Design and Pricing of Private Long-term Care Insurance: An Australian Analysis

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Conference in Celebration of David Wilkie's 90th Birthday
11 April 2024

Background

- Increasing emphasis globally on a well constructed system of long-term care (LTC)
- Australian LTC system
  - A hybrid system combining a tax-based universal model and means-tested system.
  - Differentiated from social insurance models financed by compulsory contributions (e.g., Japan, South Korea), the tax-based universal model (e.g., Denmark, Finland), or means-tested system (e.g., UK, US)
- More sustainable LTC system can be achieved by developing a private long-term care insurance (LTCI) market.

Research objective

- The objective of the research is to provide a detailed analysis of the pricing of a range of LTCI products for Australian retirees.
  - A five-state Markov model of functional disability and illness in our recently published study (Park and Sherris, 2023) is applied for pricing and assessments including utility analysis.
  - To ensure international comparability, we considered product types and pricing assumptions found in other studies based on a systematic literature review of LTCI pricing methods and results.

Literature review on LTCI design and pricing

- Stand-alone LTCI
  - Cui 2019 (China), Lim et al. 2019 (Australia), Esquivel et al. 2021 (Portugal), Perdana et al. 2022 (Indonesia), Sherris and Wei 2022 (US)
- Life care annuity (LCA, stand-alone LTCI + annuity)
  - Hsieh et al. 2018 (US), Lim et al. 2019 (Australia), Wan et al. 2021 (China), Chen et al. 2022 (Switzerland), Ramsay and Oguledo 2022 (US), Sherris and Wei 2022 (US)
- Family joint LTCI
  - Ventura-Macro et al. 2022 (Australia), Xi 2022 (China)
- Other types
  - Bogataj et al. 2020 (Slovenia), Ramsay and Oguledo 2020 (US), De La Pena et al. 2021 & 2022 (Spain)

Model specification and estimation from our prior study

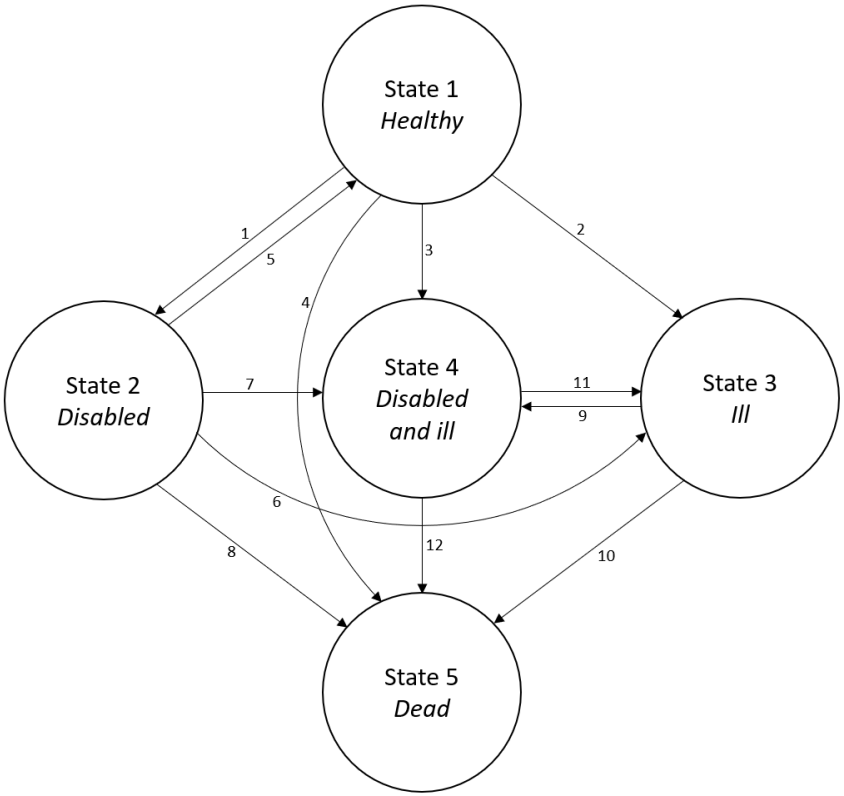

Figure: Five-state Markov model

Transition intensity for transition type s for individual k at time t, $\lambda_{k,s}(t)$, is expressed as follows based on proportional hazard specifications:

$$ln\{\lambda_{k,s}(t)\} = \beta_s + \gamma_s^{age} x_k(t) + \gamma_s^{female} F_k + \phi_s^{trend} t \quad (1)$$

Note we separately estimated **Static model** without trend factor as well as **Trend model** with trend factor.

