{\epsilon}}\right). \tag{2}$$

We estimate the parameters in Equation (1) using maximum likelihood.

In the second model, we study the demand for LTC-contingent income conditional on purchasing the LTC income product, using the same set of data from Q1-Q4. The OLS regression is given by:

$$\log(Y_{ij} | Z_{ij} = 1, X_i, A) = X_i'\beta + \delta A + \gamma_i + \mu_{ij}, \tag{3}$$

where Y_{ij} represents the amount of LTC-contingent income purchased by subject i in question j; γ_i captures the unobservable effects for subject i and is assumed to be i.i.d. normally distributed with mean zero and variance σ_{γ}^2; the residual μ_{ij} for subject i in question j is assumed to be independent of γ_i and i.i.d. normally distributed with mean zero and σ_{μ}^2.

4.1 Selection effects

Table 7 reports the estimation results for Equations (1) and (3) that relate to LTC risk and informal care.[38] We find that objective measures of exposure to LTC risk do not significantly influence the purchase decision for the LTC income product, and explain little variation in the amount of LTC-contingent income

[38] Table C1 in Online Appendix C reports the full set of estimation results.

demanded by individuals. Hence, we fail to reject Hypothesis 1. Of all variables in this category, only *Female* and *Current smoker* have a significant and negative effect (for the whole sample) on the amount of LTC-contingent income demanded (but not on the probability of purchase). As the pricing of the LTC income product is gender specific, the significance of *Female* does not signal any selection effects[39] and is possibly due to the pricing difference between males and females.[40] The negative effect of *Current smoker* on the amount of LTC-contingent income indicates that there could be an advantageous selection effect. Those who are less inclined to invest in their health (they remain a smoker) are less inclined to purchase larger amounts of LTCI. In general there is little indication of adverse selection based on objective measures, which is consistent with the result that the actuarially fair prices of the LTC income product across current health states are very similar (Brown and Warshawsky, 2013).

In contrast to the objective measures, subjective risk assessments do significantly alter demand for the LTC income product, hence we reject Hypothesis 2. Participants who rate their chance of needing residential care as lower than average are less likely to purchase the LTC income product. While those who put their chance at higher-than-average are (much) more likely to purchase the product, and conditional upon purchase they demand 55% more LTC-contingent income.[41] In fact, all 35 male participants and 25 out of 26 female participants in our survey who say they have a higher-than-average chance of needing residential care purchased the product.[42]

Moreover, we find that individuals who are more aware of LTC risk are more likely to purchase the LTC income product and they purchase more. Thus we fail to reject Hypothesis 3. In particular, the demand for LTC-contingent income per year for individuals who have set aside money for LTC risk is 28% higher, conditional upon purchase.[43] This indicates that those who are aware of LTC risk and are changing behavior (by saving more) have a higher demand for the LTC income product. This would signal that there are possible advantageous selection effects present, as those who are more aware of LTC risk and are willing to invest in their health capital, have a stronger demand for the LTC income product.

Our finding of selection effects based on subjective measures in the demand for the LTC income product is inconclusive. On the one hand, adverse selection effects exist in that the individuals who

[39] A selection effect requires a driver of product demand which does not lead to a different price.

[40] As the pricing of the LTC income product is gender specific, the amount of LTC-contingent income is lower for females for each dollar of premium paid.

[41] We calculate this as $\exp(x) - 1$ where x is the coefficient estimate.

[42] Therefore, the corresponding coefficient estimate is positive infinite for males (resulting in an estimated probability of purchasing the product equal to one) and very large for the sample. The insignificant coefficient for females is due to its small sample size, though the coefficient estimate is very large too.

[43] These results are not apparent in Section 4.3 probably for the reason that individuals who are more aware of LTC risk are also more aware of longevity risk, which leads to a higher demand for life annuities as well as the LTC income product.

Table 7: Determinants of demand for the LTC income product given income streams

The table reports the estimates of the average partial effects for Equation (1) in columns (1), (2), and (3), and of coefficients Equation (3) in columns (4), (5), and (6). The data for estimation is from Q1-Q4 of the survey. The dependent variable for columns (1), (2), and (3) is a binary variable that equals 1 if a participant purchased the LTC income product and 0 otherwise. The dependent variable for columns (4), (5), and (6) is the natural logarithm of the amount of annual LTC-contingent income for those who purchased the LTC income product. Here we report only independent variables that belong to 'Objective measures of exposure to LTC risk', 'Subjective indicators of exposure to LTC risk', 'Awareness of LTC risk', and 'Availability of informal care'. Table C1 in Online Appendix C reports the full results. An estimated average partial effect of $+\infty$ indicates that the associated independent variables perfectly predicts the purchase of the LTC income product. Robust standard errors (Huber-White) are shown in parentheses. Asterisks for σ_ν indicate significance of the random effects, derived from likelihood ratio tests (for column (1) (2) (3)) and Breusch and Pagan Lagrange multiplier tests (for column (4) (5) (6)). *, **, and *** indicate significance at 10, 5, and 1 percent level, respectively.

