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Financial Literacy, Financial Well-being and Financial Decision-making amongst Elderly Australians.

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Financial Literacy, Financial Well-being and Financial Decision-making amongst Elderly Australians

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Declaration

This thesis is submitted to Bond University in fulfilment of the requirements of the degree of Doctor of Philosophy.

This thesis represents my own original work towards this research degree and contains no material that has previously been submitted for a degree or a diploma at this University or any other institution, except where due acknowledgement is made.

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Abstract

Population ageing is accelerating, posing threats to global sustainable development. With longer life expectancy comes the need for sufficient financial resources to maintain living standards; this is achievable via an informed retirement plan. However, people with low financial literacy levels are less likely to plan sufficiently for their retirement and may suffer adverse financial outcomes as they age.

Therefore, it is necessary to improve the financial literacy of elderly people and ultimately mitigate negative societal and economic consequences generated by population ageing. The primary goal of this thesis is to provide effective and practicable policy recommendations for elderly Australians to improve their retirement living standards.

This thesis firstly constructs a reliable and robust index for measuring the financial literacy of elderly Australians, using an Item Response Theory (IRT) model to calculate a Financial Literacy Index (FLI). Compared to extant measures of financial literacy, IRT model makes use of information more sufficiently and takes into account characteristics of survey questions such as survey difficulty. Using Lasso regressions, we find that elderly Australians with higher levels of financial literacy are more likely to demonstrate the following characteristics: relatively younger age, married, predominantly male, exhibit greater net wealth and higher income, white or pink collar workers, outright

residence owners, in good health and highly educated.

Secondly, this thesis applies this newly developed FLI to investigate how financial literacy, by itself and via an interaction with consumption patterns, affects elderly Australians' financial well-being. The descriptive statistics show that overall, elderly Australians hold an optimistic attitude towards their financial status and that the "Retirement Consumption Puzzle" is not observed in Australia. The ordinal logistic regression results indicate that financial literacy by itself significantly improves financial well-being and helps strengthen the positive effects of meeting more of non-essential consumption needs. These findings provide empirical evidence that improving elderly Australians' financial literacy is key to enhancing their well-being.

Thirdly, this thesis further utilises the newly developed FLI to examine how financial literacy affects elderly Australians' decisions regarding adoption of a variety of financial strategies and the mediation mechanisms of financial concerns that transmit the effects of financial literacy on these financial strategies. Using multiple mediator models with bootstrap techniques, this study finds that financial concerns do indeed mediate the majority of financial literacy-strategy nexuses. Specifically, financially illiterate people are more likely to express financial concerns, and due to their concerns they are more likely to cut back on spending, seek more job opportunities, increase debts, and downsize or sell their residence. In addition, financially literate people are more likely to seek professional financial advice, purchase a life annuity, contribute more to superannuation and invest in more conservative assets regardless of their financial concerns. Importantly, this study provides evidence that causal inference is likely to lead to spurious and incomplete implications if mediation effects are ignored.

This thesis focuses specifically on the elderly who are the most financially vulnerable population segment. Informed and practicable policy recommendations are provided for elderly Australians to improve their financial literacy, and hence financial well-being and financial decision-making.

Keywords: Financial literacy, Financial well-being, Financial decision-making, Elderly Australians

Research Outputs and Publications during Candidature

Peer-reviewed Publications

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Conference Presentations

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List of Abbreviations

Abbreviations	Full Descriptions
1PL	One-parameter logistic model
2PL	Two-parameter logistic model
CN1	Concerns about long-term care
CN2	Concerns about investment performance
CN3	Concerns about staying in current home
CN4	Concerns about insufficient bequest
CPCA	Categorical Principal Component Analysis
DC	Defined Contribution pension plan
Edu	Education
EM	Expectation-Maximisation algorithm
Employ	Employment type
FA	Factor Analysis
FinTech	Financial technology
FL	Financial literacy
FLI	Financial literacy index
FWB	Financial well-being
IRT	Item Response Theory model
Lasso	Least Absolute Shrinkage and Selection Operation regression
Marital	Marital Status
NSA	National Seniors Australia
OLR	Ordinal logistic regression
PCM	Partial-credit model
PEarning	Partner's earnings
PEmploy	Partner's employment type
Retire	Retirement status
RSM	Rating scale model
Tenure	Home ownership
TM	Text Mining

Chapter 1

Introduction

1.1 Background and Motivation

Population ageing is a global trend that challenges social welfare (Lutz et al., 2008) and is likely to cause societal and economic problems (Orth, 2006). With the advancement of medical care and simultaneous decline of health risks, people are living longer and thus experiencing longer retirement spans. As such, increased social and financial resources are required to ensure quality of life in retirement. It is thus necessary to explore methods to mitigate the negative consequences generated by population ageing (Sanderson and Scherbov, 2005).

Financial literacy is strongly associated with retired households' welfare (Hung et al., 2009; Schmeiser and Seligman, 2013; Brüggen et al., 2017). Financially literate people are more likely to have a better grasp of financial markets and products (Lusardi and Mitchell, 2008), an accurate assessment of their financial resources (Lusardi and Mitchell, 2011b), make informed investment and saving decisions (Behrman et al., 2012; Von Gaudecker, 2015; Bianchi, 2018), plan sufficiently for their retirement (Mitchell and Moore, 1998; Lusardi and Beeler, 2006; van Rooij et al., 2011a, 2012), select reliable retirement income

products (Xiao et al., 2014), and thus have a higher chance of maintaining a reasonable standard of living after they retire (Bernheim and Garrett, 2003; Lusardi and Mitchell, 2007, 2011a; Chu et al., 2017; Xue et al., 2018). Accordingly, financial literacy plays an important role in retirement.

However, a large body of academic research has revealed a widespread lack of financial literacy (Lusardi and Mitchell, 2007, 2008, 2011b; Meier and Sprenger, 2013; Fernandes et al., 2014; Drexler et al., 2014; Kramer, 2016), particularly amongst the elderly (Finke et al., 2016; Xue et al., 2018). Within the current Defined Contribution (DC) pension plan, retirees are taking more responsibility for making their own financial decisions, which creates a possibility of higher financial returns, but also generates uncertainty (Loretto et al., 2000). This uncertainty is even greater for those with low financial literacy levels.

This is worrying because a lack of financial literacy may lead to myopic financial decision-making (Taylor et al., 2011), over-indebtedness (Gathergood, 2012), poor retirement planning (Lusardi and Mitchell, 2011a), less wealth accumulation (van Rooij et al., 2012), personal bankruptcy (Brüggen et al., 2017), and other subsequent problems such as physical and mental illness (Kinnunen and Pulkkinen, 1998) and divorce (Yeung and Hofferth, 1998). These destructive financial behaviours resulting from financial illiteracy pose a threat to retired households' well-being.