Reference: Park and Sherris (2023)

Model specification and estimation from our prior study

- Primary data used were the records from Survey of Disability, Ageing and Carers, Australia (SDAC) 1998, SDAC 2003, SDAC 2009, SDAC 2013, SDAC 2015 and SDAC 2018, from Australian Bureau of Statistics.
- These cross-sectional SDAC data sets provide the prevalence of disability and illness by age and sex in different years.
- We aimed to find the regression coefficients in the model that best explains the observed changes of the prevalence across time by tracking different age cohorts, using a numerical estimation procedure.

Method overview

- Simulations of health transitions for healthy and ill retirees
- Estimation of LTCI price as single upfront lump-sum premium
  - Stand-alone LTCI, and Life care annuity, LCA (stand-alone LTCI + annuity)
  - The premium is comprised of:
    - Expected present value of benefit payments;
    - Risk margin for the Solvency capital requirement (SCR); and
    - Expense loading (baseline assumption: 10%)
- Measurement of Epstein-Zin utility (modified from Xu et al., 2023) to understand demand
  - The function considers relative risk aversion and elasticity of intertemporal substitution separately.
- Sensitivity analysis for the utility measure

Baseline input values

Variable	Value
Interest rate	3% pa
Inflation rate	3% pa
Cost of capital	6% pa
Disability benefit	$1,500
Disability benefit limit*	$76,000
Waiting period	3 months
Annuity payment	$1,000
Expense loading	10%
Inflation protection	Yes

Table: Baseline input values

* Subject to inflation

Baseline input values (utility measure)

Utility variable	Value
Subjective discount rate	3% pa
EIS	0.5
Strength of bequest motive	2
Risk aversion	3
Monthly retirement income	\$1,700
Aged care cost	\$1,500
Consumption	\$5,000
Initial wealth	\$1,000,000