Dependent variable:	Purchase LTC income product			Log (annual LTC-contingent income)		
	Sample (1)	Male (2)	Female (3)	Sample (4)	Male (5)	Female (6)
Objective measures of exposure to LTC risk						
Female	0.001			-0.459***		
	(0.008)			(0.077)		
Age	-0.000	0.001	0.000	-0.013	-0.018	-0.018
	(0.001)	(0.003)	(0.002)	(0.013)	(0.018)	(0.018)
Health state: base case = 1						
2	-0.007	-0.067	0.028*	0.073	0.134	0.077
	(0.018)	(0.055)	(0.016)	(0.133)	(0.163)	(0.198)
3	0.001	-0.015	0.017	0.005	0.021	-0.040
	(0.010)	(0.023)	(0.017)	(0.095)	(0.115)	(0.158)
4	0.003	0.001	0.012	0.122	-0.040	0.434***
	(0.011)	(0.023)	(0.023)	(0.111)	(0.155)	(0.157)
Current smoker	-0.006	0.003	-0.014	-0.297***	-0.206	-0.423**
	(0.011)	(0.025)	(0.019)	(0.105)	(0.129)	(0.170)
Received care	-0.012	-0.063	0.021	0.142	-0.045	0.299
	(0.023)	(0.062)	(0.019)	(0.144)	(0.201)	(0.192)
Subjective indicators of exposure to LTC risk						
Subjective life expectancy	-0.001	-0.002*	-0.000	0.004	0.009*	-0.004
	(0.000)	(0.001)	(0.001)	(0.004)	(0.005)	(0.007)
Chance of needing homecare: base case = average						
Lower than the average	0.007	-0.004	0.009	-0.032	0.003	-0.130
	(0.011)	(0.023)	(0.022)	(0.104)	(0.131)	(0.185)
Higher than the average	-0.019	-0.109	0.015	-0.203	-0.121	-0.161
	(0.037)	(0.107)	(0.030)	(0.179)	(0.224)	(0.319)
Chance of needing residential care: base case = average						
Lower than the average	-0.025*	-0.056**	-0.015	-0.039	-0.207	0.176
	(0.014)	(0.027)	(0.025)	(0.101)	(0.129)	(0.177)
Higher than the average	0.015**	$+\infty$***	0.026**	0.441***	0.465**	0.097
	(0.006)	(n.a)	(0.012)	(0.169)	(0.188)	(0.339)
Awareness of LTC risk						
Financial planning for LTC: base case = do not know needs and costs						
Have set aside money but may need help	0.025**	0.058**	0.022	0.245***	0.388***	0.194
	(0.010)	(0.023)	(0.015)	(0.082)	(0.113)	(0.121)
Expect to rely on government	0.012	0.034	0.022	-0.026	0.102	-0.127
	(0.016)	(0.035)	(0.026)	(0.138)	(0.163)	(0.244)
Care provider	-0.005	0.021	-0.021	-0.077	-0.108	-0.043
	(0.009)	(0.021)	(0.016)	(0.081)	(0.107)	(0.118)
Availability of informal care and home ownership						
Source of some (low) care: base case = no informal care						
Informal care only	-0.002	-0.012	0.006	-0.202*	-0.374**	-0.004
	(0.014)	(0.035)	(0.021)	(0.116)	(0.154)	(0.173)
Informal care and other sources	0.006	0.037	-0.010	-0.246**	-0.225	-0.181
	(0.012)	(0.027)	(0.023)	(0.115)	(0.163)	(0.168)
Source of extensive (high) care: base case = no informal care						
Informal care only	0.016	0.052*	-0.011	0.230**	0.208	0.366**
	(0.011)	(0.027)	(0.029)	(0.110)	(0.141)	(0.174)
Informal care and other sources	0.012	0.034	0.006	0.265***	0.078	0.411***
	(0.011)	(0.028)	(0.016)	(0.099)	(0.137)	(0.144)
Non-partnered	0.009	0.043*	0.002	-0.034	-0.035	0.010
	(0.010)	(0.026)	(0.017)	(0.092)	(0.133)	(0.127)
Number of children	0.001	-0.001	0.003	0.030	-0.046	0.108***
	(0.003)	(0.007)	(0.005)	(0.025)	(0.036)	(0.034)
Non-homeowner	-0.013	0.015	-0.049*	-0.038	0.060	-0.215
	(0.011)	(0.024)	(0.026)	(0.103)	(0.121)	(0.169)
N	4032	1932	1960	3443	1753	1690
Log likelihood	-983.712	-494.137	-463.635			
R^2 (overall)				0.508	0.504	0.525
σ_ν	2.675***	2.612***	2.462***	1.057***	1.018***	1.086***

report a higher chance of needing residential care have a stronger demand for the LTC income product. The extent of adverse selection effects would depend on the extent to which this self-reported chance of needing residential care is informative of the future need for LTC for our sample of 54-64 year old individuals. On the other hand, a higher awareness and willingness to invest in health leads to a higher demand for the LTC product, which could indicate advantageous selection, as they would remain longer in good health.

4.2 Informal care

Consistent with Pauly (1990) and Zweifel and Strüwe (1998) who show that informal care is a substitute for expense-reimbursement LTCI, our results in Table 7 indicate that the availability of low-level (some) informal care reduces the demand for LTC-contingent income. Thus we fail to reject Hypothesis 4a and conclude that informal care is seen as a substitute in the case of low-level care.

Interestingly, we observe that availability of receiving high-level (extensive) care from close family members is associated with stronger demand for the LTC income product, unlike low-level care. For high-level care, column (2) of Table 7 shows that males who plan to rely on family members have a higher probability of purchasing the LTC income product than those who would not receive informal care (significant at 10%). Results of column (4) also show that people who would be able to receive high-level care from family members (either as the only source or together with other sources) demand about 30% more LTC-contingent income per year than those who would not. Thus we fail to reject Hypothesis 4b and conclude that the LTC income product complements the availability of high-level informal care.

Results of columns (5) and (6) in Tables 7 provide supporting evidence for Hypothesis 4c. We find that the effects of availability of receiving high-level care from family members are significant for females but insignificant (and with smaller estimated coefficients) for males. Hence the result that availability of high-level informal care is associated with stronger demand for the LTC income product is mainly driven by females who have stronger needs for *inter vivos* transfers to facilitate informal care by their children or related carers.

There are also two supportive arguments that these gender differences are caused by differences in the need for *inter vivos* transfers to provide for informal care. First, the number of children has a positive and significant effect on the product demand for females, but an insignificant (and negative) effect for males (see columns (5) and (6) of Table 7). Second, we also find that the negative impact of post-mortem bequest motives to children only appears for females, where *inter vivos* transfers to children is probably

a substitute for (strategic) post-mortem transfers.[44] Therefore, the LTC income product is a substitute for bequests to children by mothers.