More worryingly, the newly retired with low financial literacy levels are typically overconfident about their savings for retirement life (Parker et al., 2012). Without an informed plan for wealth decumulation in retirement, retirees are likely to enjoy a comfortable start, typically exhibiting overspending, but end up with depleted assets (van Rooij et al., 2012). Hence, Aguila et al. (2011)

suggest that the newly retired need to learn how to smooth their consumption to avoid adverse financial outcomes as they age. As such, healthy consumption behaviour helps improve retired households' quality of life, satisfaction with life, and thus enhances their financial well-being (Lin et al., 2017). Notably, researchers tend to analyse consumption behaviours based solely on actual consumption, ignoring consumption needs. However, it is important to consider consumption needs as part of consumption behaviours because consumption is a needs-driven behaviour (Wilk, 2002). To explore whether retired households meet their consumption needs is necessary for analysis of their financial well-being. Unfortunately, studies on the consumption needs of the elderly remain scarce.

Financial well-being is an emerging area (Brüggen et al., 2017), although well-being has been broadly analysed (Diener et al., 2003; Griggs et al., 2013; Iyer and Muncy, 2016; Bobe and Cooper, 2018). Financial well-being is beneficial on multiple levels. At the individual level, financial well-being is positively related to quality of life, mental and physical health (Blanchflower and Oswald, 2004), and helps strengthen interpersonal relationships and performance at work (Brüggen et al., 2017). At the organisational level, it facilitates formation of internal culture (stated goals, authority structure, and loyalty) and external reputation (brands, reliability, and accountability) (Vlachos et al., 2009). At the social level, it reduces societal and economic problems, improves formation of social norms and cultures (Sacks et al., 2012), and enhances social welfare (Malone et al., 2010). Therefore, it is important to empirically investigate the elderly's financial well-being.

The elderly experience a range of financial concerns as a result of increased retirement spans and the prevalence of an uncertain and unpredictable future. Retired households, particularly financially illiterate households, are increas-

ingly concerned with inflation eroding savings, medical expenses, maintaining current living standards, and insufficient bequest, to name just a few key concerns (Tomlinson et al., 2008; Higgins and Roberts, 2011). Therefore, investigating how retired households choose financial strategies and make financial decisions to manage their financial concerns becomes pertinent. The increasing deregulation of financial markets produces a variety of financial products and services (van Rooij et al., 2011b), which challenges retired households' financial knowledge and skills. Financially literate people tend to have an accurate assessment of their finances and engage more in financial practices (Lusardi and Mitchell, 2011a): hence, they are more likely to identify proper and flexible financial strategies to guarantee their financial security and mitigate any financial concerns.

Motivated by the important role that financial literacy plays in retirement, this thesis investigates the financial literacy of elderly Australians and analyses the socio-demographic characteristics of the financially literate and the financially illiterate. This research further examines how financial literacy, by itself and via an interaction with consumption patterns, affects elderly Australians' financial well-being. It also examines the relationship between financial literacy and financial decision-making, and how financial concerns affect the decision-making process. Based on empirical findings, effective and practicable suggestions are recommended to improve the elderly's living standards and ultimately mitigate adverse consequences generated by population ageing.

1.2 Aims and Research Questions

The primary aim of this thesis is to investigate the financial behaviours of elderly Australians. Financial literacy is at the heart of this thesis. As financial literacy cannot be observed directly, many attempts have been made to construct a Financial Literacy Index (FLI). However, a standard measurement of

financial literacy has not yet been developed (Huston, 2010). Therefore, the first aim of this thesis is to develop a reliable and robust FLI that can measure and reflect elderly Australians' financial literacy in a precise and accurate manner.

Building and extending on this newly developed FLI, this thesis will examine how financial literacy, by itself and via an interaction with consumption patterns, affects elderly Australians' financial well-being.

The newly developed FLI will also be used to investigate how financial literacy affects elderly Australians' financial decision-making and how financial concerns affect the decision-making process.

Therefore, this thesis addresses the following research questions:

- **Research Question 1:** Is it possible to construct a financial literacy index as a measurement of the financial literacy of elderly Australians? If so, what are the socio-demographic characteristics of the financially literate and the financially illiterate?
- **Research Question 2:** Are elderly Australians satisfied with their financial situation? What are the roles of financial literacy and consumption patterns in determining their financial well-being?
- **Research Question 3:** How does the financial literacy of elderly Australians affect their financial decision-making? How do financial concerns mediate the relationship between financial literacy and financial decision-making?

1.3 Main Contributions

Firstly, this thesis makes a methodological contribution to the field of financial literacy. Using an Item Response Theory (IRT) model, this thesis develops a suitable Financial Literacy Index (FLI) and uses it to measure the financial literacy of elderly Australians. Extant measurement of financial literacy is associated with information loss, such as factor analysis (Thompson, 2004). The iterative process of the Expectation-Maximisation (EM) algorithm in the IRT model facilitates the repeated use of information during the iterations, which provides a more reliable and robust FLI. Least Absolute Shrinkage and Selection Operation (Lasso) regression is applied to investigate the relationship between financial literacy and a wide range of socio-demographic characteristics. Compared to other dimension reduction techniques in selecting important explanatory variables, Lasso regression is more flexible, interpretable, and is able to circumvent the collinearity problem.

Secondly, this thesis empirically tests how financial literacy, by itself and via an interaction with consumption patterns, affects elderly Australians' financial well-being. Financial well-being is an emerging area that remains scarce. This thesis provides empirical evidence about the relationship between financial well-being and elderly Australians' socio-demographic characteristics. In addition to actual consumption, this thesis takes into account consumption needs, which are rarely considered in prior research, when investigating the effects of financial literacy and consumption patterns on financial well-being. Text Mining (TM) techniques are utilised to reveal the reasons for changes in consumption patterns over the course of retirement.

Thirdly, this thesis examines the effects of financial literacy on the adoption of a variety of financial strategies. Multiple mediator models with bootstrap tech-

niques are used to identify the mechanisms of financial concerns that transmit the effects of financial literacy to specific financial strategies. A large number and a wide range of financial concerns and strategies are included. The use of mediation models with bootstrap techniques avoids the often-violated multivariate normality assumptions. To our knowledge, this thesis is the first to apply multiple mediator models with bootstrap techniques to financial literacy research area. In addition, this thesis finds that causal inference of how financial literacy affects financial decision-making can lead to spurious and incomplete implications if financial concerns are ignored.

Fourthly, this thesis takes into account a broader range of socio-demographic characteristics of elderly Australians than heretofore available. Empirical evidences about their relationships with financial literacy, financial well-being and financial decision-making are provided in this thesis. It is noteworthy that socio-demographic factors such as health and home ownership are rarely analysed in prior literature. This thesis therefore provides a more nuanced and complete understanding of the relationship between the financial behaviours and socio-demographic characteristics of elderly Australians and recommends more targeted suggestions.