Table: Baseline input values

Survival curves with and without trend

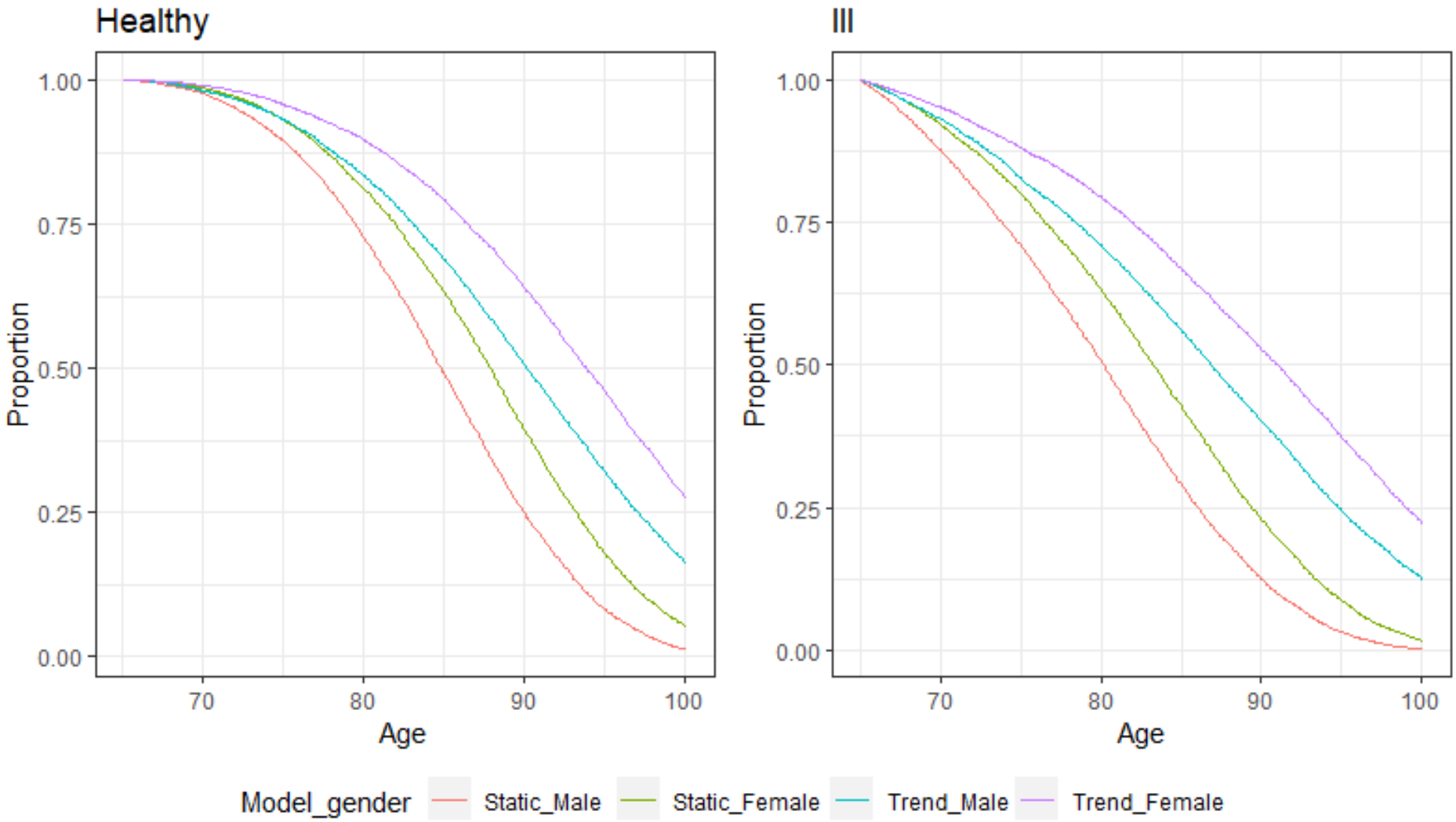

Figure: Survival curve

Proportion of disabled individuals by age

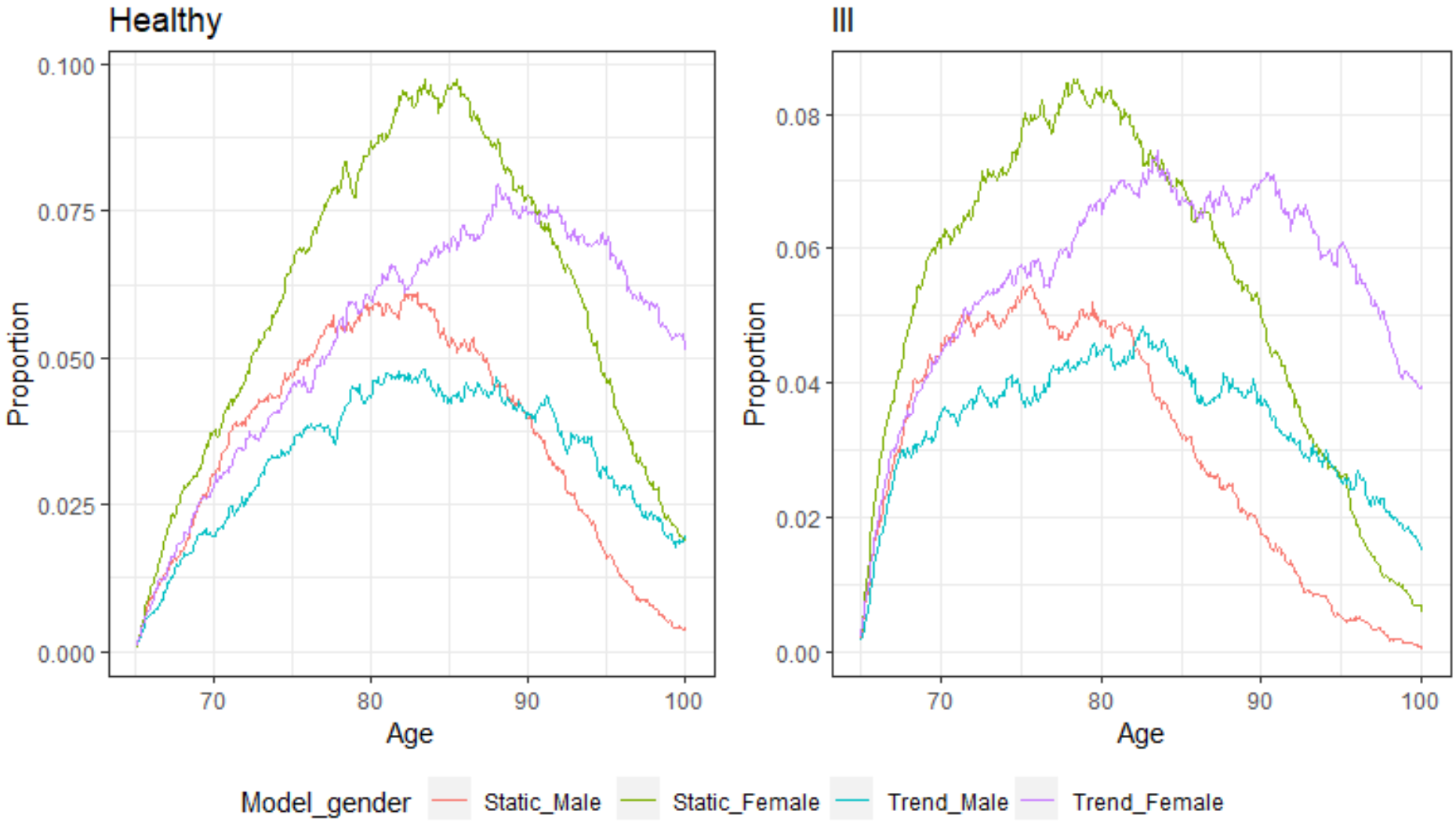

Figure: Proportion of disabled individuals

Estimated premiums for stand-alone LTCI

Table: Stand-alone LTCI premium for healthy retirees aged 65

	Static model		Trend model	
	Male	Female	Male	Female
Premium	26,224	40,433	27,672	39,264
Premium component				
Disability benefit	19,421	30,050	18,619	28,100
Annuity	0	0	0	0
Risk margin	4,419	6,707	6,537	7,595
Expense loading	2,384	3,676	2,516	3,569

Note: Standard deviations are in parentheses.

Estimated premiums for LCA

Table: LCA premium for healthy retirees aged 65

	Static model		Trend model	
	Male	Female	Male	Female
Premium	297,877	345,862	360,606	402,897
Premium component				
Disability benefit	19,421	30,050	18,619	28,100
Annuity	233,530	265,243	288,399	319,692
Risk margin	17,846	19,128	20,805	18,478
Expense loading	27,080	31,442	32,782	36,627

Note: Standard deviations are in parentheses.

Estimated premiums for stand-alone LTCI (ill)

Table: Stand-alone LTCI premium for ill retirees aged 65

