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Flexible insurance for informal long-term care: An experimental study of demand

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ABSTRACT

We study stated preferences for long-term care insurance that pays income instead of reimbursing formal care costs. Our results show that long-term care income insurance is likely to provide two important benefits to aging societies. First, it can facilitate flexible, informal, long-term care - seniors who plan to rely on family members for extensive care find income insurance particularly attractive. Second, it can enhance risk-pooling - if long-term care income insurance were available, many seniors would release funds set aside to self-insure long-term care risk and purchase additional longevity insurance. Our results rule out adverse selection into the long-term care income insurance product on objective risk factors but show both adverse and advantageous selection effects on private information. We conclude that a flexible insurance product that supports informal care has both demand- and supply-side advantages over typical expense-reimbursement cover.

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

JEL Classifications: G52, I13, J32

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1 Introduction

Between 50 and 65 percent of people now aged 65 will need long-term care at some time before they die (Ameriks et al., 2018; Hewitson et al., 2011; Productivity Commission, 2011; Colombo et al., 2011). The costs of long-term-care will consume more of elderly households' financial resources than other health-related expenses (French et al., 2019). One way to manage this risk is to purchase long-term-care insurance but such insurance is not sold at all in many countries, and even where it is available, few people buy it (Ameriks et al., 2011; Lockwood, 2018). The development of markets for long-term care insurance has been limited by i) the incentive for insured families to substitute formal (insured) care for informal (uninsured) care, increasing claims (Pauly, 1990; Zweifel and Strüwe, 1998; Mommaerts, 2016; Ko, 2016); and ii) the difficulty insurers have appraising purchaser risks that leads to broad exclusions (Sloan and Norton, 1997; Brown and Finkelstein, 2007; Webb, 2009; Hendren, 2013; Braun et al., 2019). Aging societies need more flexible, accessible and affordable long-term care insurance products.

Here we study an emerging insurance product that can help the elderly and their families manage long-term-care risk. We measure potential purchasers' interest in a long-term care insurance product that pays a regular income whenever the insured person needs care, irrespective of the formal care costs they incur. We do this by collecting and modelling the stated preferences of over 1,000 pre-retirees for this product, that we call "long term care income insurance".[1]

Our results show that long-term care income insurance is likely to provide several benefits to aging societies. We find that this product can lower incentives to switch from informal to formal care (Pauly, 1990; Zweifel and Strüwe, 1998) and thus facilitate flexible care arrangements more readily than conventional expense-reimbursement long-term-care insurance. Our tests confirm that long-term care income insurance cover is a complement to, not a substitute for, informal care. We also show that long-term care income insurance is likely to require less risk appraisal of purchasers by insurers than the common type of expense-reimbursement insurance. We estimate that potential purchasers who have higher observable risk characteristics do not have a significantly higher demand for long-term care income insurance. At the same time, we find some evidence of both adverse and advantageous selection on subjective, and therefore unobservable to the insurer, measures (de Meza and Webb, 2001; Finkelstein and McGarry, 2006; Hendren, 2013). On balance, we conclude that a long-term care income product is more likely

[1] A version of this product has been introduced in the US market as an annuity product with a long-term care rider (LIMRA, 2017) and such hybrid products now comprise around 80 percent of new sales of long-term care insurance in the US (American Association for Long Term Care Insurance, 2019).Brown and Warshawsky (2013) introduced the idea for a long-term-care-contingent annuity and it has since been advocated in (French et al., 2019). Demand for similar products has been studied in Ameriks et al. (2018) and (Society of Actuaries, 2018).

to be commercially viable than expense-reimbursement products, because it could be offered with less underwriting, lower loadings, and, consequently, at a lower price.

Long-term care income insurance could also encourage longevity-risk pooling. We show that if people can access a long-term care income product, they are more likely to release savings set aside as a precaution against future care costs and purchase longevity insurance (Ko, 2016; Mommaerts, 2016). Previous studies offer mixed evidence of the effects of long-term care risk and health cost risk on the demand for longevity insurance (life annuities). On one hand, people could purchase more longevity insurance and use the increasing-with-age mortality credits to buffer care costs (Davidoff et al., 2005; Davidoff, 2009; Pang and Warshawsky, 2010; Peijnenburg et al., 2017). On the other hand, people might lower annuitization and instead hold more liquid wealth to self-insure for long-term care risk (Turra and Mitchell, 2008; Reichling and Smetters, 2015; Wu et al., 2016; Ameriks et al., 2011; Ameriks et al., 2015). A significant proportion of participants in our study treat the long-term care income product as a complement to longevity insurance, particularly those with lower long-term care risk. This complementarity means that a "bundle" of longevity insurance and long-term care income insurance might encourage longevity insurance purchases by unhealthy individuals (Brown and Warshawsky, 2013).

Overall, around 75% of pre-retirees in our experiment chose to "spend" at least some of their retirement savings on long-term care income. The median annual long-term-care contingent income they chose, at around A$45,000, is comparable with estimated costs for high-level care. At the same time, these results put the stated demand for long-term care income well above the actual demand for private expense-reimbursement cover in real markets (Ameriks et al., 2018) and we treat this estimated demand with caution. We recognise that the experimental setting smooths some important "real-world" purchasing frictions.

A challenge for research into the viability of new and emerging products, such as long-term care income insurance, is the lack of revealed preference data. Given this constraint, we base our findings on stated preferences.[2] Similar stated preference methods have been used to elicit interest in life annuities in the US (Beshears et al., 2014), Australia (Bateman et al., 2018) and Canada (Boyer et al., 2020a); valuation of life annuities (Brown et al., 2017; Brown et al., 2020); and interest in and valuation of long term care insurance in the US (Ameriks et al., 2011; Ameriks et al., 2018; Akaichi et al., 2020) and Canada (Boyer et al., 2020b).

[2]Stated preference data overcomes some of the difficulties of analyzing revealed preference data, such as uncontrolled and complex institutional settings and market incompleteness, while still conveying implications for decisions in real life (Louviere et al., 2000).

We incentivized a representative sample of participants in a choice experiment to learn about one new, and two existing, products: a long-term care income insurance product that exchanges a single premium payment for health-contingent income benefits, a life annuity, and a liquid investment account. We then asked participants to divide their hypothetical retirement savings between these products through a series of choice tasks that identify their preferences for health-contingent and survival-contingent income. They then answered questions about demographics, health and illnesses, subjective expectations about the need for care, potential sources of care, and a variety of personal characteristics.

We collected the data in Australia, a setting with several advantages. First, the publicly financed long-term care system in Australia shares many features with other developed countries, especially the UK, such as the absence of a private market for long-term care insurance, so our results are informative in many other settings. Second, Australians are very unlikely to have experienced a private market for long-term-care insurance. Australian participants come to the hypothetical scenarios in the choice experiment with no influences from previous experiences. Third, pre-retirees in Australia participate in the mandatory defined contribution (DC) retirement saving system and have responsibility for managing their own retirement account balances (Clare, 2019). For these reasons, decisions about retirement wealth are consequential, relevant, and imminent for participants in our experiment.

Our investigation of demand for long-term care insurance speaks to an urgent issue for social and economic policy. Home-based care is increasingly favored by elderly people and governments, especially in countries with a familism culture (Costa-Font et al., 2009; Costa-Font, 2010), but also in countries where formal long-term care arrangements are more common, such as in the US, Europe, and Australia (Barczyk and Kredler, 2019).[3] As the usage rates of home-based care increase, elders and their families are calling for more flexible financial support (Muir, 2017; Commonwealth of Australia, 2019). And while the care provided by family members may be unpaid, it is not costless. Carers bear substantial implicit and explicit costs such as lost time, lost earnings, and detriments to physical and mental health (Colombo et al., 2011; Schmitz and Westphal, 2017; Caplin et al., 2018; Do et al., 2015). These losses are not reimbursed by typical long-term care insurance policies and are only partially offset in public systems that pay carers.