Lastly, this thesis focuses specifically on the elderly that constitute the most financially vulnerable population segment. The financial literacy, financial well-being and financial decision-making of elderly people are important but seldom investigated. Exploring and modifying the financial behaviours of elderly people are an effective way to improve their living standards and ultimately manage problems and risks generated by population ageing. Accordingly, this thesis provides informed and practicable policy recommendations for elderly Australians, particularly those with low financial literacy levels, to improve their financial literacy, and hence financial well-being and financial

decision-making.

1.4 Thesis Outline

Chapter 2 introduces the main survey instrument used to collect data pertinent to this thesis. This survey investigates the financial behaviours of 15,000 elderly Australians and also collects information regarding a wide range of socio-demographic characteristics.

Chapter 3 reviews the existing literature on financial literacy and develops a financial literacy index (FLI) (Research Question 1) using an Item Response Theory (IRT) model. Lasso regression is used to examine the relationship between financial literacy and socio-demographic characteristics.

Chapter 4 builds and extends on the FLI developed in Chapter 3, applying the FLI to examine how financial literacy, by itself and via an interaction with consumption patterns, affects elderly Australians' financial well-being (Research Question 2). This chapter reports the financial well-being of elderly Australians and explores the changes in actual consumption and consumption needs over the course of retirement. Ordinal logistic regression is used to examine the direct effects of financial literacy and its interaction effects with consumption patterns on financial well-being. The relationship between financial well-being and socio-demographic characteristics is also investigated.

Chapter 5 uses the FLI developed in Chapter 3 to investigate how financial literacy affects elderly Australians' decisions regarding adoption of a variety of financial strategies (Research Question 3). Multiple mediator models with bootstrap techniques are used to identify the mechanisms of four major financial concerns that affect the financial literacy-strategy nexuses. This chapter also reports descriptive statistics of the four major concerns with respect to

different socio-demographic characteristics.

Chapter 6 concludes this thesis by summarising the main findings. Informed and practicable policy recommendations are presented based on the main findings. Future research directions are also explored.

Chapter 2

Primary Data Source

2.1 Survey Motivation

The data analysed in this thesis was collected through a national survey conducted in August 2010.[1] The survey investigated 15,000 randomly selected elderly Australians aged 55 or above who were members of National Seniors Australia (NSA). Within two months, 3,484 people completed the survey, representing a response rate of 23.23 percent. The primary goal of the survey is to investigate the impacts of financial behaviours, consumption patterns, financial concerns, financial strategies, and socio-demographic characteristics on elderly Australians' living standards in the context of accelerating population ageing.

The survey comprised ten modules, including information about financial literacy, financial well-being, changes in consumption patterns, superannuation, financial concerns, financial strategies, habits, and demographics. More detail about the survey can be found in Higgins and Roberts (2011), who provide an

[1] The survey was sent out by mail and conducted by a team of researchers at the Australian National University led by Prof.Terry O'Neill, and was financially supported by Australian Research Council Linkage Grant LP0776784 in collaboration with AMP, Rice Warner Actuaries and the National Seniors Australia.

overview of the survey and preliminary findings.

This thesis makes use of specific information in the survey to shed light on financial literacy, financial well-being, consumption patterns, financial concerns, and financial strategies. Based on empirical findings, this thesis prescribes tailored and practicable policy recommendations to policy-makers and fund providers alike in order to improve elderly Australians' financial literacy, and hence financial outlook and living standards.

Section 2.2 details the socio-demographic survey questions and descriptive statistics. These socio-demographic variables are utilised to investigate each of the three research questions in Chapter 3, 4, and 5, respectively.

2.2 Socio-demographic Information

The NSA members were stratified by age, gender and geographical location. Members within the stratified bands were randomly selected in proportion to the census data from Australian Bureau of Statistics (ABS), therefore, the survey data analysed in this thesis is representative. Higgins and Roberts (2011) describe the stratification and selection process of survey participants in detail. To avoid overlap, this thesis does not show the distribution of socio-demographic information partitioned by geographical locations; instead, it displays the information at an aggregate (national) level and describes how the socio-demographic indicators are processed in regression modelling. The survey questions are listed in Appendix A.

Table 2.1 presents the socio-demographic variables and how these variables are coded. The first twelve variables regarding the respondents and the last two variables regarding their partner are displayed. Overall, the 14 variables reflect the main socio-demographic characteristics of the respondents.

Table 2.1: Socio-demographic information of survey respondents

Variable	Response rate	Type	Category	Level	Count	Proportion
Wealth	84.18%	Continuous			2933	
Age	97.88%	Continuous		⩾80	855	25.07%
				70 - 79	1027	30.12%
				60 - 69	1292	37.89%
				<60	236	6.92%
Gender	98.28%	Categorical		Female	1523	44.44%
				Male	1904	55.56%
Marital Status	90.67%	Categorical	Unmarried	Single	223	6.51%
				Widowed	364	10.63%
				Separated/divorced	302	8.82%
			Married	Married	2408	70.33%
				De facto	127	3.71%
Health	98.22%	Categorical	Very Healthy	Excellent	415	12.13%
				Very good	1288	37.64%
			Healthy	Good	1112	32.50%
			Unhealthy	Fair	493	14.41%
				Poor	114	3.33%
Tenure	95.72%	Categorical	Outright	Outright	2601	77.99%
			Not Outright	Paying off	565	16.94%
				Renting	169	5.07%
Income	87.54%	Continuous			3050	
Education	90.67%	Categorical	Higher Education	University degree or higher	993	31.43%
			Other	Trade certificate or diploma	318	10.07%
				Other certificate or diploma	742	23.49%
				Year 12 or equivalent	313	9.91%
				Year 10 or 11	540	17.09%
				Year 9 or below	208	6.58%
				Never attended school	3	0.09%
				Other education attainment	42	1.33%
Occupation	68.40%	Categorical	White Collar	Manager	463	15.31%
				Professional	1197	39.58%
			Pink Collar	Community and Personal Service worker	133	4.40%
				Clerical and Administrative worker	616	20.37%
				Sales worker	101	3.34%
			Blue Collar	Technician and Trades worker	341	11.28%
				Machinery operator and driver	81	2.68%
				Labourer	92	3.04%
Retirement Status	100%	Categorical	Retired		2234	64.12%
			Pre-retired		1250	35.88%
Loan	77.38%	Continuous			2696	
Earnings	50.55%	Continuous			1761	
Partner's Occupation	86.80%	Categorical	White Collar	Manager	267	11.20%
				Professional	686	27.79%
			Pink Collar	Community and Personal Service worker	179	7.51%
				Clerical and Administrative worker	574	24.09%
				Sales worker	169	7.09%
			Blue Collar	Technician and Trades worker	260	10.91%
				Machinery operator and driver	90	3.78%
				Labourer	158	6.63%
Partner's Earnings	37.11%	Continuous			1293	

The five variables - *Wealth*, *Income*, *Loan*, *Earnings* and *Partner's Earnings* - are processed as continuous variables, in line with Higgins and Roberts (2011). *Age* is also a numeric response. The remaining eight variables - *Gender* (Female, Male), *Marital Status* (Unmarried, Married), *Health* (Unhealthy, Healthy, Very Healthy), *Tenure* (home ownership: Outright, Not Outright), *Education* (Higher Education, Other), *Occupation* (White Collar, Pink Collar, Blue Collar), *Retirement Status* (Retired, Pre-retired), and *Partner's Occupation* (White

Collar, Pink Collar, Blue Collar)- are coded as categorical variables.