	Static model		Trend model	
	Male	Female	Male	Female
Premium	21,875	34,920	26,114	38,823
Premium component				
Disability benefit	16,406	26,745	18,904	28,308
Annuity	0	0	0	0
Risk margin	3,480	5,000	4,836	6,986
Expense loading	1,989	3,175	2,374	3,529

Note: Standard deviations are in parentheses.

Estimated premiums for LCA (ill)

Table: LCA premium for ill retirees aged 65

	Static model		Trend model	
	Male	Female	Male	Female
Premium	232,633	285,170	319,616	367,255
Premium component				
Disability benefit	16,406	26,745	18,904	28,308
Annuity	180,154	213,945	251,844	285,922
Risk margin	14,925	18,555	19,811	19,639
Expense loading	21,148	25,925	29,056	33,387

Note: Standard deviations are in parentheses.

Measured utility

Table: Utility for healthy and ill retirees aged 65

	Static model		Trend model	
	Male	Female	Male	Female
LTCI, *H*	88,025 (87,048)	79,949 (77,649)	75,498 (74,461)	71,737 (69,020)
LCA, *H*	87,245 (87,048)	76,091 (77,649)	71,479 (74,461)	67,581 (69,020)
LTCI, *I*	104,705 (104,456)	92,441 (90,345)	81,297 (79,904)	75,990 (73,215)
LCA, *I*	110,678 (99,867)	91,380 (86,642)	78,255 (77,709)	71,569 (71,390)

Note: Utility when LTCI product is not purchased is in parentheses.