Our findings also add to the body of research on the underdeveloped private markets for long-term care insurance. In the US, the coverage rate of private long-term care insurance is around 7% and has

[3]In Australia increased emphasis on home-based care was formalized in the Living Longer Living Better Aged Care Reform Package introduced in 2012 (Department of Health and Ageing, Australian Government, 2012) and was expanded in the 2018 More Choices for Longer Life Package (https://archive.budget.gov.au/2018-19/factsheets/supporting-choice.pdf). These issues are also high on the policy agenda in the UK (see Mayhew et al., 2010; Jarrett, 2019).

been falling (LIMRA, 2017), while, in Europe, a recent study of SHARE data identifies large country variations, but low overall coverage, with the exception of France and Israel (Bucher-Koenen et al., 2017). There is no private market at all for long-term care insurance in the UK or Australia. Explanations for weak markets in long-term care insurance include adverse selection (Sloan and Norton, 1997; Finkelstein and McGarry, 2006; Brown and Finkelstein, 2009; Webb, 2009; Hendren, 2013), poor product design (Brown and Finkelstein, 2007; Ameriks et al., 2018; Akaichi et al., 2020), availability of public care (Sloan and Norton, 1997; Brown and Finkelstein, 2008), means-testing of public benefits (De Nardi et al., 2016; Braun et al., 2016), reliance on unpaid care givers (Pauly, 1990; Zweifel and Strüwe, 1998; Brown et al., 2012), self-insurance using home equity (Davidoff, 2010), (non-strategic) bequest motives (Pauly, 1990; Lockwood, 2018), limited awareness of risk (Zhou-Richter et al., 2010), and state-dependent utility (Brown and Finkelstein, 2009). Our results are consistent with several of these explanations and but also show that long-term care income insurance can potentially encourage stronger demand.

The remainder of the paper is structured as follows. In the next section, we describe the experimental sample and incentives. In Section 3, we go through the choice task and report descriptive statistics. Section 4 presents econometric results that focus on the connection between preferences for, and access to, informal care and the demand for the long-term care income product and selection effects. We then investigate the relationship between longevity insurance and long-term care income insurance, and the impact on precautionary savings. Section 5 concludes.

2 Sample and incentives

We selected our sample to represent the population of pre-retirees who are likely to be interested in, and capable of purchasing, long-term care and longevity insurance at retirement. We sampled 1,008 people aged 55-64 years in October 2015 from a panel of over 180,000 Australians maintained by the web panel provider Lightspeed GMI[4], excluding people who said they had dementia, or that they needed help with two or more activities of daily living (ADLs). These conditions would make them immediately eligible for health-contingent income, and therefore disqualified from purchasing the insurance policy.

We put participants into eight (2×4) treatment groups based on gender (2 groups) and their net wealth excluding the family home (4 groups). This put a roughly even number in each wealth group. We constructed choices for each group based on endowments of retirement savings approximating actual

[4]Appendix A provides a brief explanation of the financing of long-term care in Australia.

levels, at $50,000, $175,000, $375,000 or $1,000,000.[5] Table 1 compares the demographics of the sample with the Australian population aged 55-64. The sample is similar to the population except that the participants were better educated and had higher personal income, on average, which was probably the consequence of requiring a minimum net wealth for participation.

Table 1: 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 need help with two or more activities of daily living. The population data come 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			A$1 to A$20,799	28.8	24.8
Employed (FT)	37.3	27.0	A$20,800 to A$41,599	24.3	25.2
Employed (PT)	23.1	20.6	A$41,600 to A$64,999	18.4	20.7
Unemployed	2.4	5.8	A$65,000 to A$103,999	13.4	16.0
Not in labor force	37.2	46.6	A$104,000 or more	7.6	5.7

The web panel provider recruited participants by email invitation and paid eligible participants A$4 if they completed the online survey, with a chance to earn a bonus of up to A$3. The bonus depended on participants' answers to a quiz that tested how much product information they could recall, motivating them to pay attention to product attributes.[6] In the survey, eligible participants first completed an

[5] Table 9 in Appendix B reports the wealth groups

[6] Ideally, we would offer an incentive payment to participants that was compatible with the hypothetical allocations of

experimental task then answered three sets of questions relating to preferences, long-term care risks, financial knowledge and demographics. The median time participants took to complete the survey was 30 minutes and we checked the participants' inattention using two instructional manipulation checks (IMC)[7] (Oppenheimer et al., 2009).

When they had finished answering questions, we asked participants to assess the clarity of the survey over six levels that ranged from "completely clear" to "completely confusing". Over half of the participants reported that the survey was "completely clear" or "mostly clear", while only 5% found the survey "mostly confusing" or "completely confusing".[8]

3 Experimental task and preliminary results

We designed the experimental task, first, to explore the connection between preferences for informal care and for the long-term care income product; second, to assess whether high- or low-risk purchasers demand the long-term care income product; and third, to better understand the connection between the long-term care income product, longevity risk insurance (life annuities), and liquid precautionary savings. Conditioning on wealth group assignment, all participants answered all questions, thus avoiding selection effects in the stated preference data.

We asked participants to compare three financial products in a three-stage task that identified their most preferred mix of retirement income and insurance products. Our choice of products allows us to measure participants' trade-offs between cover for two key risks, health- and survival-contingent income, and for uninsured risks, via the liquid investment account. The first product was long-term care insurance that provides a fixed regular income for the period of time the insured needs care. When the insured person has either dementia and/or needs help with at least two ADLs out of (i) eating, (ii) bathing, (iii) dressing, (iv) toileting, and (v) getting into or out of bed, the insurer pays the agreed income.[9] The insurer stops the income payments if the insured dies or recovers from these conditions. The product does not guarantee to cover total formal care expenditure and the costs of care can exceed the income

their retirement savings made in the experimental tasks. However, an incentive payment that is compatible with the trade-off between long-term care insurance coverage and liquidity is a complicated multi-period payment that continues over the whole of retirement and is thus infeasible in this experiment.

[7] We repeated questions about dementia and ADL limitations two times in the survey. A participant failed an IMC if either the answers provided in an IMC were not consistent with his or her previous answers, or the participant failed to recognize that these questions had appeared before. Under these criteria, 9% of participants failed the IMCs.

[8] The dynamic version of the survey is available at: `https://survey.confirmit.com/wix/3/p3074038853.aspx`. A full set of screenshots from the survey that include the wording of all questions and in-structions is available in Online Appendix A at `http://www.cepar.edu.au/publications/working-papers/online-appendices-flexible-insurance-for-informal-long-term-care.pdf`.

[9] In reality, these limitations in ADLs are usually determined by a physician to reduce moral hazard.

benefits. The regular income can be used at the discretion of the insured to pay for professional care, for care provided by family members, or to cover other expenses. The second product was an immediate life annuity that provides fixed, inflation-indexed, lifetime income. The third product was a liquid investment account where withdrawals can be made at any time. We priced the life annuity and the long-term care income product at actuarially fair value that was based on gender and a risk-free, real interest rate of 3%. We took both the mortality probabilities and health transition probabilities for pricing the life annuity and the long-term care income product from estimates by Brown and Warshawsky (2013). (See Appendix C for details on mortality and health probabilities.)[10]

The experimental task started with introductory information about how people could meet retirement expenses, such as the estimated average chance and costs of long-term care (Productivity Commission, 2011).[11] We then asked participants to compare their chances of needing in-home care and residential care against an average person of their gender. After that, we described the three retirement income products, illustrated their prices, and explained the opportunity for bonus earnings for correct answers in a recall quiz. (We summarized the important features of the products in a table that also pops up during the task if participants put their cursor on the product names.) Next, we described the setting for their decision: a simple situation where everyone was paid a flat-rate public pension, was not subject to taxation, and could be confident that the insurers would not default.[12]

Participants then answered nine questions in a sequence we set to simplify a potentially complex choice set (Besedeš et al., 2015). Before answering the questions, participants read the following: "We are now going to present you with 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."

[10]Preliminary focus group analysis of the choice task showed that Australians understood the labels "Aged care income", "Lifetime annual income", and "Account-based pension" best. Long-term care is called "aged care" in Australia. As not all annuity products provide longevity insurance in Australia (and purchases of term annuities are far more common than life annuities), the life annuity is labeled "Lifetime annual income". The "Account-based pension" is the most popular decumulation product for DC pension plans (i.e., superannuation funds) in Australia. It is a liquid investment account that allows an individual to choose their asset allocation and make regular withdrawals, subject to tax concessions for withdrawals that meet the prescribed minimum drawdown limits. These limits are ignored in the experimental design.

[11]To control for the effects of public support for aged care costs that are subject to complex means testing rules, we also abstracted from the means testing rules and only presented the unsubsidized costs of care to participants.