As shown in Table 2.1, more than two-thirds of respondents provided responses to most of the socio-demographic questions, whereas only 50.55 and 37.11 percent of respondents provided responses to the *Earnings* and *Partner's Earnings* questions. It is consequently not surprising that these two variables are removed by Least Absolute Shrinkage and Selection Operator (Lasso) regression models.

Before fitting the regressions in Chapters 3 through 5, dimension reduction techniques are used to select explanatory variables. Lasso regression model proposed by Tibshirani (1996) aims to shrink some coefficients of the explanatory variables to zero and hence select a subset as the input variables to interpret the model. The Lasso method is utilised throughout this thesis to select the socio-demographic variables. As suggested by Tibshirani (1996), another advantage of applying Lasso regressions is to circumvent the collinearity problem.

In addition, the interactions between the explanatory variables must not be ignored. Before implementing Lasso regressions, this thesis utilises a regression tree to detect the interaction items (De'ath and Fabricius, 2000). Along with socio-demographic variables, all interaction items identified by regression tree analysis are included in a Lasso regression individually and as a whole. The explanatory variables selected by Lasso regressions are used to obtain a final model. The detailed selection process is explained in each of the following three chapters.

2.3 Summary

This chapter presented the aims and motivation of the survey instrument used in this thesis. The socio-demographic variables and their preliminary processing are detailed. The fourteen variables, along with their interactions identified by regression tree analysis, will be selected using Lasso regressions to obtain the final models used in Chapter 3, 4, and 5, in order to examine the relationship between socio-demographics and financial literacy (Research Question 1), financial well-being (Research Question 2), and financial decision-making (Research Question 3), respectively.

Chapter 3

Financial Literacy amongst Elderly Australians[1]

3.1 Introduction

In the wake of the liberalisation and deregulation of financial markets over recent decades, there is now a wide array of financial products and services available to consumers. Individuals are faced with both challenges and opportunities. However, this presents a new challenge, requiring people to be well-equipped with financial knowledge and skills (Lusardi and Mitchell, 2011b; Lusardi et al., 2017).

Within the typical Defined Contribution (DC) pension plan, the elderly actively take more responsibility for their pension accounts (Niblock et al., 2017; Clark et al., 2019; Gallagher et al., 2019). As they have to make financial decisions on their own in a more diversified financial market, they are exposed to more financial risks (Lusardi and Mitchell, 2011a).

[1] This chapter is a revised and amended version of a paper published in *Accounting and Finance*, 2018, DOI: 0.1111/acfi.12362, available at: https://onlinelibrary.wiley.com/doi/epdf/10.1111/acfi.12362.

Lusardi and Mitchell (2011b) find that low levels of financial literacy are widespread amongst developed and developing countries. Further, people tend to be overconfident of their financial knowledge and skills (van Rooij et al., 2011b). A low level of financial literacy is more likely to lead to low savings rates (Moore and Mitchell, 1997) and less retirement wealth accumulation (Bernheim et al., 2001). Such people are therefore more likely to experience asset loss (Lusardi and Mitchell, 2007) and have problems with debt (van Rooij et al., 2011b).

In contrast, those with greater levels of financial literacy tend to make efficient and effective financial decisions (van Rooij et al., 2011b), and thus make better financial plans for their retirement life (Orth, 2006; Lusardi and Mitchell, 2011a; Clark et al., 2017).

In Australia, households are exposed to more risks in the financial environment due to increasingly easier access to financial products and services. The ANZ Bank's 2014 Survey of Adult Financial Literacy in Australia reports the widespread presence of financial illiteracy amongst Australians (ANZ, 2015). In another survey, Roy Morgan Research (2003) finds that young Australian adults of low socio-economic background are much less likely to make well-informed financial decisions.

This chapter analyses data from the survey described in Chapter 2, focusing on people on the verge of retirement and retirees. Three questions in the survey were designed to test the respondents' financial literacy; this study constructs a financial literacy index (FLI) based on these literacy questions.

Although several existing studies have measured financial literacy (Huston, 2010; Lusardi and Mitchell, 2011a,b; van Rooij et al., 2011b, 2012; Klapper

et al., 2013), its measurement amongst the older population has received little attention. Therefore, this study utilises the Item Response Theory (IRT) model to construct a financial literacy index (FLI). Compared to commonly used factor analysis (FA), the IRT model makes use of information repeatedly when obtaining the unobserved trait index (Gibbons and Hedeker, 1992; Thompson, 2004).

Further, this chapter also considers a wider range of socio-demographic factors compared with prior research, such as home ownership (outright, mortgaged, or rented) and self-assessed health (poor, fair, good, very good, excellent). This approach should facilitate new insights into financial literacy across different socio-demographic features and provide an empirical basis for policy-makers to make informed financial policies.

The structure of the reminder of this chapter is as follows. Section 3.2 reviews prior literature related to financial literacy. Section 3.3 introduces the financial literacy survey questions and Section 3.4 describes the IRT models. Section 3.5 explains the use of the IRT model to construct the FLI. The regression tree analysis and Lasso regression model are used to determine socio-demographic factors relevant to financial literacy. Financial literacy levels across different socio-demographic factors are examined by a regression model. Section 3.6 concludes this chapter.

3.2 Review of Prior Research

Bernheim (1995) was amongst the early researchers to reveal a lack of financial literacy amongst most households in the United States. These findings were later confirmed by a comparative study of financial literacy between people from the United States and Japan (Cutler, 1997). Cutler (1997) concluded that the public fails to make well-informed decisions about financial affairs in both

countries.

Whether people are really financial literate or not has become a prominent research and social topic. A growing literature has investigated and analysed the circumstances and theories of personal financial literacy in developed countries, such as the United States, Russia, Germany, the Netherlands, Italy, Australia, New Zealand, Japan, and Korea (Beal and Delpachitra, 2003; Lusardi and Mitchell, 2008; Bucher-Koenen and Lusardi, 2011; van Rooij et al., 2011b; Klapper et al., 2013), as well as developing countries, such as Chile, India, Mexico, and China (Arenas et al., 2006; Hastings and Tejeda-Ashton, 2008; Cole et al., 2011; Xia et al., 2014). Research overwhelmingly reveals that financial illiteracy is a global problem (Bernheim, 1995, 1998; Bernheim and Garrett, 2003; Hilgert et al., 2003; Mandell, 2005; OECD, 2005; Agnew and Szykman, 2005; Lusardi and Mitchell, 2007; Christelis et al., 2010; Bruine de Bruin et al., 2010; Lusardi and Mitchell, 2011b; Lusardi et al., 2017; Boisclair et al., 2017; Clark et al., 2017).