Sensitivity analysis for risk aversion

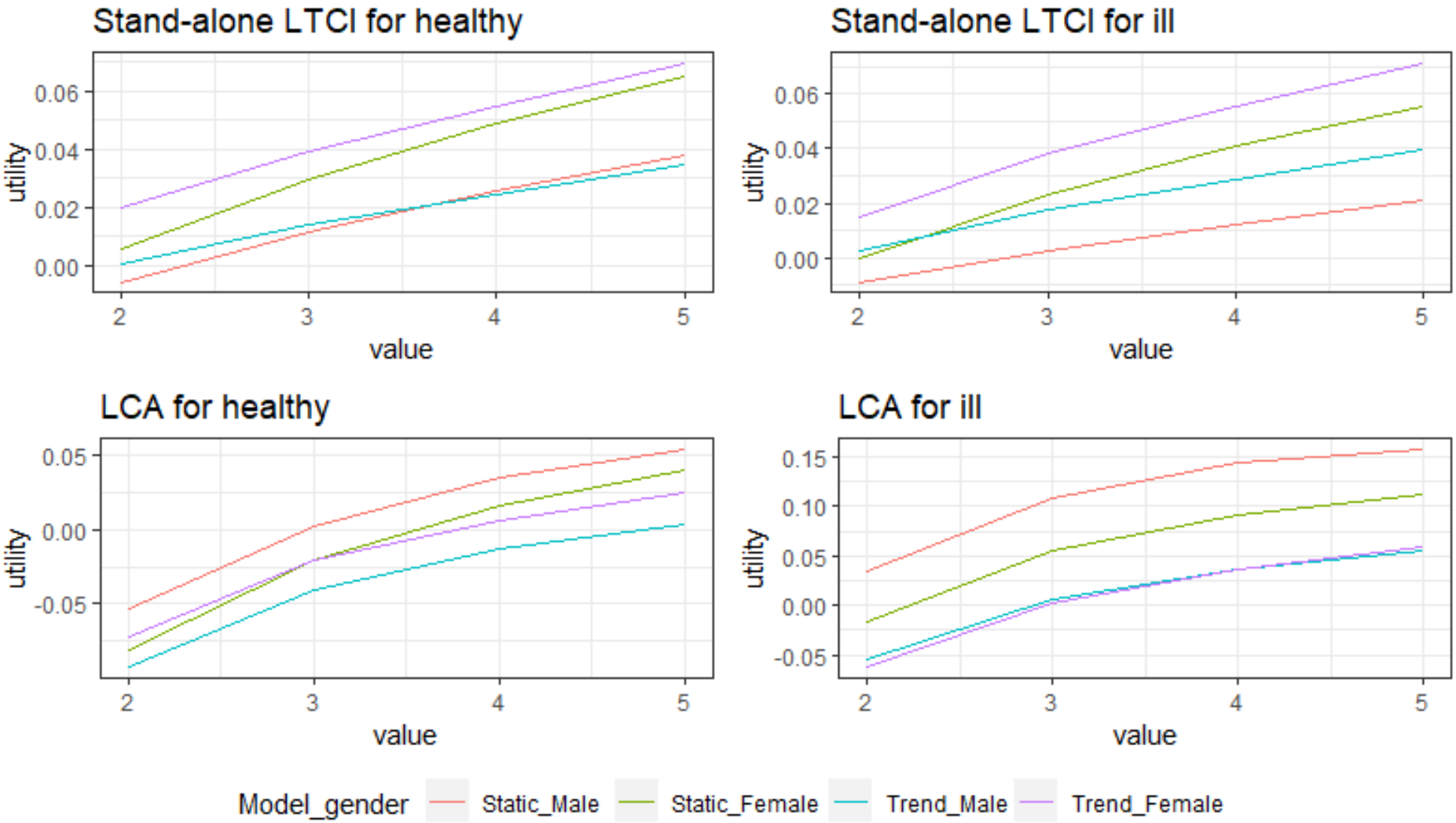

Figure: Sensitivity of gain in utility by risk aversion

Sensitivity analysis for wealth level

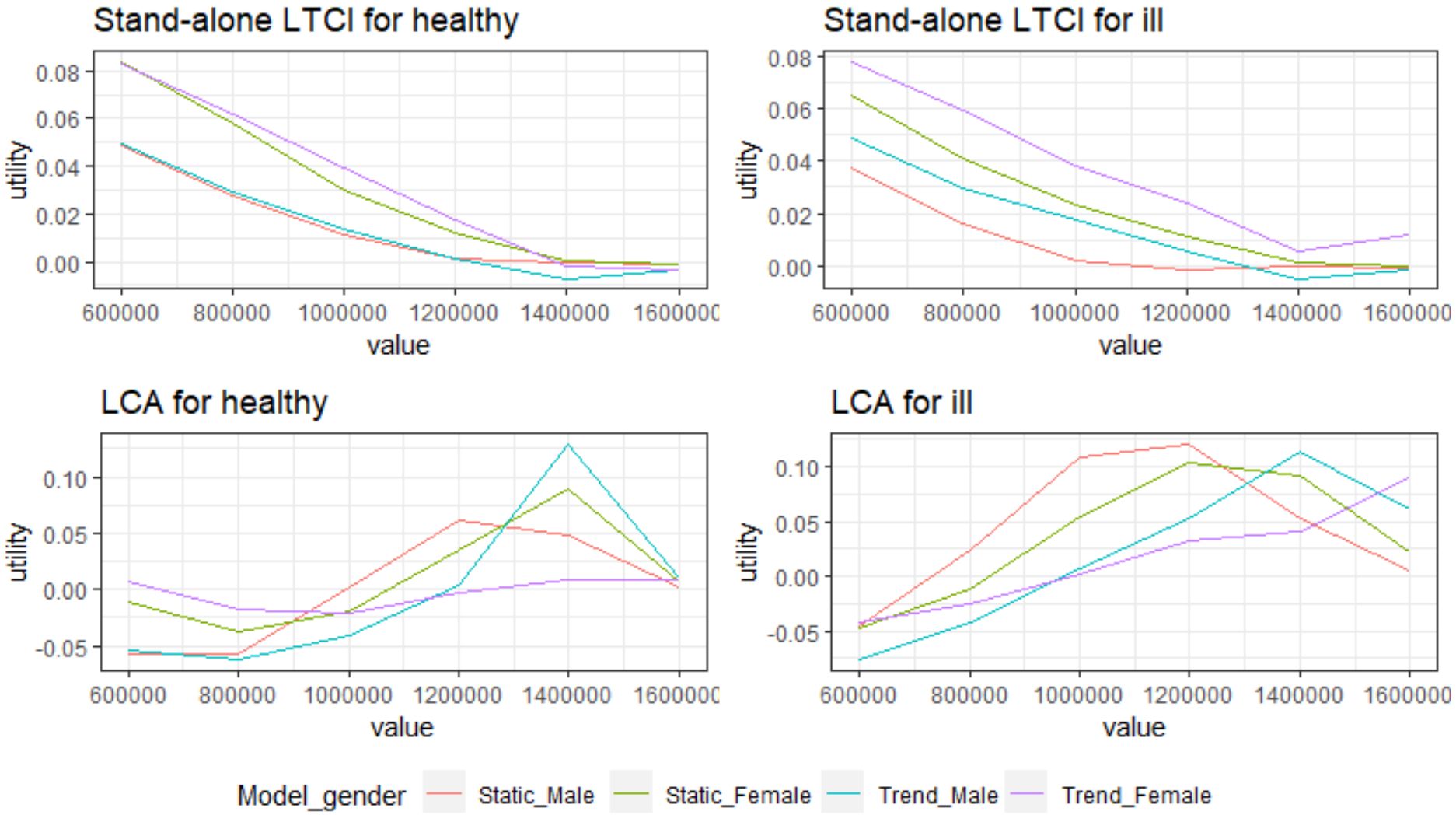

Figure: Sensitivity of gain in utility by initial wealth

Conclusion

- This research provides for the first time a careful analysis of potential LTCI products for the Australian market.
- The estimated premiums account for the longer life expectancy of females than males, along with the observed trend of increasing life expectancy but decreasing time spent with disability observed during 20-year period up to 2018 in Australia.
- The measured utilities show potential demand on the LTCI products. The extent of preference was varied with assumptions including those for risk aversion and wealth levels.
- Our study offers additional insights into the development of the private LTCI market, considering factors such as population demographics, ageing trends, retirement income and expenses, as well as determinants of consumer preferences like risk aversion and wealth level.