[12]The public pension in Australia is the Age Pension that is means-tested and covers more than 70% of Australians over the eligibility age of 65 (Department of Social Services, Australian Government, 2018). We labeled the public pension in the experiment as "Age Pension" but also told participants explicitly both in the instructions and in the experiment questions that the amount of income from the public pension was constant and would not change with the choices they made.

3.1 Long-term-care income insurance choices

Questions one to four (Q1 - Q4) measured the participants' stated demand for long-term care income at incrementally increasing levels of lifetime annual (public pension and annuity) income. For example, Q1 asked participants how much long-term care income they would like to buy if they also received an inflation-linked lifetime income of A$22,000 per annum from the public pension (basic retirement income). Any remaining wealth stayed in a liquid investment account (account-based pension). The participants made their choices by moving a slider, and, as they did so, they could see changes in their health-contingent (long-term or "aged" care) income and related changes in their liquid wealth (i.e., the account-based pension balance), always constrained by their total retirement savings. Figure 1 shows an example of the first question of the experimental task. In Q1, we allocated 0% of retirement savings to the life annuity; Q2-Q4 repeated the same decision but with the share of retirement wealth paid for a life annuity rising from 25%, to 50%, to 75%.

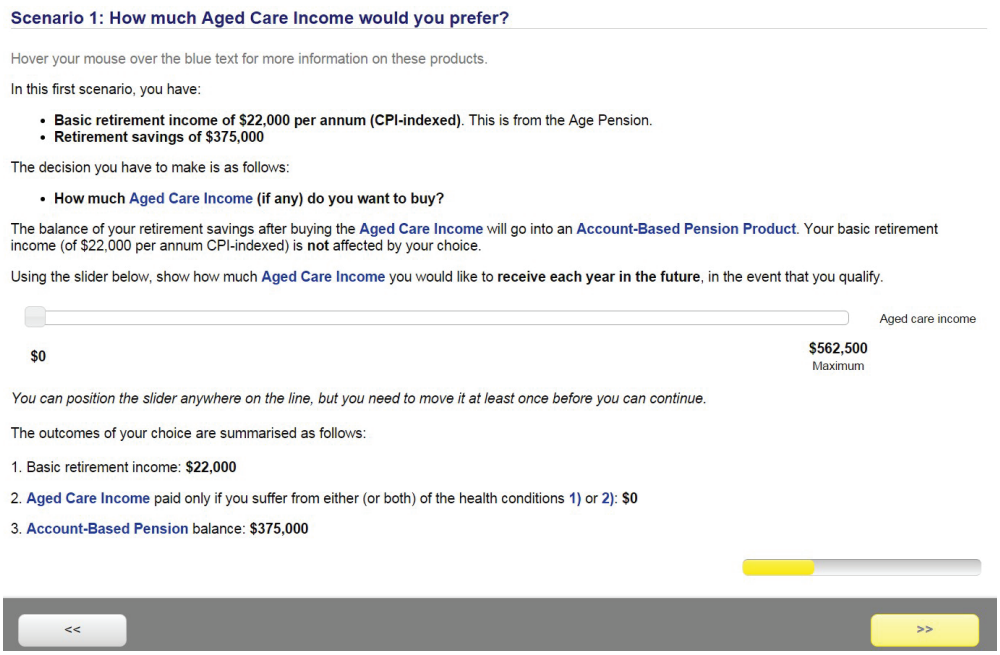

Figure 1: Allocation question for a male in wealth group 3

In these tasks, around 85% of participants chose to purchase at least some of the long-term care income product at all pre-determined levels of annuitization. The percentage of remaining savings allocated to the long-term care income product generally increased as pre-set annuitization rose, consistent with people choosing to maintain a nominal amount of long-term care income. Figure 2 graphs the cumulative proportion of male and female participants (vertical axis) that chose a percentage of remaining retirement

savings (horizontal axis) to purchase the long-term care income product at each pre-set amount of life annuity.

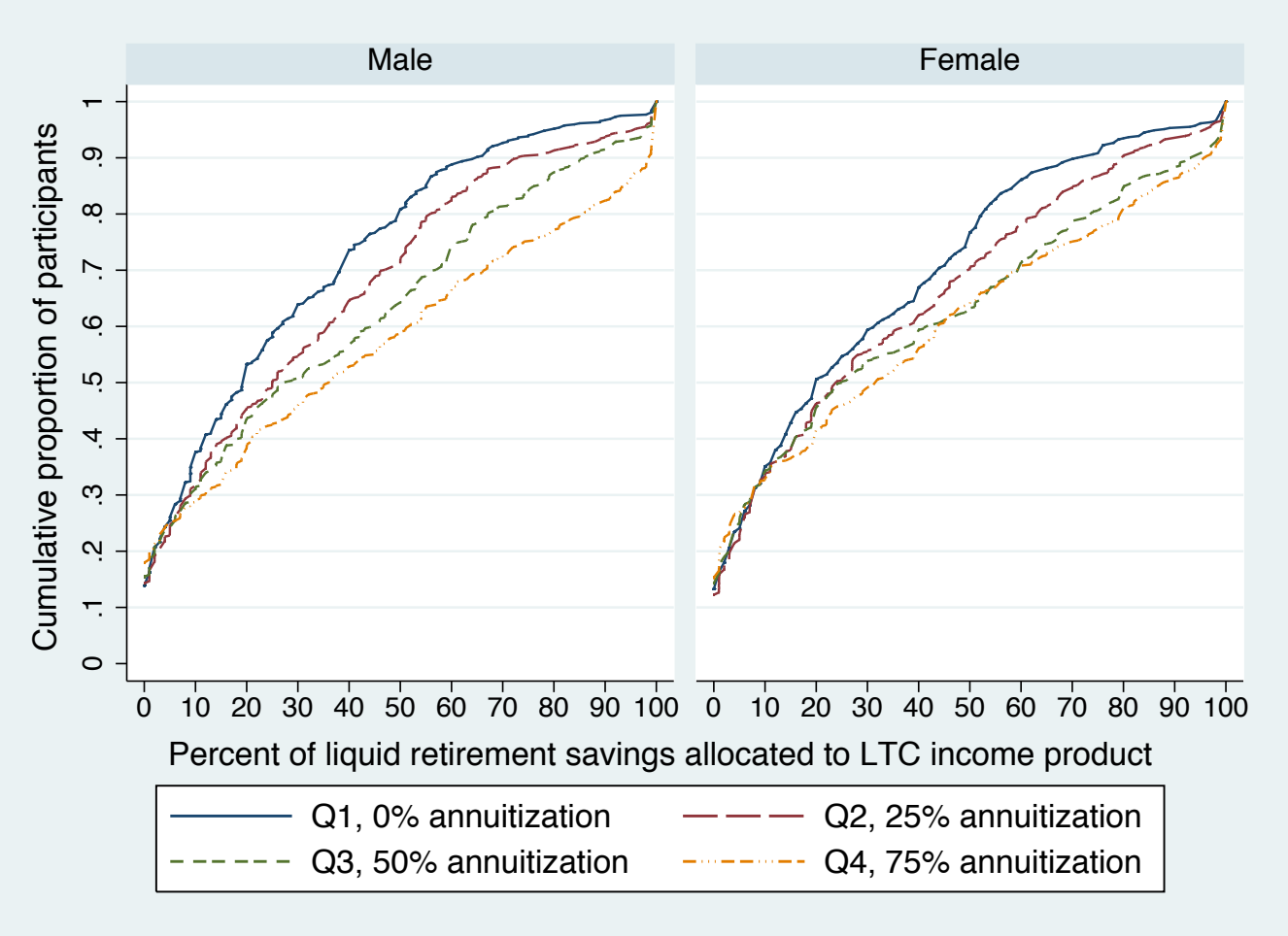

Figure 2: Cumulative proportion of participants choosing to allocate a given percentage of available retirement savings to the long-term care income product at predetermined levels of annuitization. Data used in the calculations is from Q1-Q4 of the experimental task.

Table 2 shows the distribution of participants' choices in terms of dollar values of long-term care income insurance. The amount chosen by the median participant decreases from A$50,700 (A$35,300) at a 0% level of annuitization to A$18,800 (A$11,800) at a 75% level of annuitization for males (females). Females are objectively more likely to need long-term care (Brown and Finkelstein, 2007), but the dollar amounts chosen by males were higher, probably in response to fair pricing that makes the long-term care income product 33% less expensive for males than females.[13]

The majority of participants maintained some liquidity at the expense of long-term care insurance

[13]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 long-term care states soon, or they are reporting errors due to a misunderstanding of the experimental tasks or product features.