More worryingly, individuals tend to be overconfident about their financial literacy. Regardless of their financial performance, people are inclined to rate themselves as financially literate or knowledgeable, overstating their actual knowledge (Hogarth, 2002). A considerable number of households have limited literacy, to the extent that most are not aware of the vulnerability of their finances (van Rooij et al., 2011b).

3.2.1 Definition of Financial Literacy

Although an increasing amount of literature focuses on financial literacy, there are no systematic theories, and the standard definition and measurement are still disputable and ambiguous (Huston, 2010). Table 3.1 summarises different definitions of financial literacy according to prior literature.

Table 3.1: Different definitions of financial literacy

Key feature	Description	Related literature
Financial skills	The ability to manage money well	Noctor et al. (1992) Schagen and Lines (1996) Cude et al. (2006) Servon and Kaestner (2008) Hung et al. (2009)
Financial knowledge	Understanding key financial terms and concepts	McDaniel et al. (2002) Bowen (2002) Foster et al. (2015)
Financial skills and knowledge	Understanding financial knowledge and apply it to practice	Hogarth (2002) Beal and Delpachitra (2003) Huston (2010)

Noctor et al. (1992) define financial literacy as "the ability to make efficient decisions with regard to money management", which mainly focuses on financial skills. Similar definitions concentrating on skills and applications of financial knowledge are found in later literature, such as in Hung et al. (2009), who define financial literacy as "the ability to apply skills to manage money efficiently for long-term financial well-being". A number of other studies apply and cite definitions of financial literacy in terms of financial skills or applications of financial knowledge, including Schagen and Lines (1996), Cude et al. (2006), and Servon and Kaestner (2008).

Other researchers define financial literacy in terms of financial knowledge. For example, financial literacy has been defined as "understanding key financial terms and concepts needed to function daily in society" (Bowen, 2002), or simply "numeracy and financial knowledge" (Foster et al., 2015). McDaniel et al. (2002) expand the definition by introducing the knowledge of cash flows, management compensation, and internal control related items.

A more reasonable definition consists of both financial knowledge and its application to financial practices. Hogarth (2002) combines the two aspects, de-

scribing financial literacy as "knowledge of basic financial conceptions and the ability to apply financial knowledge to plan and make decisions". Beal and Delpachitra (2003) specifically consider the working of financial institutions, services, and a variety of practical skills directed to financial matters. Huston (2010) simplifies the definition to "measuring how well a person can understand and use personal knowledge related to financial issues".

Accordingly, with the rapid growth and development of financial markets that create a more complicated financial environment for individuals, the appropriate concept of financial literacy covers a wide range of information far beyond financial knowledge and skills.

3.2.2 Effects of Financial Literacy

Today, people typically take increased responsibility for their day-to-day financial management and are therefore exposed to more financial risks (Perry, 2008; Boisclair et al., 2017).

According to Milevsky and Salisbury (2006), today's retirees are mainly faced with two financial risks, namely longevity risk and investment returns risk. As people are living longer, it is possible that they will outlive their money when they approach old age. Longevity risk can be more significant if they are financially illiterate. Compared to those with low financial literacy levels, highly-literate people are more likely to make a well-informed retirement plan to manage this risk (Orth, 2006), as they tend to have a more accurate assessment of their financial resources (Lusardi and Mitchell, 2011b).

Investment returns risk mainly results from the unstable fluctuation of financial markets (Burtless, 2000), causing investment returns to be unpredictable and not secured. van Rooij et al. (2011b) find that financially literate retirees

are more likely to diversify and minimise their financial risks.

On the positive side, higher levels of public and personal financial literacy are expected to contribute significantly to economic development, national savings, and employment (Jappelli, 2010). At the household level, households with adequate financial knowledge and skills tend to have better understanding of financial markets and products, make wise judgements, and avoid making mistakes or being misled about financial affairs (Mandell, 2008; van Rooij et al., 2011b). They are also more likely to make well-informed saving decisions, maintain savings liquidity, and display healthier financial well-being (Garman et al., 1999; Bernheim and Garrett, 2003).

Moreover, Calvet et al. (2006) find that literate households are more likely to invest in stock markets efficiently, and are more skilled in selecting mutual funds with lower costs than people with low financial literacy (Lusardi and Mitchell, 2007; Hastings et al., 2010).

On the negative side, those who lack financial literacy tend to make less efficient choices (Joo and Grable, 2000; Kim and Garman, 2004) and are more likely to make financial mistakes (Shen et al., 2016), which ultimately result in unhealthy national economic well-being (Remund, 2010). Low financial literacy levels have also been found to be associated with serious social problems, such as physical and mental illness and divorce (Kinnunen and Pulkkinen, 1998; Yeung and Hofferth, 1998).

With respect to household debt and credit behaviours, low-literacy households are more likely to take debts with high costs and employ poor loan strategies (Lusardi and Tufano, 2015). Agarwal et al. (2009) show that high-cost credit instruments are chosen by low literacy consumers, who often pay housing

loans or mortgages with higher interest rates.

In addition, there is a relationship between financial literacy and individual behaviours. Low levels of financial literacy may lead to poor financial decision-making (Lusardi, 2012; Cheah et al., 2015; Nguyen et al., 2017), destructive saving behaviour (Lusardi, 2003; Butt et al., 2017), lack of portfolio diversification (Banks and Oldfield, 2007), less net wealth accumulation (Gustman et al., 2012; van Rooij et al., 2012), and ineffective retirement planning (Lusardi and Mitchell, 2011a). It is clear that the importance of financial literacy in financial markets should not be neglected.

3.2.3 Financial Literacy and Retirement

There are an increasing number of studies that test the relationship between financial literacy and retirement (Hastings and Mitchell, 2011; Bucher-Koenen and Lusardi, 2011; van Rooij et al., 2011b; Earl et al., 2015; Eugster, 2017). Financial illiteracy has negative ramifications on retirement. The majority of the older population is not well-equipped with advanced or even basic financial knowledge and skills, and are thus less likely to plan for retirement (Behrman et al., 2012). This will result in limited savings and less wealth accumulation (Kapteyn et al., 2005; Bateman, 2006), or in the worst-case scenario, exhausting their assets at old age (Orth, 2006).

A cause for concern is that employees who are preparing for retirement and the newly retired are overconfident in their savings for retirement life (Parker et al., 2012). Retirees with less financial knowledge tend to borrow more and accumulate less wealth (Stango and Zinman, 2009). More worryingly, little is known about the reasons why they fail to make a retirement plan (Lusardi and Mitchell, 2011a).