For other sources of financing, we find that neither homeownership nor an expectation of relying on the government for receiving care is important in explaining the demand for the LTC income product. Therefore, we reject Hypotheses 5a and 5b.

In contrast to the typical expense-reimbursement insurance, an income-indemnity LTCI compensates people relying on both informal care and professional care with costs. In our sample, 22% of participants declare that they would prefer to receive high-level care only from close family members. Another 28% of participants indicate informal care as one of the sources for high-level care. Hence, the potential market for an income-indemnity LTCI would cover a much larger proportion of the population by including these people. More importantly, the finding that the LTC income product complements the need and desire to rely on family members for high-level care implies stronger demand among these people.

4.3 Selection and informal care effects on preferred income differential between LTC state and healthy state

Next we turn to the demand for LTC-contingent income in participants' optimal allocations, controlling for the amount of total retirement savings. Here we consider preferences where participants can choose their allocations to longevity insurance as well as LTCI. This difference is important due to the possible interaction between demand for LTCI and longevity insurance (e.g., Davidoff, 2009). We use the data obtained from Q6 that reflect participants' optimal mix of LTC-contingent income, survival-contingent income, and liquid wealth. Descriptive statistics of the optimal allocations to the three products can be found in Section 3.3.2.

We estimate a model of the ratio of LTC-contingent income to survival-contingent income with the following OLS regression:

$$L_i = X_i'\beta + \varepsilon_i, \tag{4}$$

where L_i denotes the ratio of LTC-contingent income over survival-contingent income preferred by subject i. The amount of survival-contingent income includes both the income from life annuities (chosen by the participant) and the public pension income (given as fixed). The residual ε_i for participant i is assumed to be independent and identically distributed with mean zero and variance σ_ε^2.

[44] These results are discussed in Appendix B. The estimation results are reported in Table C1 in Online Appendix C.

Table 8 presents the regression results for Equation (4). Since the dependent variable is the ratio of LTC-contingent income per year over survival-contingent income per year, a positive and significant coefficient indicates that cross-sectionally the variable leads to a stronger preference for LTC-contingent income against survival-contingent income.

Selection effects Consistent with previous results we find that objective measures of exposure to LTC risk explain little variation in individuals' preferences about the mix of income streams. Thus, we fail to reject Hypothesis 1. The coefficient on *Smoker*, which was found to have a negative impact on the demand for LTC-contingent income in column (4) of Table 7, becomes insignificant (column (1)).[45] This may be because smoking negatively affects expected lifetimes (Belanger et al., 2002), reducing the demand for life annuities to a similar extent as the effect on the LTC income product.

Consistent with previous findings, we also find that expectation about the chance of needing residential care is important and thus reject Hypothesis 2. The ratio of LTC-contingent income over survival-contingent income preferred by those with a higher chance of needing residential care is found to be 2.264 units higher than those at the average.

Results also show that females who have experience of providing care have stronger preference for LTC-contingent income against survival-contingent income. The estimate coefficients (column (1)) for both *Care provider* and *Have set aside money* are positive for the whole sample, although they are not significant. These results are consistent with the previous finding that individuals with better awareness of LTC risk have stronger demand for LTCI. Thus we fail to reject Hypothesis 3.

Informal care Results confirm that the distinction between low-level (some) care and high-level (extensive) care is important. For example, individuals who would only rely on family members for low-level care have a lower ratio than individuals who would not (significant at 10 percent level in column (1)), suggesting that they have a weaker preference for LTC-contingent income against survival-contingent income than people who do not expect to use informal care. However, individuals who would only rely on family members for high-level care show a stronger preference for LTC-contingent income than people who do not expect to use informal care. These results are most driven by females.[46] Therefore, we fail to reject Hypotheses 4a, 4b and 4c.

Overall, these results are largely consistent with the findings in Section 4.1 and Section 4.2. Thus,

[45] Though it is still significant and negative for males.

[46] An exception is that males have a significant and positive coefficient for *Informal care only* in column (2) of Table 8, but this is also with a negative sign for the variable *Informal care and other sources*.

Table 8: Determinants of the optimal mix of income streams

The table reports estimates of coefficients for Equation (4). The data for estimation is from Q6 of the survey. The dependent variable is the ratio of annual LTC-contingent income over annual survival-contingent income. Only independent variables that belong to 'Objective measures of exposure to LTC risk', 'Subjective measures of exposure to LTC risk', 'Awareness of LTC risk', and 'Availability of informal care' based on the categorization in Section 2 are shown. Table C2 in Online Appendix C reports the full results. Robust standard errors (Huber-White) are shown in parentheses. *, **, and *** indicate significance at 10, 5, and 1 percent level, respectively.