Table 2: Percentiles of annual long-term-care-contingent income chosen (in A$000)

The table reports selected percentiles, mean, and standard deviations of annual health-contingent income chosen at predetermined levels of annuitization for both genders. Data are from Q1-Q4 of the experimental task.

	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

coverage as annuitization increased. Around 17% of participants chose a fixed nominal long-term-care-contingent income, even at the expense of exhausting their liquid savings, while around 14% purchased almost none.

3.2 Preferred allocations of retirement savings

The next part of the task asked participants which of the allocations they had made at 25% to 75% annuitization (Q2-Q4) they most and least preferred (Q5). Then, to discover their most preferred allocation from 0% to 100% annuitization, we showed participants their highest ranked alternative from Q5, together with participants' choice from Q1 (zero annuitization) and a third alternative that assumed 100% annuitization (i.e., no long-term care income or savings in the investment account). We then asked participants to rank these three allocations (Q6). Responses to Q5 and Q6 together thus gave us participants' most preferred ratios of health-contingent to survival-contingent income, along with their preferred allocation to liquid wealth.

Figure 3 illustrates the cumulative distribution of allocations of retirement savings to the three financial products introduced in the survey: the long-term care income product, the life annuity, and the investment account, respectively. Around 75% of participants chose to "spend" at least some of their

retirement savings on long-term care income.[14] The median annual health-contingent income chosen is around A$45,000. These results put the stated demand for long-term care income insurance well above the actual demand for the expense-reimbursement variant in real markets – in line with Ameriks et al. (2018).[15] This apparently high demand for long-term care income insurance is partly explained by the fact that the experimental setting removes real world barriers to purchasers. That is to say, we explain all three financial products and incentivize participants to learn about them. We also circumvent intermediaries and distributers by asking participants directly about their preferences. Stated preference studies for similar insurance products show similar high potential demand (see Brown et al., 2008; Beshears et al., 2014; Brown et al., 2017 Bateman et al., 2018; Brown et al., 2020).

From this point we can infer participants' most preferred ratios of health-contingent income to survival-contingent income (consisting of income from the life annuity and public pension). Table 3 shows selected percentiles.[16] Over three quarters of participants chose a ratio below three. The health- to survival-contingent income ratio generally increases with wealth, partly because the fixed (and pre-set) public pension is a large component of the allocations of participants with low wealth, but a declining share of the allocations of wealthier participants, giving the latter's ratios a higher upper bound. We elaborate on the mechanism underlying choices of this ratio in the multivariate analysis that follows.

3.3 Long-term care, annuitization and precautionary savings

The next part of the task (Q7) measured how access to long-term care income insurance affected participants' demand for life annuities and precautionary saving. In this question, we told participants that the long-term care income product was no longer available. We asked them to rank three options: 1) their preferred allocation (from Q6), but where the money they spent on long-term care income was refunded to their liquid investment account with the level of lifetime income remaining the same; 2) option 1 with 25 percentage points higher annuitization; and 3) option 1 with 25 percentage points lower annuitization. Questions 8 and 9 collected complementary information: how participants would finance any purchases of long-term care insurance they might make in the future (Q8); and whether they preferred long-term

[14] Note that this number is lower than the 85% reported in Section 3.1 (Figure 2), as just over 10% of participants choose full annuitization in Q6.

[15] Only the US has a private market for long-term care insurance, and it is widely agreed that the expense-reimbursement long-term care insurance product is poorly designed (Brown and Warshawsky, 2013; Ameriks et al., 2018).

[16] $L_i = \frac{INC_i^{LTC}}{INC_i^S}$, where INC_i^{LTC} represents the annual amount of health-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).

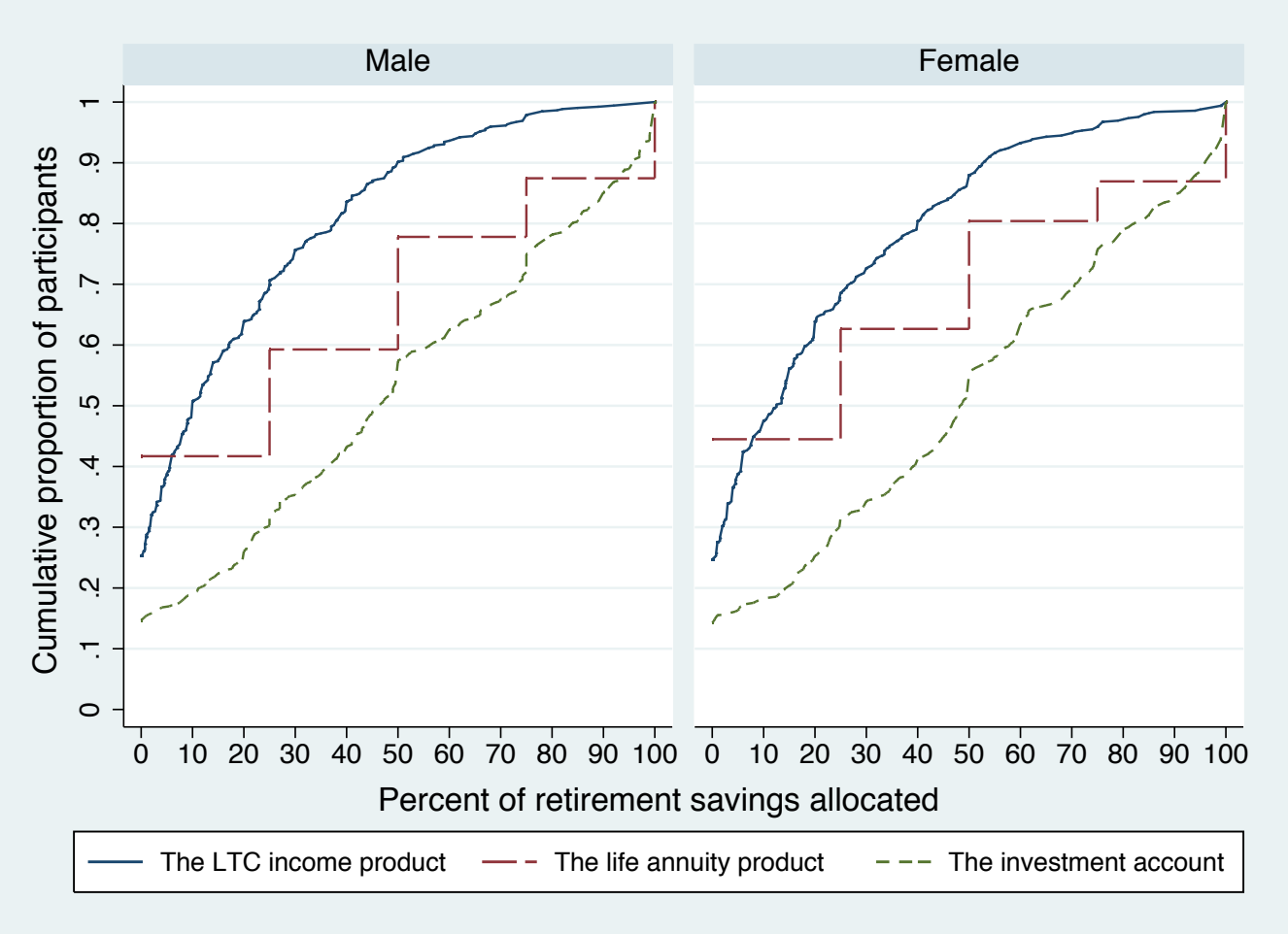

Figure 3: Cumulative distribution for allocation of retirement savings. The figure shows the cumulative distribution of the percentage of retirement savings allocated to the long-term care income product (continuous from 0% to 100%), the life annuity product (discrete from 0% to 100% at an interval of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

Table 3: Percentiles of the ratio of health-contingent income over survival-contingent income

This table displays selected percentiles and the mean and standard deviations of the ratio of health-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 by using the data from Q6 of the experimental task. Wealth groups are classified as in Table 9.

	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	141	121	115	113	490

care insurance benefits paid as income (labeled as fixed payments) or expense-reimbursement (labeled as reimbursement) (Q9). The experimental task concluded with a recall quiz on the key features of the three financial products.