References I

Kyu Park and Michael Sherris (2023)
Actuarial Modelling of Australian Population Retirement Risks: An Australian Functional Disability and Health State Model
Decision in Economics and Finance DOI: 10.1007/s10203-023-00418-w

Bogataj, David and Rogelj, Valerija and Bogataj, Marija and Drobež (2020)
Housing equity withdrawal for development of assisted-living facilities
Facilities 38(9/10), 651 - 690

Chen, An and Fuino, Michel and Sehner, Thorsten and Wagner, Joël (2022)
Valuation of long-term care options embedded in life annuities
Facilities 16(1), 68 - 94

Cui, Xiaodong (2019)
Health State Transition Probability and Long-Term Care Cost Estimation
ICPEM

De La Peña, J Iñaki and Fernández-Ramos, M Cristina and Garayeta, Asier (2021)
Cost-free LTC model incorporated into private pension schemes
International Journal of Environmental Research and Public Health 18(5), 2268

References II

De La Peña, J Iñaki and Fernández-Ramos, M Cristina and Garayeta, Asier and Martín, Iratxe D (2022)
LTC of a Defined Benefit Employee Pension Scheme
Mathematical and Statistical Methods for Actuarial Sciences and Finance: MAF 2022 188 - 194

Esquível, Manuel L and Guerreiro, Gracinda R and Oliveira, Matilde C and Corte Real, Pedro (2021)
Calibration of transition intensities for a multistate model: application to long-term care
Risks 9(2), 37

Hsieh, Ming-hua and Wang, Jennifer L and Chiu, Yu-Fen and Chen, Yen-Chih (2018)
Valuation of variable long-term care annuities with guaranteed lifetime withdrawal benefits: a variance reduction approach
Insurance: Mathematics and Economics 78, 246 - 254

References III


Lim, William and Khemka, Gaurav and Pitt, David and Browne, Bridget (2019)
A method for calculating the implied no-recovery three-state transition matrix using observable population mortality incidence and disability prevalence rates among the elderly
Journal of Population Research 36, 245 - 282


Perdana, Hendra and Satyahadewi, Neva and Kusnandar, Dadan and Tamtama, Ray (2022)
MULTI-STATE MODEL FOR CALCULATION OF LONG-TERM CARE INSURANCE PRODUCT PREMIUM IN INDONESIA mortality incidence and disability prevalence rates among the elderly
BAREKENG: Jurnal Ilmu Matematika dan Terapan 16(4), 1293 - 1302


Ramsay, Colin M and Oguledo, Victor I (2020)
Doubly Enhanced Annuities (DEANs) and the impact of quality of long-term care under a multi-state model of Activities of Daily Living (ADL)
North American Actuarial Journal 24(1), 57 - 99

References IV


Ramsay, Colin M and Oguledo, Victor I (2022)
Doubly Enhanced Medicaid Partnership Annuities (DEMPANs): A New Tool for Providing Long Term Care to Retired US Seniors in the Medicaid Penumbra
North American Actuarial Journal 1 - 25


Ventura-Marco, Manuel and Vidal-Meliá, Carlos and Pérez Salamero González, Juan Manuel (2022)
Life care annuities to help couples cope with the cost of long-term care
Available at SSRN 4109189


Wan, Cheng and Bateman, Hazel and Hanewald, Katja (2021)
Optimal portfolio choice with longevity and health insurance: A developing country context


Xi, Ying (2022)
Development and Model Construction of Home Long-Term Care Insurance
2022 International Conference on Economics, Smart Finance and Contemporary Trade (ESFCT 2022) 1413 - 1423

References V

Michael Sherris and Pengyu Wei (2021)
A multi-state model of functional disability and health status in the presence of systematic trend and uncertainty
North American Actuarial Journal 25(1), 17 - 39.

Xu, Mengyi and Alonso-García, Jennifer and Sherris, Michael and Shao, Adam W (2014)
Insuring longevity risk and long-term care: Bequest, housing and liquidity
Insurance: Mathematics and Economics 111, 121 - 141.

Thank you very much

Questions? Comments?