Dependent variable:	LTC-contingent income/survival-contingent income		
	Sample (1)	Male (2)	Female (3)
Objective measures of exposure to LTC risk			
Female	-1.392***		
	(0.432)		
Age	-0.086	-0.121	-0.037
	(0.057)	(0.100)	(0.064)
Health state: base case = 1			
2	0.091	0.042	0.461
	(0.584)	(0.999)	(0.511)
3	-0.212	0.115	-0.377
	(0.509)	(0.738)	(0.604)
4	0.701	0.564	0.819
	(0.667)	(1.082)	(0.596)
Current smoker	-0.505	-1.498**	0.359
	(0.408)	(0.631)	(0.535)
Received care	-0.449	-0.699	-0.283
	(0.760)	(1.141)	(0.544)
Subjective indicators of exposure to LTC risk			
Subjective life expectancy	0.007	0.029	-0.012
	(0.018)	(0.026)	(0.027)
Chance of needing homecare: base case = average			
Lower than the average	0.251	0.381	-0.299
	(0.468)	(0.748)	(0.457)
Higher than the average	-0.499	0.921	-1.946**
	(0.676)	(1.180)	(0.908)
Chance of needing residential care: base case = average			
Lower than the average	-0.647	-1.374**	0.301
	(0.413)	(0.669)	(0.395)
Higher than the average	2.264**	3.188**	0.507
	(1.054)	(1.529)	(1.000)
Awareness of LTC risk			
Financial planning for LTC: base case = do not know needs and costs			
Have set aside money	0.387	0.552	0.433
	(0.336)	(0.594)	(0.396)
Expect to rely on government	-0.534	-0.533	-0.525
	(0.369)	(0.625)	(0.493)
Care provider	0.277	-0.285	1.067**
	(0.382)	(0.615)	(0.453)
Availability of informal care and home ownership			
Source of some (low) care: base case = no informal care			
Informal care only	-0.883*	-0.397	-1.385***
	(0.496)	(0.912)	(0.483)
Informal care and other sources	-0.299	0.503	-1.099**
	(0.571)	(1.061)	(0.474)
Source of extensive (high) care: base case = no informal care			
Informal care only	2.120***	2.312**	1.841***
	(0.595)	(0.982)	(0.711)
Informal care and other sources	0.607	-0.437	0.876*
	(0.513)	(0.959)	(0.465)
Non-partnered	0.472	0.949	-0.043
	(0.457)	(0.809)	(0.379)
Number of children	0.089	0.077	0.094
	(0.118)	(0.211)	(0.126)
Non-homeowner	0.158	1.014	-0.699
	(0.501)	(0.860)	(0.429)
N	1008	518	490
R^2	0.183	0.226	0.206

our results about the influence of LTC risk factors and availability of informal care on the demand for LTC-contingent income hold both when the amount of survival-contingent income is exogenously given to individuals and when it is endogenously chosen by individuals.

5 Precautionary savings and income-indemnity LTCI demand

In this section we explore the impact of having access to the LTC income product on the demand for life annuities (thus we test the hypotheses in Section 2.3). We use the data obtained from Q7 of the experimental task, which asks participants how they would like to re-allocate their retirement savings when the LTC income product is no longer offered. By default, we deposit the amount of money the participant previously allocated to the LTC income product (in Q6) back to their investment account. Q7 let participants increase or decrease their annuitization level by 25%,[47] or keep it unchanged. The answers to Q7 measures the within-individual effect of having access to the LTC income product on the demand for life annuities. In this way, we are able to minimize, if not eliminate, the effects of other individual-specific factors.

In Section 5.1, we first carry out a univariate test on whether the proportion of participants who chose to increase their level of annuitization is equal to the proportion of participants who chose to decrease. To explain the heterogeneity in individuals' reactions, we then estimate in Section 5.2 a multinomial logit model. We denote the choice of individual i by M_i and use no change in level of annuitization ($M_i = 2$) as the base outcome. The specifications for the probabilities of individual i preferring a decrease ($M_i = 1$) and an increase ($M_i = 3$) in annuitization level are given by:

$$\log\left(\frac{\Pr(M_i = 1|X_i)}{\Pr(M_i = 2|X_i)}\right) = X_i'\beta_1 \text{ and} \tag{5}$$

$$\log\left(\frac{\Pr(M_i = 3|X_i)}{\Pr(M_i = 2|X_i)}\right) = X_i'\beta_3 \tag{6}$$

where X_i is the set of individual-i specific covariates (including an intercept) β_1 and β_3 are the coefficients for outcomes 1 and 3 respectively, and can be interpreted as the marginal effects on log-odds of outcomes 1 and 3 relative to the base outcome i.e. 2. We estimate these equations jointly using maximum likelihood.

[47] A magnitude of change as much as 25% (the same as the increment in Q1-Q4) is required because otherwise one would not be able to identify whether the change is due to the treatment or rounding behaviors.

5.1 Release of precautionary savings versus substituting income products

Table 9 shows how participants respond when the LTC income product is no longer offered. A little less than half of the sample keep their level of annuitization unchanged, leading to an increase in their investment account balances by the amount of money allocated to the LTC income product. The results indicate that we can reject neither hypothesis 6a nor hypothesis 6b.

Table 9: Distribution of responses to the unavailability of the LTC income product

	Change of annuitization level		
	-25%	0%	25%
Percent of participants	31.9	48.3	19.8
95% confidence interval	(27.6, 36.2)	(43.7, 52.9)	(16.1, 23.5)

We find that more people decrease their level of annuitization to boost their liquid wealth than increase it (significant at a 5% level). Therefore for most individuals, whose portfolio choices are materially affected by whether they have access to the LTC income product, the product allows them to release precautionary savings kept for self-insuring LTC risk (and therefore purchase additional longevity insurance; in line with 6b). Nonetheless, there is still a substantial proportion (around 20%) of people who use life annuities as a substitute hedging instrument in the absence of the LTC income product (in line with hypothesis 6a).

5.2 The incidence of releasing of precautionary savings and substituting income products

Table 10 reports the coefficient estimates of the multinomial logit model specified in Equations (5) and (6). Interestingly, we find that individuals with low LTC risk, in either objective or subjective measures, are more likely to decrease their level of annuitization when the LTC income product is no longer offered on the market, compared with an average or high LTC risk individual. In the absence of LTCI coverage, the demand for life annuities for the low LTC risk individuals is substantially reduced because they need liquid wealth to self-insure. However, the effect of having access to LTCI coverage on the demand for life annuities is limited for individuals with high LTC risk, because their own lower survival prospects make life annuities relatively expensive (as a result of risk pooling pricing as explained in Section 3.1). This result does not contradict the findings in Section 4.1 (Table 7). Individuals with higher perceived LTC risk are more likely to purchase the LTC income product and they purchase more, while individuals with lower LTC risk are more likely to purchase more life annuities after they obtain coverage for LTC. This implies that offering LTCI coverage may strengthen the demand for life annuities for the healthy

Table 10: Regression of participants' responses to the withdrawal of the LTC income product

The table reports estimates of coefficients for the Equations (5) and (6). The data for estimation is from Q7 of the survey. The sample includes participants who chose partial annuitization in the presence of the LTC income product in Q7 of the survey. The dependent variables are the choices of participants with respect to their level of annuitization when the LTC income product is no longer offered. Independent variables that do not show significance at 5% level for at least one column are not reported in this table, but are in Table C1 in Online Appendix C. Robust standard errors (Huber-White) are shown in parentheses. *, **, and *** indicate significance at 10, 5, and 1 percent level, respectively.