3.4 Participant characteristics

The survey collected an array of personal information about participants including: i) risk attitudes (Dohmen et al., 2011), patience, and preferences for spending in different health conditions; ii) measures of exposure to long-term care risk, including health, subjective longevity, smoking status, bequests, experience of receiving or providing care, purchase of private health insurance, availability of informal care, and planning for financing care; and iii) personal demographic characteristics and financial capability measures, including past experiences with insurance products. Table 4 displays the summary statistics for the participants' characteristics.

Table 4: Participants' Characteristics: Summary statistics

The table displays the definitions and summary statistics for participants characteristic variables from survey responses.

Variable:	Mean	Standard deviation	Variable type
Panel A: Key variables of interests			
Objective measures of exposure to long-term care 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 long-term care 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
Availability of informal care			
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
Panel B: Other control variables			
Awareness of long-term care 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
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 A$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 on a 0-3 scale
No. of mistakes in Numeracy	1.298	1.091	Continuous on a 0-3 scale
No. of correct answers in recall quiz	3.119	1.705	Continuous on a 0-6 scale
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			
Intend 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			
Not born in Australia	0.243	0.429	Binary
Bachelor degree or above	0.327	0.469	Binary
Work status			Categorical
Full time	0.270		Proportion in this group
Part time	0.206		Proportion in this group
Unemployed/not in labor force	0.384		Proportion in this group
Retired	0.140		Proportion in this group
Household gross income	73.672	55.188	Continuous in thousand dollars/Year

continued on next page

Table 4 – continued

Variable:	Mean	Standard deviation	Variable type
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
Non-partnered	0.326	0.469	Binary
Number of children	1.961	1.465	Continuous
Non-homeowner	0.191	0.394	Binary

Objective measures of exposure to long-term care risk can help identify selection effects, including health status, smoking status, and past receipt of care. We measure the health status of survey participants against four health states. (See Appendix C.) The majority of participants have no health issues, while 5.7% of participants reported being smokers, and 6.2% had received care in the past five years.

Participants may have additional private information about their long-term care risk (Hendren, 2013). The three subjective indicators of exposure to long-term care risk we collect are subjective life expectancy and the self-assessed need for home care or residential care, respectively. Participants, on average, were subjectively pessimistic about their survival prospects, consistent with other studies (e.g., Wu et al., 2015). However, participants were more likely to be optimistic than pessimistic about their probability of needing in-home or residential care: around 40% rated their chances of needing care as below average, compared with fewer than 8% who rated their chances as above average. The small number of participants who reported a higher-than-average chance of needing residential care are consistent with unrealistic optimism about health problems found in other studies (Weinstein, 1982, 1987).

These responses help us evaluate selection effects based on subjective risk assessments. None of these three variables is observable by a product provider, and selection based on any of them cannot be addressed directly by underwriting, except to the extent that they are correlated with observable risks that lead to exclusions (Hendren, 2013). Moreover, we do not know the extent to which an *ex ante* selection based on these variables will be realized in *ex post* benefit payments, for this sample. For example, participants with subjective indicators of high long-term care risk could in fact be high risks (Hendren, 2013), be mistaken, or they could have higher risk perceptions, which can lead to better health behaviors and thus lower risks (Finkelstein and McGarry, 2006).

We are also particularly interested in the relationship between the demand for the long-term care income product and informal care. Thus, we collect data on the availability of informal care for both low-level and extensive care as well as whether participants are partnered and the number of children they have (if any). Around 70% of participants had access to low-level informal care, and 50% to high level care. In terms of awareness of long-term care risk, around 50% of participants report that they had

"set aside money", while just over 40% responded that they "do not know needs and costs" with the remaining 8% reporting that they expected to rely on government. Just over one quarter of participants reported that they had provided care in the past five years.

Other control variables - including variables measuring awareness of long-term care risk, utility parameters and covariates such as financial capabilities, product and system knowledge, retirement planning and demographics - are reported in Table 4 (Panel B) and discussed in detail in Online Appendix B. Responses to questions on financial capability indicated modest levels of financial literacy and numeracy in accordance with previous studies (Bateman et al., 2018) and good general product knowledge. Participants also showed adequate knowledge of the three financial products introduced in the experimental task. Two thirds of the participants answered at least 3 out of the 6 questions correctly.

4 Results and Discussion

In this section, we begin by reporting results from econometric models of demand for long-term care income insurance. First, we investigate whether people expect to use the long-term care income insurance to fund informal as well as formal care, that is, whether the moral hazard associated with insurance that reimburses formal care expenses is reduced with income insurance. Second, we determine whether people choose the long-term care income product if they are more likely to need to claim the benefit, that is, whether there are selection effects. A viable market for long-term care income insurance depends on the answers to these two questions. We then review the impact of the long-term care income product on the demand for life annuities.

Using data from Q1-Q4, we estimate two random effects models. In the first model, we use a random-effects probit specification to analyze the binary decision to purchase the long-term care income product or not. Second, we use OLS to estimate models of the demand for dollar-amounts of health-contingent income, for participants who have chosen to purchase a non-zero amount of the long-term care income product.

In both the probit and OLS specifications, we include explanatory variables relating to objective and subjective indicators of long-term care risk and the availability of informal care, and a set of controls. To avoid difficulties with multiple hypothesis testing, we select controls from the long list of possibilities shown in Table 4 using the machine learning technique Least Absolute Shrinkage and Selection Operator (LASSO) based on the extended Bayesian information criterion (EBIC, Chen and Chen, 2008).[17] The

[17]We also estimate models that include the key variables of interest and *all* other control variables listed in Panel B of

LASSO method selected *No. of correct answers in recall quiz* - a measure of knowledge of the three financial products introduced to participants, two variables measuring financial planning for long-term care, *Have set aside money* and *Expect to reply on government*, as well as *Wealth group* and *Level of annuitization*. Table 5 displays the estimation results from the random effects probit model for the purchase decision (columns 1-3) and OLS models for the dollar amount of health-contingent income conditional on purchase (columns 4-6).

4.1 Effects of access to informal care

Participants who expect to receive extensive, high-level care from informal sources have a stronger demand for long-term care income insurance than participants who do not expect to receive any care informally. The estimated coefficient on the indicator for informal-only, extensive care is significant and positive (Table 5, column 1). While the sign on the estimated coefficient on the indicator for having access to some (low-level) informal care is negative, consistent with the results of Pauly (1990) and Zweifel and Strüwe (1998) for expense-reimbursement long-term care insurance, the coefficient is insignificant. For high-level (extensive) care, results in column (2) of Table 5 show that males who plan to rely exclusively on family members for care have a significantly higher probability of purchasing the long-term care income product than males who do not plan to rely on informal care sources. (The related coefficient for females is also positive, but insignificant.)

Notably, the results of column (4-6) confirm complementarity. Males and females who have access to extensive informal care demand 25-37% *more* health-contingent income per year than those who do not. We conclude that the long-term care income product complements the availability of extensive informal care.

Some differences between males and females are worth highlighting. The point estimates in columns (5) and (6) in Table 5 suggest that females who expect to rely exclusively on extensive care from family members are willing to buy more income cover than males. Further estimation supports this view.[18] First, females with more children demand significantly more long-term care income insurance, but males do not. More children implies a better chance of, and/or more access to, informal care, which then justifies more transfers to be financed by the long-term care income product while the elderly female is alive. Second, we also find that a negative impact of bequest motives to children on the demand for

Table 4. Table C1 in Online Appendix C displays the estimation results for the full models, which are consistent with the results reported below using the reduced models.

[18]These results are reported in the full model in Table C1 of Online Appendix C.

long-term care income product only appears for females. Transfers while the elderly parent is alive are probably a substitute for (strategic) *post-mortem* bequests. It makes sense that if women choose the long-term care income product to reward their children for informal care, then those mothers who prefer a conventional *post-mortem* bequest will have lower demand for the long-term care income product, as our results confirm.

In contrast to the typical expense-reimbursement insurance, a long-term care income product compensates people who rely on either informal care or professional care. In our sample, 22% of participants say that they would prefer to receive extensive (high-level) care only from informal sources. Another 28% of participants say that they prefer to use both informal and other sources for extensive care. Hence, the potential market for the long-term care income product covers a much larger proportion of the population than expense-reimbursement long-term care insurance by potentially covering people who prefer at least some informal care. More importantly, the finding that the long-term care income product complements the need and desire to rely on family members for extensive care indicates a stronger demand among these people.