Not surprisingly, retirees with higher levels of literacy are more likely to plan for their retirement and stick to their plans (Lusardi and Mitchell, 2011a; Blanchett and Kaplan, 2013). Thus, many studies recommend professional planning for retirement (Klapper and Panos, 2011; Clark et al., 2017). It is clear from the literature that the important role of financial literacy in retirement life should receive more research attention.

3.2.4 Financial Literacy and Socio-demographics

Among early studies, Volpe et al. (1996) examine the financial literacy of American university students, concluding that low levels of financial literacy are typically found in young females with non-business majors and with little or no work experience. This lack of financial knowledge and skills amongst young adults is further confirmed by Roy Morgan Research (2003), Lusardi and Mitchell (2009), and Lusardi et al. (2010).

Females are found to be more likely to have low levels of financial knowledge (Worthington, 2004). Lusardi and Mitchell (2008), in a study of the financial literacy of women, find that those who are less educated and unmarried tended to score lower on a number of financial literacy questions, with older women performing worst.

With respect to marital status, Lusardi and Mitchell (2008) and Servon and Kaestner (2008) both find that the unmarried are less financially literate than the married. Unmarried people have to make financial decisions by themselves, which may result in the employment of less effective financial strategies than those of their married counterparts (Fonseca et al., 2012).

In addition, little attention has been paid to the relationship of health and of residence ownership to financial literacy. Taking into account a broad range

of socio-demographic characteristics is expected to further strengthen the financial literacy literature.

3.2.5 Summary and Contributions

Prior research has developed integrative views of the definition of financial literacy and explored the relationship between financial literacy and financial behaviours. However, measurement of financial literacy in previous studies is associated with information loss (see Section 3.4 for more detail). Hence, more research is needed to craft consensus on the appropriate measurement of financial literacy. In addition, financial literacy within the elderly group remains relatively unexamined. Moreover, prior studies only focus on the relationship between financial literacy and a few demographic factors and therefore do not constitute a comprehensive view.

IRT model is utilised in this chapter to construct a Financial Literacy Index (FLI), which is able to make use of information more sufficiently relative to extant approaches such as factor analysis. As population ageing becomes prevalent, it is vitally important to focus specifically on the elderly. This chapter also examines the relationship between a wide range of socio-demographic characteristics and financial literacy.

3.3 Financial Literacy Data

Three questions in the survey described in Chapter 2 assessed financial literacy. Details of these questions are as follows:

Q3.11: Which of the following investment options do you think is most likely to lead to a loss of money over a one year period?
A. Conservative/Cash, **B.** Growth/High Growth, **C.** Balanced, **D.** Don't know

Q3.12: Which of the following investment options do you think is least likely to lead to a loss of money over a one year period?
A. Conservative/Cash, **B.** Growth/High Growth, **C.** Balanced, **D.** Don't know

Q5.9: If you had a choice between receiving $10,000 now, or a greater amount of money one year from now, what is the minimum amount you would need to receive in one year in order for you to choose this option instead of $10,000 now? (numeric response).

The definitions of Growth/High Growth, Balanced, and Conservative/Cash investment options were explained in the survey as follows:

- **Growth/High Growth:** a higher concentration of shares, and a lower concentration of fixed interest, property and cash than balanced.
- **Balanced:** a more even mix of shares, fixed interest, property and cash.
- **Conservative/Cash:** a greater concentration of cash and/or fixed interest, and a low to negligible concentration of shares.

These questions test two aspects of the respondent's financial literacy: investment strategy and risk (Q3.11 and Q3.12) and time value of money (Q5.9). Section 3.5.1 applies the IRT model to construct the FLI based on these three financial literacy questions.

3.4 Item Response Theory (IRT) model

Although many attempts have been made to construct a financial literacy index (FLI), a standard measurement of financial literacy remains elusive (Huston, 2010). A number of researchers have utilised factor analysis (FA) with regard to categorical data to calculate a FLI (Lusardi and Mitchell, 2007, 2008,

2009, 2011a,b; van Rooij et al., 2011b,a, 2012). However, one disadvantage of FA is that in constructing an index it will lose part of the information (Thompson, 2004), because FA involves reducing a large number of variables into fewer underlying factors.

In order to measure people's financial literacy more precisely, it is necessary to use an index with the least amount of information loss. Less information loss is one advantage of the IRT model (Gibbons and Hedeker, 1992), where the iterative process of the Expectation-Maximisation (EM) algorithm is applied to estimate parameters (Bock and Aitkin, 1981). This process facilitates the repeated use of information during the iterations. Accordingly, the IRT models outweigh other techniques in constructing the FLI. This thesis therefore utilises the IRT model to obtain the FLI with less information loss.

Another advantage of the IRT model is that the characteristics of the survey questions themselves are taken into account when constructing the FLI. Specifically, in obtaining the FLI, the IRT model incorporates item-difficulty information; namely, how difficult it is for respondents to answer each question correctly. As there are three financial literacy questions in the survey that vary in their difficulty, the IRT model is appropriate because it incorporates this information.

3.4.1 Introduction to IRT Model

Item response theory (IRT) models are mainly used to solve questions with respect to categorical response variables, which are usually derived from questionnaires and tests. The response variables are designed to measure unobserved abilities of the respondent and the IRT model is applied to describe the relationship between the latent variable and the response variables. As financial literacy cannot be observed directly, the IRT model is applied to calculate

the FLI based on the three financial literacy questions in the survey.

According to Rabe-Hesketh et al. (2004), there are two types of IRT models: 1-parameter logistic (1PL) IRT model and 2-parameter logistic (2PL) IRT model. Both models are used for dichotomous response variables. For multi-nominal (polytomous) issues, the partial-credit model (PCM) and rating scale model (RSM) can be implemented (Zheng and Rabe-Hesketh, 2007).

3.4.2 Structure and Estimation of IRT Model

One-parameter logistic (1PL) IRT model is the fundamental IRT model (Rasch, 1960). It describes the relationship between item difficulty - the difficulty of each response variable - and the latent variable. The formula for the 1PL model is shown below:

$$Pr(x_{in} = 1|\theta_n) = \frac{exp(\theta_n - \delta_i)}{1 + exp(\theta_n - \delta_i)}. \tag{3.1}$$

where $i = 1, 2, ..., m$, m is the number of response items (variables) and x_{in} is the response to the i^{th} item. δ_i is the item difficulty parameter, described as the ability level (financial literacy level) at which people have a 50 percent chance of providing correct answers to the item. θ_n is the latent variable (financial literacy) of person (respondent) n.

As can be seen from the formula, the 1PL-IRT model reflects the relationship between the probability of answering response items (literacy questions) correctly and the latent variable. Based on equation 3.1, the following equation can be easily obtained:

$$ln\frac{Pr(x_{in} = 1|\theta_n)}{Pr(x_{in} = 0|\theta_n)} = \theta_n - \delta_i. \tag{3.2}$$

This equation shows that the log odds is a linear function of the item difficulty parameter (δ_i), which can make the calculation process more parsimonious and efficient. This means that the larger the item difficulty parameter, the lower the chance of answering the question correctly.