Base outcome: No change on annuitization	Decrease by 25%	Increase by 25%
	(1)	(2)
Objective measures of exposure to LTC risk		
Health state: base case = 1		
2	0.621	0.413
	(0.513)	(0.543)
3	-0.006	-0.034
	(0.359)	(0.402)
4	-1.072**	0.030
	(0.478)	(0.443)
Subjective indicators of exposure to LTC risk		
Chance of needing residential care: base case = average		
Lower than the average	1.074***	0.687
	(0.405)	(0.442)
Higher than the average	-0.590	0.523
	(0.881)	(0.849)
Awareness of LTC risk		
Financial planning for LTC: base case = do not know needs and costs		
Have set aside money	-0.195	-0.683**
	(0.284)	(0.317)
Expect to rely on government	-0.794	-0.023
	(0.580)	(0.642)
Retirement planning		
Financial planning for retirement	0.598	1.016**
	(0.406)	(0.516)
Demographics and other controls		
Wealth group: base case = 1		
2	-1.154***	0.317
	(0.435)	(0.570)
3	-2.818***	-0.092
	(0.486)	(0.585)
4	-2.533***	-0.065
	(0.474)	(0.595)
N	-389.964	
Log likelihood	445.000	

individuals, but it will provide little help with solving the annuitization puzzle (Yaari, 1965; Davidoff et al., 2005) for the unhealthy individuals, highlighting the importance of bundling longevity insurance and LTCI.[48]

6 Conclusions

While substantial LTC risk has led to conservative wealth drawdown by retirees, the private markets for LTCI are thin or non-existent in most developed countries. Most existing studies focus on the expense-reimbursement LTCI policies, which provides benefits for paid LTC services. We show that income-indemnity LTCI has a large potential demand, in particular for those relying on informal care. With declining utilization of residential care facilities and many people relying on unpaid LTC from close family members, the income-indemnity LTCI policy which offers LTC-contingent income whether payments are made for LTC services or not, may better suit the needs of a large and increasing proportion of individuals.

In this paper, we designed and implemented an experimental survey to study the demand for income-indemnity LTCI, with a focus on selection effects, the role of informal care, and the impact on precautionary savings. Using stated preference data collected from the survey, we find that the estimated demand for the LTC income product is larger than the actual LTCI holdings, so we conclude that imperfections of existing LTCI products contribute to the low demand for LTCI coverage in current markets.

In contrast to expense-reimbursement LTCI policies where underwriting has to be taken to prevent adverse selection, we find no evidence of selection effects based on objective measures of exposure to LTC risk. While there is some evidence of adverse selection based on subjective measures such as self-reported chances of needing residential care, there is also some indication of advantageous selection effects. Participants who are more aware of LTC risk and adjust their behavior, have a higher demand for the LTC insurance.

More importantly, we find that the income-indemnity LTC insurance product demand is stronger for individuals (especially females) who plan to rely on family members for high-level care. In other words, the product complements, rather than substitutes in the case of expense-reimbursement LTCI, availability of high-level informal care. We provide reasons for the complementary relationship and present supporting evidence. This result has important practical implications: not only can income-indemnity LTCI cover

[48] Wu et al. (2016) show that the optimal survival-contingent income for individuals in health state 4 is higher when LTCI is provided in bundle with longevity insurance.

a much larger proportion of the population by including the informal care users, but it will also be more attractive to this group of people than expense-reimbursement policies.

Finally, we looks into people's choices of longevity insurance when they can also insure LTC risk. Our findings show that having access to the LTC income product changes the annuitization choices of around half of the participants. However, there is considerable heterogeneity. A proportion of individuals see longevity insurance as a hedge for LTC costs in the absence of LTC insurance, whereas there is a larger proportion who will use the availability of LTC insurance to release precautionary savings in order to purchase more longevity insurance. Further analysis shows that individuals with lower LTC risk are more likely to do so. This implies that offering LTCI coverage will help with solving the annuitization puzzle for healthy individuals, but it may be less effective for unhealthy individuals.

Appendix A Means tested publicly financed LTC system in Australia

In most cases, LTC is referred to as aged care in Australia. The 2011 Census identified just over 3 million Australians aged 65 or above. About one fifth of them (570,000) needed help with one or more ADLs, of which 150,000 lived in a residential care facility (CEPAR, 2014).

Similar to the U.S. and the U.K., the publicly financed aged care system in Australia is means tested, with a recent reform having taken place in 2012 (Department of Health and Ageing, Australian Government, 2012). Subject to approval from an eligibility assessment authority[49], people who need (paid) care either in their own home or in a residential care facility receive financial support from the Australian Government. The amount of support is determined by means testing rules, which are some what integrated with the means-tested public pension (the Age Pension).[50] In aggregate, Australian Government expenditures on aged care are around 0.9% of GDP in 2014-15, with a projected increase to 1.7% of GDP in the next half century (The Treasury, Australian Government, 2015).