4.2 Selection effects

We find that objective measures of exposure to long-term care risk do not significantly influence the purchase decision for the long-term care income product. Of all variables in this category, *Female* and *Current smoker* have a significant and negative effect on the dollar amount of health-contingent income demanded, but not on the probability of purchase. The long-term care income product is priced differently for males and females, so the significance of the coefficient on *Female* in column 4 does not signal any adverse selection effects. The negative impact of *Current smoker* on the amount of health-contingent income purchased by participants is consistent with an advantageous selection effect, where those who continue to smoke are also less inclined to purchase more long-term care insurance. In general, there is little indication of adverse selection based on the objective measures for people in our relatively young and healthy sample, which is consistent with the result that the actuarially fair prices of the long-term care income product across current health states are very similar (Brown and Warshawsky, 2013).

In contrast to the objective measures, the subjective indicators of exposure to long-term care risk are linked to a higher demand for long-term care income insurance. The participants who rated their chance of needing residential care as lower than average were less likely to purchase the long-term care income product. However, those who put their chance at higher-than-average were (much) more likely

to purchase the product, and, conditional on the purchase, they demanded 81% more health-contingent income.[19] In fact, all 35 male participants and 25 out of 26 female participants in our survey who said they had a higher-than-average chance of needing residential care indicated that they would purchase the product. Therefore, the corresponding coefficient estimate is positively infinite for males (resulting in an estimated probability of purchasing the product equal to one) and very large for the sample as a whole. The insignificant coefficient for females is due to its small sample size, though the coefficient estimate is very large too.

At the same time, we find that the participants who were more aware of long-term care risk were also more likely to purchase the long-term care income product, and they purchased more. In particular, the demand for health-contingent income for participants who had set aside money for long-term care risk (included as an 'Additional control variable') was 39% higher, conditional upon purchase. This high demand for the long-term care income product indicates that those who are aware of long-term care risk are also changing their behavior by saving more. This signals that there are possibly advantageous selection effects present, as those who are more aware of long-term care risk, and are willing to invest in their health capital, have a stronger demand for the long-term care income product.

Our finding of selection effects based on subjective measures is inconclusive. On the one hand, adverse selection exists in that participants at higher risk of residential care had a stronger demand for the long-term care income product. The extent of the adverse selection depends on the extent to which the self-reported chance of needing residential care is informative of the actual future need for long-term care for our sample of 54 to 64 year-old participants. On the other hand, a higher awareness and willingness to invest in health also leads to a higher demand for the long-term care product, which could indicate advantageous selection if these people maintain good health for longer. Hendren (2013) finds that private information on long-term care risk is correlated with observable exclusion factors, such as older age and illness, to the extent that prices for such risk-types are so prohibitively high as to be unviable, justifying exclusions. Our results are derived from a relatively young and healthy sample, where participants have less private information on future care needs than the very elderly, are based on preferences for a one-off, purchase of long-term care income insurance at retirement, and so offer different insights.

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

Table 5: Determinants of demand for the long-term care income product

The table displays the estimated coefficients for random effects probit model in columns (1), (2), and (3) and for random effects OLS model in columns (4), (5), and (6). The data for the estimation come from Q1-Q4 of the experimental task. The dependent variable for columns (1), (2), and (3) is a binary variable that equals one if a participant purchased the long-term care income product and zero otherwise. The dependent variable for columns (4), (5), and (6) is the natural logarithm of the amount of annual health-contingent income chosen by participants who purchased the long-term care income product. In these columns, we report the reduced model with only independent variables that belong to "Objective measures of exposure to long-term care risk", "Subjective indicators of exposure to long-term care risk", "Availability of informal care", and additional control variables selected by LASSO based on EBIC. Table C1 in Online Appendix C displays the results of estimations with all covariates. $+\infty$ indicates that the associated independent variables perfectly predict the purchase of the long-term care income product. Robust standard errors (Huber-White) are shown in parentheses. Asterisks for σ_ν indicate significance of the random effects that are derived from likelihood ratio tests (for columns (1), (2), and (3)) and Breusch and Pagan Lagrange multiplier tests (for columns (4), (5), and (6)). The *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively.

Dependent variable:	Purchase long-term care income product			Log (annual health-contingent income)		
	Sample (1)	Male (2)	Female (3)	Sample (4)	Male (5)	Female (6)
Objective measures of exposure to long-term care risk						
Female	0.216			-0.448***		
	(0.202)			(0.073)		
Age	-0.013	-0.026	-0.009	-0.013	-0.031*	0.003
	(0.035)	(0.052)	(0.050)	(0.013)	(0.017)	(0.018)
Health state: base case = 1						
2	-0.109	-0.957*	0.635	0.082	0.132	-0.028
	(0.386)	(0.567)	(0.585)	(0.134)	(0.159)	(0.213)
3	0.327	0.163	0.469	0.010	0.014	-0.028
	(0.270)	(0.355)	(0.447)	(0.096)	(0.121)	(0.151)
4	0.201	0.283	0.085	0.145	0.024	0.337**
	(0.331)	(0.452)	(0.516)	(0.112)	(0.155)	(0.157)
Current smoker	-0.120	0.134	-0.205	-0.315***	-0.210	-0.494***
	(0.279)	(0.409)	(0.405)	(0.108)	(0.131)	(0.173)
Received care	0.146	-0.292	0.993	0.187	0.007	0.420**
	(0.448)	(0.632)	(0.791)	(0.138)	(0.188)	(0.185)
Subjective indicators of exposure to long-term care risk						
Subjective life expectancy	-0.017	-0.035**	0.004	0.003	0.011**	-0.007
	(0.012)	(0.017)	(0.020)	(0.004)	(0.005)	(0.007)
Chance of needing homecare: base case = average						
Lower than the average	0.512*	0.256	0.840	-0.016	-0.019	-0.032
	(0.308)	(0.395)	(0.533)	(0.104)	(0.127)	(0.182)
Higher than the average	-0.657	-1.392	-0.117	-0.339**	-0.266	-0.323
	(0.612)	(0.935)	(0.894)	(0.171)	(0.205)	(0.288)
Chance of needing residential care: base case = average						
Lower than the average	-0.875***	-1.048***	-0.851*	-0.038	-0.147	0.099
	(0.299)	(0.388)	(0.516)	(0.102)	(0.126)	(0.178)
Higher than the average	5.527***	$+\infty$***	3.691**	0.591***	0.712***	0.326
	(1.154)	(n.a)	(1.655)	(0.165)	(0.176)	(0.311)
Availability of informal care						
Source of some (low) care: base case = no informal care						
Informal care only	-0.385	-0.492	-0.392	-0.126	-0.302**	0.017
	(0.316)	(0.461)	(0.464)	(0.107)	(0.133)	(0.170)
Informal care and other sources	-0.177	0.530	-0.847*	-0.188*	-0.225	-0.174
	(0.306)	(0.450)	(0.447)	(0.111)	(0.143)	(0.165)
Source of extensive (high) care: base case = no informal care						
Informal care only	0.887***	1.331***	0.497	0.284***	0.252*	0.373**
	(0.331)	(0.478)	(0.485)	(0.110)	(0.142)	(0.169)
Informal care and other sources	0.217	0.350	0.266	0.227**	0.080	0.364**
	(0.282)	(0.435)	(0.392)	(0.099)	(0.132)	(0.145)
Additional control variables						
No. of correct answers in recall quiz				-0.129***	-0.113***	-0.149***
				(0.024)	(0.032)	(0.034)
Financial planning for LTC: base case = do not know needs and costs						
Have set aside money				0.327***	0.452***	0.282**
				(0.077)	(0.103)	(0.114)
Expect to rely on government				-0.007	0.104	-0.151
				(0.145)	(0.175)	(0.239)
Wealth group: base case = 1						
2				1.106***	1.068***	1.181***
				(0.100)	(0.130)	(0.151)
3				1.786***	1.702***	1.873***
				(0.106)	(0.148)	(0.150)

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Table 5 – continued

Dependent variable:	Purchase long-term care income product			Log(annual health-contingent income)		
	Sample (1)	Male (2)	Female (3)	Sample (4)	Male (5)	Female (6)
4				2.331***	2.237***	2.482***
				(0.110)	(0.147)	(0.163)
Level of Annuitization: base case = 0%						
25%	0.055	-0.053	0.167	-0.127***	-0.080***	-0.176***
	(0.132)	(0.185)	(0.189)	(0.021)	(0.030)	(0.028)
50%	-0.187	-0.227	-0.147	-0.425***	-0.358***	-0.496***
	(0.129)	(0.182)	(0.184)	(0.028)	(0.041)	(0.037)
75%	-0.441***	-0.580***	-0.295	-1.002***	-0.858***	-1.151***
	(0.126)	(0.178)	(0.180)	(0.034)	(0.046)	(0.049)
Constant	4.561**	5.347*	4.642	10.853***	11.928***	9.338***
	(2.101)	(3.107)	(2.964)	(0.767)	(1.047)	(1.096)
N	4032	1932	1960	3443	1753	1690
Log likelihood	-1030.131	-525.518	-494.979			
R^2 (overall)				0.479	0.468	0.480
σ_ν	3.423***	3.342***	3.336***	1.077***	1.030***	1.109***

4.3 Demand for health- and survival-contingent income

In this subsection, we examine the demand for health-contingent income in participants' optimal allocation of total retirement savings. To do so, we consider the situation where participants can choose their allocations to longevity insurance (life annuities) as well as long-term care income insurance. This expansion of the choice set is important because of the possible interaction between the demand for long-term care and longevity insurance (e.g., Davidoff, 2009). We examine this relationship by using the data from Q6 that reflects participants' optimal mix of health-contingent income, survival-contingent income, and liquid wealth.