Two-parameter logistic (2PL) IRT model, proposed by Birnbaum (1968), adds a slope parameter (or discrimination parameter, λ_i) to the 1PL model to measure the extent to which item i distinguishes persons of different trait abilities (financial literacy levels). With this discrimination parameter, the 2PL model is more flexibly able to reflect the relationship between item difficulty and latent traits than the 1PL model. The formula for the 2PL-IRT model is shown below:

$$Pr(x_{in} = 1|\theta_n) = \frac{exp\{\lambda_i(\theta_n - \delta_i)\}}{1 + exp\{\lambda_i(\theta_n - \delta_i)\}}. \tag{3.3}$$

Masters (1982) extended the basic 1PL-IRT model to the 1PL partial-credit model (PCM). In the 1PL-PCM, the response items are polytomous with j categories ordered as 1,2,...,k_i for item i. The formula for the 1PL-PCM is shown as follows:

$$Pr(x_{in} = j|\theta_n) = \frac{exp\{\sum_{m=2}^{j}(\theta_n - \delta_{im})\}}{1 + \sum_{l=2}^{k_i} exp\{\sum_{m=2}^{l}(\theta_n - \delta_{im})\}}. \tag{3.4}$$

According to Zheng and Rabe-Hesketh (2007), δ_{ij} is termed the "step difficulty parameter" related to category j of response item i, representing the added difficulty transfer between the two categories (from $j-1$ to j).

Rating scale model (RSM) is a special PCM with $k_i = k$ (Dodd, 1990). In the case where $k_i = k = 2$, the PCM and RSM become a basic IRT model.

In this study, amongst the three financial literacy questions, responses to Q3.11

and Q3.12 are categorical, whereas responses to Q5.9 are numeric. We thus characterise these numeric responses to three categories with respect to degree of correctness; namely, correct, partially correct, and incorrect. As Q5.9 is now a polytomous variable, the PCM is utilised to construct the FLI.

Muraki (1992) further incorporated the 2PL model into the PCM by adding a slope parameter, which is known as the 2PL-PCM. The structure of the 2PL-PCM is shown below:

$$Pr(x_{in} = j|\theta_n) = \frac{exp\{\sum_{m=2}^{j} \lambda_i(\theta_n - \delta_{im})\}}{1 + \sum_{l=2}^{k_i} exp\{\sum_{m=2}^{l} \lambda_i(\theta_n - \delta_{im})\}}. \tag{3.5}$$

Following similar simplification procedure produces the simplified 2PL-PCM:

$$ln\frac{Pr(x_{in} = j|\theta_n)}{Pr(x_{in} = j-1|\theta_n)} = \lambda_i(\theta_n - \delta_{ij}). \tag{3.6}$$

As proposed in Zheng and Rabe-Hesketh (2007), the 1PL models are harder to be realised in practice. Therefore, the 2PL-PCM is applied to construct the FLI in this study.

3.5 Empirical Analysis

3.5.1 Measurement of Financial Literacy

This study utilises the 2PL-PCM to estimate the financial literacy index (FLI) based on three financial literacy questions in the survey. The software used to implement the 2PL-PCM is the R package ltm.

The parameter estimations of the 2PL-PCM are listed in Table 3.2. The item difficulties of Q3.11 and Q3.12 are approximately -0.18 and 0.14, respectively. The first step difficulty of Q5.9 is around 1.78 and the figure for the second

step is about 2.54. As explained in Section 3.4.2, the larger the item difficulty parameter, the more difficult the question. The results thus indicate that Q5.9 is the hardest financial literacy question, followed by Q3.12. Q3.11 is the easiest question to be answered. For Q5.9, it is much harder to move from "Partly correct" to "Correct" than from "Incorrect" to "Partly correct".

Table 3.2: Parameter estimations of the 2PL-PCM

Question	Parameter	Value	Standard error	z-value
Q3.11	$\hat{\delta_1}$	-0.1834	0.0877	5.6917
	$\hat{\lambda_1}$	2.7211	0.4051	6.7176
Q3.12	$\hat{\delta_2}$	0.1393	0.3469	-2.0100
	$\hat{\lambda_2}$	5.2282	1.8346	2.8497
Q5.9	$\hat{\delta_{32}}$	1.7830	0.0396	-18.0339
	$\hat{\delta_{33}}$	2.5415	0.0635	-16.0535
	$\hat{\lambda_3}$	0.4009	0.0349	11.4859

The values of the discrimination parameters are approximately 2.72, 5.23, and 0.40, respectively, indicating that Q3.12 has the greatest discrimination power to distinguish respondents with high literacy from low literacy, followed by Q3.11. In comparison, people with different financial literacy abilities cannot be easily distinguished through Q5.9.

2PL-PCM applies the difficulty parameters and discrimination parameters to obtain the FLI, which is a clear advantage of the IRT model (as discussed in Section 3.4). Figure 3.1 demonstrates the distribution of the estimated FLI. The FLI ranges from -0.722 to 0.830 with mean of -0.001 (close to 0) and median of -0.056. It is clear that approximately 27 percent (934) of respondents have the lowest financial literacy ability (-0.722). On the other hand, only about 7 percent (243) of people possess the highest literacy ability (0.830).