For people who receive care in their own home, costs comprise a subsidized basic daily fee and a care fee. The basic daily fee is 17.5% of the single basic rate of Age Pension.[51] The care fee is income-tested. Generally speaking, individuals whose income is in the Income Free Area[52] do not need to pay any care fees, with all costs paid by the Government. For those whose yearly income is above this area, their income-tested care fee increases by A$0.5 per year for every dollar of income in excess, up to different annual caps for part Age Pensioners and non-pensioners.[53]

For people who receive care in a residential facility, their costs consist of a subsidized basic daily fee, a care fee, and an accommodation payment. The basic daily fee is 85% of the single basic rate of Age Pension.[54] Both the care fee and accommodation payment are means tested, under an income test and an asset test. The value of family home is exempt in the asset test if it is occupied by a spouse or dependent children, but is assessed up to a capped amount if not.[55] Results of both tests are used to determine the amount of the care fee and accommodation payment that are payable by care users. Similar to home care users, an annual cap applies to the means-tested care fee for residential care users.[56]

[49]This is called the Aged Care Assessment Team (ACAT).

[50]For all thresholds of the means testing rules for home and residential care in April 2016, please see Department of Social Services, Australian Government (2016). All thresholds are indexed and adjusted twice per year, with new rates published in March and September by the Government.

[51]In April 2016, this corresponds to A$9.93 per day.

[52]This corresponds to yearly income less than A$25,659 for singles and combined yearly income less than A$39,822 for couples in April 2016. People in group are most likely the full Age Pensioners.

[53]These caps are A$5,188 per year for part Age Pensioner and A$10,376 for non-pensioners in April 2016.

[54]In April 2016, this corresponds to A$48.25 per day.

[55]This corresponds to $157,051 in April 2016.

[56]This corresponds to A$25,940 per year in April 2016.

On top of these provisions, the system also provides a lifetime stop-loss scheme on the amount of care fees paid out-of-pocket, although individuals are still liable to pay a subsidized basic daily fee and accommodation payment in the case of residential care. There is a lifetime cap, amounting to A$62,256 in April 2016. Individuals will not be required to pay more than the cap amount for means-tested care fees (the sum of both home care and residential care) in their lifetime.

The Australian Government also provides support to informal care givers, which is not included in the publicly financed aged care system. This consists of Carer Allowance (a supplement to cover some costs of caring) and Carer Payment (for those unable to work as a result of caring). For instance, around 220,000 Australian aged 65 or above received informal care from those receiving Carer Payment. In total, these cost an additional A$7 billion to the Government, with an estimated annual growth rate of over 6 percent in real terms for the next 20 years (National Commission of Audit, Australian Government, 2014).

Appendix B Other determinants of demand for the LTC income product

Analysis in Section 4 focuses on the influence of LTC risk factors and availability of informal care on the demand for the LTC income product. In this section, we discuss the effects of other categories of covariates. Table C1 in Online Appendix C reports the effects of these variables on the demand for the LTC income product when the level of survival-contingent income is fixed, whereas Table C2 focuses the effects when participants are able to choose the level of survival-contingent income.

Regarding measures of utility parameters, results in Table C1 show that willingness to take risk in a financial context has an inverse-U shape effect on the demand for the LTC income product. This inverse-U shape relationship is found for both the probability of purchasing and the purchased amount of LTC-contingent income. Thus for people with low risk aversion, the less willing they are to take risk the higher their demand for the LTC income product. For people with high risk aversion, the less willing they are to take risk the lower the demand for the LTC income product. The turning point is around 5 on the scale from 0 to 10.

Clarke (2016) shows theoretically that when insurance benefits are imperfectly correlated with the purchaser's net loss, demand for the insurance is low for very risk averse individuals. This is due to basis risk, the insurance could both worsen the worst possible outcome (suffer a loss without adequate benefits) and improve the best possible outcome (no loss but receive benefits). Giné and Yang (2009) and Cole et al. (2013) find empirical evidence supporting this argument in the market for wealth index insurance, where the insurance benefits depend on a wealth index rather than the actual losses of the purchaser. This is similar to our case: as an income-indemnity LTCI, benefits of the LTC income product depend on the disability status of the insured, rather than the costs of LTC (thus an imperfect correlation).

However, when individuals are able to choose the amount of survival-contingent income (Table C2), we find willingness to take risk does not explain the preferences for LTC-contingent income against survival-contingent income. The likely reason for this is that the demand for the LTC income product is measured relative to the demand for life annuities which is also affected by willingness to take risk. In this case, the reasons for the inverse-U shape relationship do not hold.

We also find that utility in bad health does not affect the demand for the LTC income product. Moreover, we find that strength of bequest motives significantly reduces the probability of purchasing the LTC income product and has a negative (but not significant) impact on the purchased amount

of LTC-contingent income. Note that despite statistically significance, the variable is not economically significant. The estimated average partial effect of bequest motive suggests that one percentage point increase in the chance of leaving $100K bequest decreases the chance of purchasing LTCI by less than 0.1 percentage point. In addition, we also find a strong negative impact of preferring an expense-reimbursement LTCI on the demand for the LTC income product. This is not apparent in the preferences for LTC-contingent income against survival-contingent income, because the negative impact of preferring an expense-reimbursement LTCI also reduces the demand for life annuities (as they are also an income product).

We observe that in general participants with better financial literacy, numeracy, and knowledge about retirement financial products have a lower demand for the LTC income product. This implies that they are more capable and likely self-insure against LTC risk using the investment account. The most important factors are numeracy and recall quiz earnings, which show significant and negative impact on the demand for the LTC income product in both Tables C1 and C2. Finally, we find retirement planning has little impact on the demand for the LTC income product.

References

Ameriks, J., Briggs, J. S., Caplin, A., Shapiro, M. D., and Tonetti, C. (2015a). Late-in-life risks and the under-insurance puzzle. Working paper, Vanguard.

Ameriks, J., Briggs, J. S., Caplin, A., Shapiro, M. D., and Tonetti, C. (2015b). Long-term care utility and late in life saving. Working Paper w20973, National Bureau of Economic Research.