We regress participants' preferred ratio of health-contingent income to survival-contingent income on objective and subjective long-term care risk factors, informal care indicators and other controls. Table 6 presents the regression results. A positive and significant coefficient indicates that, cross-sectionally, the variable signifies a stronger preference for health-contingent income over survival-contingent income.

Estimates confirm that the distinction between low-level (some) care and extensive care is important to demand for long-term care income insurance. For example, participants who would rely exclusively on informal sources for low-level care chose a lower ratio of health-contingent to survival-contingent income than participants who did not expect to use informal care (significant at the 10% level in column (1)). However, participants who would exclusively rely on informal sources for extensive care showed a stronger preference for health-contingent income than those who did not expect to use informal sources for extensive care. These results are mostly driven by females. An exception is that males have a significant and positive coefficient for *Informal care only* in column (2) of Table 6.

Overall, these results are largely consistent with the findings in Section 4.2 and Section 4.1. Thus, our findings about the influence of long-term care risk factors and the availability of informal care on the demand for health-contingent income hold, both when the amount of survival-contingent income is exogenously given to participants, and when it is endogenously chosen by participants.

Consistent with previous results we find that objective measures of exposure to long-term care risk explain little variation in participants' preferences about the mix of income streams. The coefficient on *Smoker*, which has a negative impact on the demand for health-contingent income in column (4) of Table 5 becomes insignificant (column (1)), although it is still significant and negative for males. This change may occur because smoking reduces expected lifetimes (Belanger et al., 2002) and thus demand for life annuities as well as demand for the long-term care income product.

We again find that participants' subjective expectations of needing residential care are important. The ratio of health-contingent income over survival-contingent income preferred by those with a higher chance of needing residential care is 2.264 units higher than for those at the average.

4.4 Precautionary savings and demand for long-term care income insurance

We now examine the impact of having access to the long-term care income product on the demand for longevity insurance (life annuities). We use the data obtained from Q7 of the experimental task, that asked participants how they would like to re-allocate their retirement savings when the long-term care income product was no longer offered. In the experiment, we reset participants' allocations so that the amount of retirement wealth they had previously allocated to the long-term care income product (in Q6) was "deposited" back into their investment account. Participants could then increase or decrease their annuitization level by 25%, or keep the new allocation we gave them unchanged.[20] The answers to Q7 measure the within-participant effect of having access to the long-term care income product on their demand for life annuities. In this way, we are able to minimize, if not eliminate, the effects of other participant-specific factors.

We first carry out a univariate test on whether the proportion of participants who chose to increase their level of annuitization was equal to the proportion of participants who chose to decrease it. To explain the heterogeneity in participants' reactions, we then report results from a multinomial logit model with three states: 1) the participant prefers a decrease in annuitization when long-term care income insurance is not available; 2) a base case of no change in annuitization when long-term care income insurance is

[20] 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.

Table 6: Determinants of the optimal mix of income streams

The table displays the estimates of the coefficients from an OLS regression of a participant's preferred ratio of health-contingent to survival-contingent income on indicators of risk and available care. The data for the estimation come from Q6 of the experimental task. Only key variables of interest in relating to "Objective measures of exposure to long-term care risk", "Subjective measures of exposure to long-term care risk" and "Availability of informal care" are shown. Table C2 in Online Appendix C sets out the full results. Robust standard errors (Huber-White) are shown in parentheses. The *, **, and *** indicate significance at 10, 5, and 1% levels, respectively.

Dependent variable:	health-contingent income/survival-contingent income		
	Sample (1)	Male (2)	Female (3)
Objective measures of exposure to long-term care 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 long-term care 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)
Availability of informal care			
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)
Other control variables			
Awareness of long-term care risk	Yes	Yes	Yes
Measures of utility parameters	Yes	Yes	Yes
Individual capability and knowledge about retirement financial products	Yes	Yes	Yes
Retirement planning	Yes	Yes	Yes
Demographics	Yes	Yes	Yes
N	1008	518	490
R^2	0.183	0.226	0.206

not available; and 3) the participant prefers an increase in annuitization when long-term care income insurance is not available.

Table 7 shows how participants responded when the long-term care income product was no longer offered. Fewer than half kept their level of annuitization unchanged, which therefore led to an increase in their investment account balances by the amount of money allocated to the long-term care income product.

Table 7: Distribution of responses to the unavailability of the long-term care 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 participants decreased their level of annuitization to boost their liquid wealth than increased it (significant at a 5% level). Therefore, for most participants whose portfolio choices were materially affected by whether they had access to the long-term care income product, the product allowed them to release precautionary savings kept for self-insuring against long-term care risk (and therefore purchase additional longevity insurance).

Table 8 presents the coefficient estimates of the multinomial logit model. We find that participants with low long-term care risk, in either objective or subjective measures, were more likely to decrease their level of annuitization when the long-term care income product was no longer offered on the market than an average or high long-term care risk individual.

In the absence of long-term care insurance coverage, the demand for life annuities for the low long-term care risk participants is substantially reduced, because they choose liquid wealth to self-insure. Participants with higher perceived long-term care risk are more likely to purchase the long-term care income product, and they purchase more, while participants with lower long-term care risk are more likely to purchase more life annuities after they obtain coverage for long-term care. This means that the availability of separate long-term care income insurance may strengthen the demand for life annuities for healthy participants but not for the unhealthy participants, highlighting the importance of bundling longevity insurance and long-term care insurance, to improve risk pooling.

Table 8: Regression of participants' responses to the withdrawal of the long-term care income product

This table reports estimation of the multinomial logit model of the probability that participants decrease (case 1), do not change (base case), or increase (case 3) annuitization when the long-term care income insurance product is withdrawn. The data for the estimation come from Q7 of the experimental task. The sample includes participants who chose partial annuitization in the presence of the long-term care income product in Q7 of the experimental task. Independent variables that do not show significance at the 5% level for at least one column are not reported in this table but are in Online Appendix C, Table C3. Robust standard errors (Huber-White) are shown in parentheses. The *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively.

Base outcome: No change in annuitization	Decrease by 25%	Increase by 25%
	(1)	(2)
Objective measures of exposure to long-term care 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 long-term care 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 long-term care 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		
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	

5 Conclusions

The private markets for long-term care insurance are thin or nonexistent in most developed countries, despite substantial long-term care risk. Earlier studies mainly focus on expense-reimbursement long-term care insurance policies, which provide benefits for professional, formal long-term care services.

Our analysis of stated preferences shows that a more flexible product that pays a regular income when the insured person needs care has a large potential demand, in particular from those expecting to rely on informal care. With declining utilization of residential care facilities and many people relying on unpaid long-term care from close family members, a flexible long-term care insurance policy that offers health-contingent income may better suit the needs of this large and increasing proportion of seniors.

In this paper, we present the results of an experimental survey of the demand for a long-term care income product that focused 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 estimated demand for the long-term care income product is higher than "real-world" long-term care insurance holdings, consistent with the findings of other studies that imperfections in the existing long-term care insurance products contribute to the low demand for long-term care insurance coverage in current markets (Brown and Finkelstein, 2007 and Ameriks et al., 2018).