Ameriks, J., Caplin, A., Laufer, S., and Van Nieuwerburgh, S. (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.

Australian Government Actuary (2009). Australian life tables 2005-07. Available at: www.aga.gov.au.

Bateman, H., Eckert, C., Geweke, J., Louviere, J., Satchell, S., and Thorp, S. (2016). Risk presentation and portfolio choice. *Review of Finance*, 20(1):201–229.

Belanger, A., Martel, L., Berthelot, J.-M., and Wilkins, R. (2002). Gender differences in disability-free life expectancy for selected risk factors and chronic conditions in Canada. *Journal of Women and Aging*, 14(1-2):61–83.

Beshears, J., Choi, J. J., Laibson, D., Madrian, B. C., and Zeldes, S. P. (2014). What makes annuitization more appealing? *Journal of Public Economics*, 116:2–16.

Brown, J. and Warshawsky, M. (2013). The life care annuity: A new empirical examination of an insurance innovation that addresses problems in the markets for life annuities and long-term care insurance. *Journal of Risk and Insurance*, 80(3):677–704.

Brown, J. R. and Finkelstein, A. (2007). Why is the market for long-term care insurance so small? *Journal of Public Economics*, 91(10):1967–1991.

Brown, J. R. and Finkelstein, A. (2008). The interaction of public and private insurance: Medicaid and the long-term care insurance market. *American Economic Review*, 98(3):1083–1102.

Brown, J. R. and Finkelstein, A. (2009). The private market for long-term care insurance in the United States: A review of the evidence. *Journal of Risk and Insurance*, 76(1):5–29.

Browne, M. (2006). Adverse selection in the long-term care insurance market. In Chiappori, P.-A. and Gollier, C., editors, *Competitive Failures in Insurance Markets*, pages 97–112. MIT Press, Cambridge, MA.

Buchmueller, T., Fiebig, D., Jones, G., and Savage, E. (2008). Advantageous selection in private health insurance: The case of Australia. *CHERE Working Paper 2008/2*.

CEPAR (2014). Aged care in Australia: Part I Policy, demand and funding. CEPAR Research Brief 2014/01, ARC Centre of Excellence in Population Ageing Research (CEPAR). Available at: http://www.cepar.edu.au/research-briefs.aspx.

Charles, K. K. and Sevak, P. (2005). Can family caregiving substitute for nursing home care? *Journal of Health Economics*, 24(6):1174–1190.

Clare, R. (2015). Superannuation balances by age and gender. Technical report, The Association of Superannuation Funds of Australia Limited (ASFA).

Clarke, D. J. (2016). A theory of rational demand for index insurance. *American Economic Journal: Microeconomics*, 8(1):283–306.

Cole, S., Giné, X., Tobacman, J., Townsend, R., Topalova, P., and Vickery, J. (2013). Barriers to household risk management: Evidence from India. *American Economic Journal: Applied Economics*, 5(1):104.

Colombo, F., Llena-Nozal, A., Mercier, J., and Tjadens, F. (2011). *Help Wanted? Providing and Paying for Long-Term Care*. OECD Publishing, Paris, France.

Davidoff, T. (2009). Housing, health, and annuities. *Journal of Risk and Insurance*, 76(1):31–52.

Davidoff, T. (2010). Home equity commitment and long-term care insurance demand. *Journal of Public Economics*, 94(1):44–49.

Davidoff, T., Brown, J. R., and Diamond, P. A. (2005). Annuities and individual welfare. *American Economic Review*, 95(5):1573–1590.

de Meza, D. and Webb, D. C. (2001). Advantageous selection in insurance markets. *Review of Economic Studies*, 32(2):249–262.

Department of Health and Ageing, Australian Government (2012). Living longer. living better. aged care reform package. Available at: http://www.health.gov.au/internet/publications/publishing.nsf/Content/ageing-living-longer-living-better-reform-package-toc.

Department of Social Services, Australian Government (2016). Schedule of fees and charges for residential and home care: From 20 March 2016. Available at: https://www.dss.gov.au/ageing-and-aged-care/aged-care-funding/aged-care-fees-and-charges/schedule-of-fees-and-charges-for-residential-and-home-care-from-20-march-2016.

Finkelstein, A. and McGarry, K. (2006). Multiple dimensions of private information: Evidence from the long-term care insurance market. *American Economic Review*, 96(4):938–958.

Giné, X. and Yang, D. (2009). Insurance, credit, and technology adoption: Field experimental evidence from Malawi. *Journal of Development Economics*, 89(1):1–11.

Harmer, J. (2008). Pension review. Background paper, Department of Families, Housing, Community Services and Indigenous Affairs, Australian Government, Canberra.

Hewitson, B., Seale, B., and Joyce, L. (2011). Public engagement exploring care and support funding options. Technical report 224301, May 2011, TNS BMRB on behalf of the Commission on Funding of Care and Support (the Dilnot Commission). Available at: http://dilnotcommission.dh.gov.uk/2011/05/18/report-of-qualitative-research-now-available-2.

Kaye, H. S., Harrington, C., and LaPlante, M. P. (2010). Long-term care: Who gets it, who provides it, who pays, and how much? *Health Affairs*, 29(1):11–21.

Lipkus, I. M., Samsa, G., and Rimer, B. K. (2001). General performance on a numeracy scale among highly educated samples. *Medical Decision Making*, 21(1):37–44.

Lloyd, J. (2011). Gone for good? Pre-funded insurance for long-term care. Technical report, February 2011, The Strategic Society Centre, London.

Lockwood, L. M. (2014). Incidental bequests: Bequest motives and the choice to self-insure late-life risks. Working Paper No. w20745, National Bureau of Economic Research.

Louviere, J. J., Hensher, D. A., and Swait, J. D. (2000). *Stated choice methods: Analysis and applications*. Cambridge University Press, Cambridge.