In contrast to expense-reimbursement long-term care insurance policies where insurers need to exclude many potential purchasers to prevent adverse selection (Sloan and Norton, 1997; Finkelstein and McGarry, 2006; Brown and Finkelstein, 2007; Webb, 2009; Hendren, 2013), we find no evidence of selection effects based on the objective measures of exposure to long-term care risk. However, we do find that the subjective measures of long-term care risk matter when they contain private information, such as participants' self-reported chances of needing residential care. We also observe stronger demand from people who perceive more long-term care risk in general, a kind of advantageous selection. Overall, these findings indicate that firms could probably offer a commercially viable long-term care income product with narrower scoped exclusions and less underwriting.

More importantly, we find that the demand for an long-term care income product is stronger for people (especially females) who plan to rely on informally-provided but, extensive, care. To put it differently, the product complements the availability of extensive, informal care, rather than substitutes for it, as is the case for expense-reimbursement long-term care insurance (Pauly, 1990; Zweifel and Strüwe, 1998). This result has practical implications: not only can flexible long-term care income insurance cover a larger proportion of the population by including those who prefer to use informal care, it would also be more

attractive to this group of people than expense-reimbursement policies.

We also investigate the demand for longevity insurance when people can simultaneously insure long-term care risk. Having access to the long-term care income product changes the annuitization decisions of around half of participants. A proportion of participants see longevity insurance as a substitute (hedge) for long-term care costs in the absence of long-term care insurance. However, there is a larger proportion who would use the availability of long-term care insurance to release precautionary savings in order to purchase more longevity insurance, particularly those with lower long-term care risk. This finding means that for healthy participants, the availability of the long-term care income product offers a partial solution to the annuity puzzle.

Our results can inform product innovation in long-term care public policy. Policy responses to long-term care needs range from tax financing (Nordic countries), social insurance (Germany, Japan, and the Netherlands), means-tested support (Australia, the UK, and the US), and cash payments (Austria, the Czech Republic, and Italy) (Colombo et al., 2011; CEPAR, 2019; Norton, 2016). However, irrespective of the financing format, public long-term care costs are high and rapidly increasing[21], and in OECD countries are expected to at least double over the next 40 years (de la Maisonneuve and Martins, 2015). Only a few countries have private markets for long-term care insurance that can complement or supplement public support.

While our research findings support a market for an long-term care income product, there remain key policy design, supply-side and demand-side issues to be addressed such as integration with publicly-funded support to deal with potential crowding-out, consumer awareness and understanding of health-contingent products (Boyer et al., 2019) and strategies for risk management (Eling and Ghavibazoo, 2019). There are, in addition, a number of practical implementation matters, including the efficacy of providing cash payments to the elderly and cognitively impaired (Norton, 2016), the attractiveness (or not) of a single premium at retirement in terms of affordability and present bias, effective assessment and monitoring of disability status to address moral hazard issues, and the challenges associated with the communication of a complex product to potential purchasers. These issues provide a menu for future research.

[21]The consensus of international studies puts the annual cost of home or institutional long-term care as at least as high as the average disposable income for the over 65 year-old population (Muir, 2017; Boyer et al., 2019; Ameriks et al., 2018).

Appendix A Financing long-term care (LTC) in Australia

In most cases, long-term care is referred to as "aged care" in Australia. The 2016 Census identified just over 3.6 million Australians aged 65 or above, which represented 15.3% of the population. About one-fifth of this group needed help with one or more ADLs (CEPAR, 2014).

Similar to the US and the UK, the publicly financed aged-care system in Australia is means tested (Department of Health, Australian Government, 2019a). This system compares with the tax-funded schemes popular in Nordic countries and social insurance in other OECD countries. Unlike the US, but similar to the UK (Dilnot, 2011), there is no private market for long-term care insurance in Australia. Subject to approval from an eligibility assessment authority as required by the Aged Care Assessment Team (ACAT), people who need 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 integrated with the means-tested public pension (the Age Pension).[22] In aggregate, the Australian government's expenditures on aged care were around 1.1% of GDP in 2019-20 (The Treasury, Australian Government, 2019) and are projected to increase to 1.7% of GDP in the next half-century (The Treasury, Australian Government, 2015). However, the total costs of aged care includes these public expenditures, out-of-pocket private expenditures, and costs associated with informal care. Costs differ depending on whether the individual receives care in their own home or in a residential facility.

People who receive care in their own home are required to pay a basic daily fee, a means-tested care fee, and fees for any additional services that are not covered by their care package (e.g., haircuts at home). The basic daily fee was set at 17.5% of the single Age Pension until 30 June 2019, and is now set between 15.68% and 17.5% depending on the consumer's home care package level.[23] The means-tested care fee is subject to an income test. There is an Income Free Area which excludes a certain amount of annual income from the income test in home care fees. This corresponds to yearly income less than A$27,463.80 for singles and combined yearly income less than A$42,588.00 for couples from September 2019. Individuals who earn below this amount (typically full pensioners) do not need to pay any care fees, with all costs paid by the government. The amount of income-tested fees is limited by a A$5,550.90 annual cap for people with income below A$53,060.80 and A$11,101.81 for income above this amount. The costs of additional services that are not covered by the home-care package are out-of-pocket.

[22] All amounts and means testing rules are for September 2019 (see Department of Health, Australian Government, 2019b). Thresholds are indexed and adjusted twice per year, with new rates published by the government in March and September of each year.

[23] From 1 September 2019, this fee corresponds to between A$9.52 and A$10.63 per day.

People who receive care in a residential facility are required to pay a basic daily fee, a means-tested care fee, an accommodation payment, and fees for any additional services. The basic daily fee is 85% of the single basic rate of age pension. From September 2019, this fee corresponded to A$51.63 per day. Both the care fee and accommodation payment are means tested by income and assets with the value of family home included in the assets test (up to a capped amount) unless the home is occupied by a spouse or dependent children. Combined, these corresponded to A$168,351 in September 2019. The results of both tests are used to determine the amount of the care fee and the accommodation payment payable by care users. Similar to home-care users, an annual cap applies to the means-tested care fees for residential care. The annual cap is A$27,463.80 of the amount paid in means-tested care fees. The means-test rules apply to the accommodation payment such that age pensioners will have their accommodation costs paid in full or in part by the Australian government. Other people will need to pay the accommodation price they negotiate with their aged-care facility. The accommodation can be paid as a daily accommodation payment (DAP) or a refundable accommodation deposit (RAD). The maximum RAD that can be charged without prior approval of the Aged Care Pricing Commissioner is A$550,000. The cost of additional services — such as more food options, daily newspapers, and access to discretionary services such as podiatry — are out-of-pocket.

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 the daily fees, the accommodation payment, and fees for any additional services. There is a lifetime cap, amounting to A$66,610.90 as of September 2019. Individuals are not required to pay more than this amount for means-tested care fees (both for home care and residential care) in their lifetime.

The Australian government also provides support to informal care givers through a Carer Allowance (a supplement to cover some costs of caring) and a Carer Payment (for those unable to work as a result of caring). Around a quarter of a million Australians aged 65 or above receive informal care from those who received a Carer Payment. In total, these cost the government an additional A$7 billion that is estimated to grow annually at a rate of over 6% in real terms over the next 20 years (National Commission of Audit, Australian Government, 2014).

Appendix B Wealth group assignment

Table 9: Categorization of wealth groups

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

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

Appendix C Financial product pricing

We priced the life annuity and the long-term care income product at actuarially fair value that was based on gender and a risk-free, real interest rate of 3%. We took both the mortality probabilities and health transition probabilities for pricing the life annuity and the long-term care income product from estimates by Brown and Warshawsky (2013), who use 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 11 health states, including death.[24] We use the first four states to describe the current health of survey participants (see Table 10). The remaining seven states (those with more than one limitation or death), together with the first four describe how participants' health evolves over time. The health transition probabilities are gender- and age-dependent. We use these estimated health transition probabilities to price the life annuity and the long-term care income product.[25] Because the hypothetical scenario in the experiment asked people to make the decisions as if they were 65, every one of the same gender faced the same price for the long-term care income product.[26]

Table 10: 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

[24] 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.

[25] We note that the health transitions are estimated from US data while the survey is fielded to a sample of 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 using long-term care for a 65 year-old American male (female) is 40 (54)%, while the probability of requiring care for a 65 year-old Australian male (female) is 48 (68)% according to the Productivity Commission (2011).

[26] The long-term care 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).

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