Lusardi, A. and Mitchell, O. S. (2009). How ordinary consumers make complex economic decisions: Financial literacy and retirement readiness. Working Paper w15350, National Bureau of Economic Research.

Mommaerts, C. (2016). Long-term care insurance and the family. Working paper, University of Wisconsin-Madison.

National Commission of Audit, Australian Government (2014). Towards responsible government. The report of the National Commission of Audit: Phase one. Available at: http://www.ncoa.gov.au/report/index.html.

National Seniors Productive Ageing Centre (2013). Expectations about ageing at home and aged care: A survey of senior Australians. Fact sheet No. 12 June 2013.

Noussair, C. N., Trautmann, S. T., and Van de Kuilen, G. (2013). Higher order risk attitudes, demographics, and financial decisions. *Review of Economic Studies*, 81(1):325–355.

Ooijen, R., Alessie, R., and Kalwij, A. (2015). Saving behavior and portfolio choice after retirement. *De Economist*, 163(3):353–404.

Oppenheimer, D. M., Meyvis, T., and Davidenko, N. (2009). Instructional manipulation checks: Detecting satisficing to increase statistical power. *Journal of Experimental Social Psychology*, 45(4):867–872.

Pang, G. and Warshawsky, M. (2010). Optimizing the equity-bond-annuity portfolio in retirement: The impact of uncertain health expenses. *Insurance: Mathematics and Economics*, 46(1):198–209.

Pauly, M. V. (1990). The rational nonpurchase of long-term-care insurance. *Journal of Political Economy*, 98(1):153–168.

Peijnenburg, K., Nijman, T., and Werker, B. J. (2015). Health cost risk: A potential solution to the annuity puzzle. *Economic Journal*, doi: 10.1111/ecoj.12354.

Pezzin, L. E., Kemper, P., and Reschovsky, J. (1996). Does publicly provided home care substitute for family care? experimental evidence with endogenous living arrangements. *Journal of Human Resources*, 31(3):650–676.

Pickard, L., Wittenberg, R., Comas-Herrera, A., King, D., and Malley, J. (2007). Care by spouses, care by children: Projections of informal care for older people in England to 2031. *Social Policy and Society*, 6(03):353–366.

Poterba, J., Venti, S., and Wise, D. (2017). What determines end of life asset? A retrospective view. In Wise, D. A., editor, *Insights in the Economics of Aging*. The University of Chicago Press, Chicago.

Productivity Commission (2011). Caring for older Australians, Report No.53, Final inquiry report. Available at: http://www.pc.gov.au/projects/inquiry/aged-care/report.

Reichling, F. and Smetters, K. (2015). Optimal annuitization with stochastic mortality and correlated medical costs. *American Economic Review*, 105(11):3273–3320.

Robinson, J. (1996). A long-term care status transition model. presented at the 1996 Bowles Symposium on the Old-Age Crisis: Actuarial Opportunities. Georgia State University, September.

Sloan, F. A. and Norton, E. C. (1997). Adverse selection, bequests, crowding out, and private demand for insurance: Evidence from the long-term care insurance market. *Journal of Risk and Uncertainty*, 15(3):201–219.

The Treasury, Australian Government (2015). Intergenerational report 2015. Available at: http://www.treasury.gov.au/PublicationsAndMedia/Publications/2015/2015-Intergenerational-Report.

Turra, C. M. and Mitchell, O. (2008). The impact of health status and out-of-pocket medical expenditures on annuity valuation. In Ameriks, J. and Mitchell, O. S., editors, *Recalibrating Retirement Spending and Saving*, pages 227–250. Oxford University Press, Oxford.

U.K. Department of Health (2013). Policy statement on care and support funding reform and legislative requirements. Available at: http://www.dh.gov.uk/health/files/2013/02/Policy-statement-on-funding-reform.pdf.

Webb, D. C. (2009). Asymmetric information, long-term care insurance, and annuities: The case for bundled contracts. *Journal of Risk and Insurance*, 76(1):53–85.

Weinstein, N. D. (1982). Unrealistic optimism about susceptibility to health problems. *Journal of Behavioral Medicine*, 5(4):441–460.

Weinstein, N. D. (1987). Unrealistic optimism about susceptibility to health problems: Conclusions from a community-wide sample. *Journal of Behavioral Medicine*, 10(5):481–500.

Wiener, J., Anderson, W. L., and Brown, D. (2009). Why are nursing home utilization rates declining? Technical report, Centres for Medicare and Medicaid Services, U.S. Department of Health and Human Services. Available at: http://www.nasuad.org/hcbs/article/why-are-nursing-home-utilization-rates-declining.

Wu, S., Asher, A., Meyricke, R., and Thorp, S. (2015a). Age pensioner profiles: A longitudinal study of income, assets and decumulation. Working Paper No. 2015/17, ARC Centre of Excellence in Population Ageing Research (CEPAR).

Wu, S., Bateman, H., and Stevens, R. (2016). Optimal portfolio choice with health contingent income products: The value of life care annuities. Working Paper 2016/17, ARC Centre of Excellence in Population Ageing Research (CEPAR).

Wu, S., Stevens, R., and Thorp, S. (2015b). Cohort and target age effects on subjective survival probabilities: Implications for models of the retirement phase. *Journal of Economic Dynamics and Control*, 55:39–56.

Yaari, M. E. (1965). Uncertain lifetime, life insurance, and the theory of the consumer. *Review of Economic Studies*, 32(2):137–150.

Zhou-Richter, T., Browne, M. J., and Gründl, H. (2010). Don't they care? Or, are they just unaware? Risk perception and the demand for long-term care insurance. *Journal of Risk and Insurance*, 77(4):715–747.

Zweifel, P. and Strüwe, W. (1998). Long-term care insurance in a two-generation model. *Journal of Risk and Insurance*, 65(1):13–32.