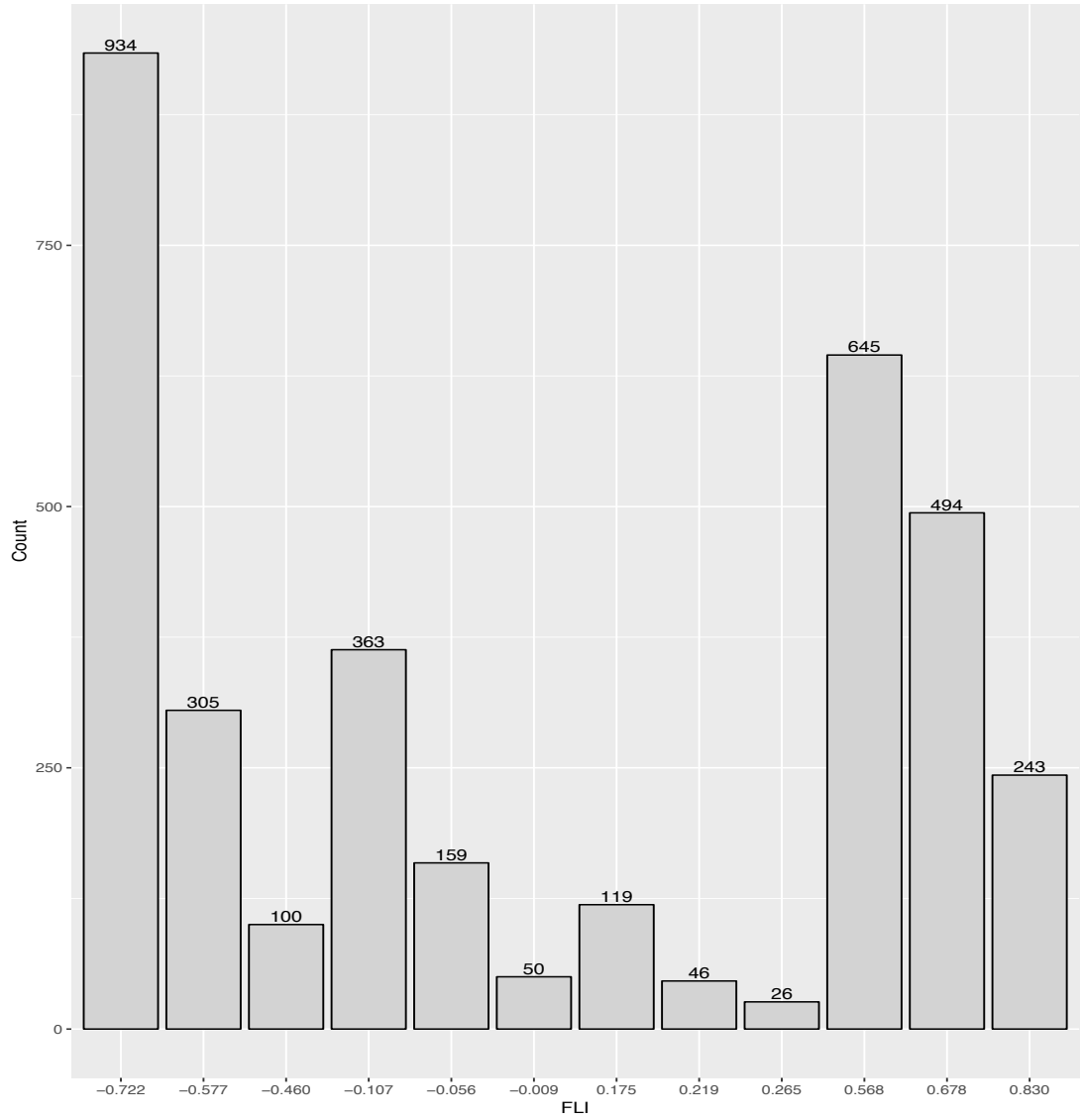

Figure 3.1: Distribution of the Financial Literacy Index (FLI)

Figure 3.2 presents the mean FLI based on *Wealth* and *Income*, and by *Gender*. There is a clear overall pattern that the mean FLI increases as wealth and income become greater. A higher level of financial literacy is thus associated with greater net wealth and higher income. Further, males appear to be more financially literate than females over almost every wealth and income level.

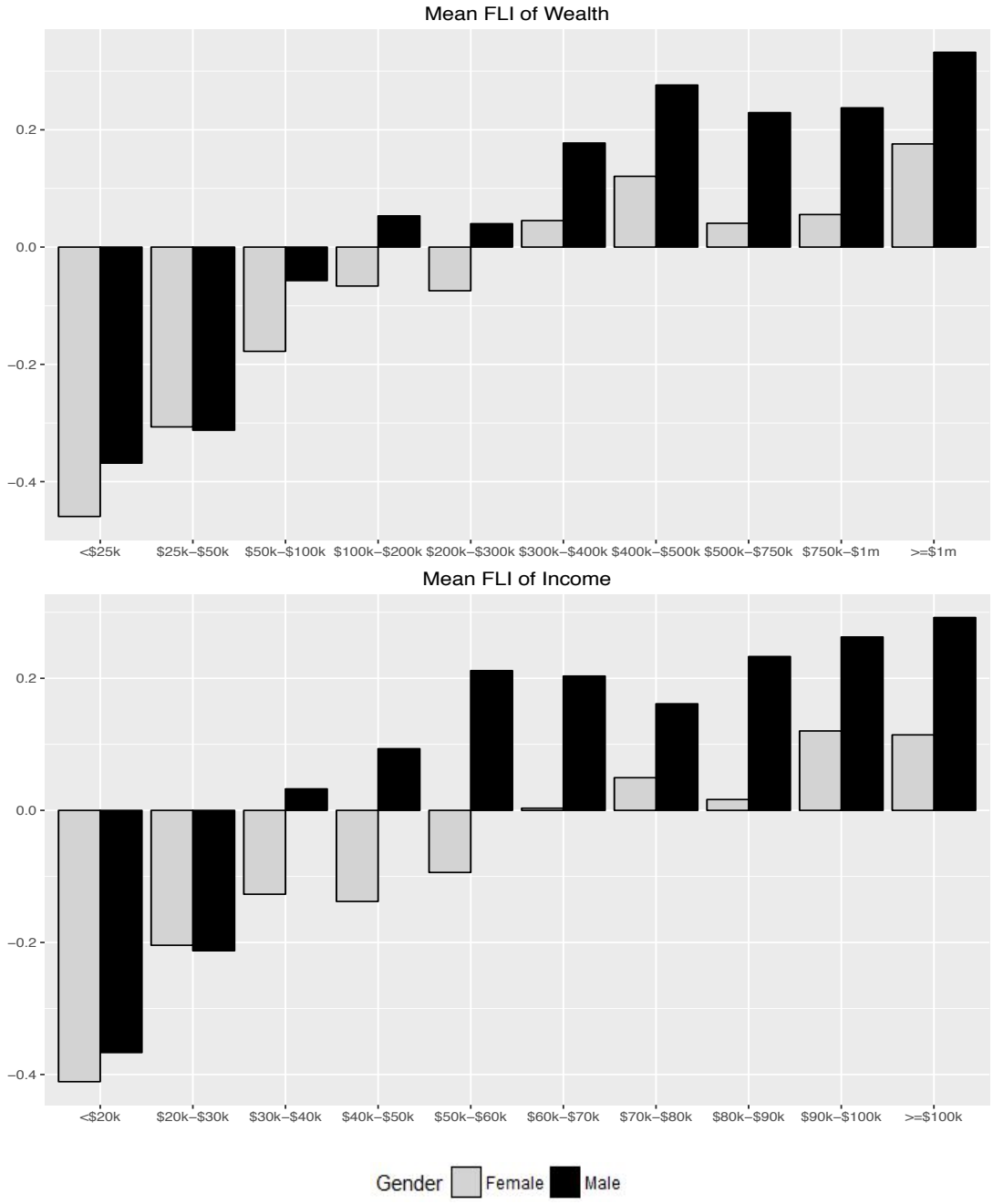

Figure 3.2: Mean FLI of Wealth and Income by *Gender*

Figure 3.3 shows the mean values of the FLI in terms of *Age*, *Marital Status*, self-assessed *Health*, *Tenure* (home ownership), *Education*, and *Occupation*. Younger elderly people possess higher levels of financial literacy. Their FLI drops substantially when they reach their 70s, especially for women. Their

literacy abilities continue to decrease dramatically as they approach older age. Within the same age group, men perform much better than women prior to reaching the age of 80.

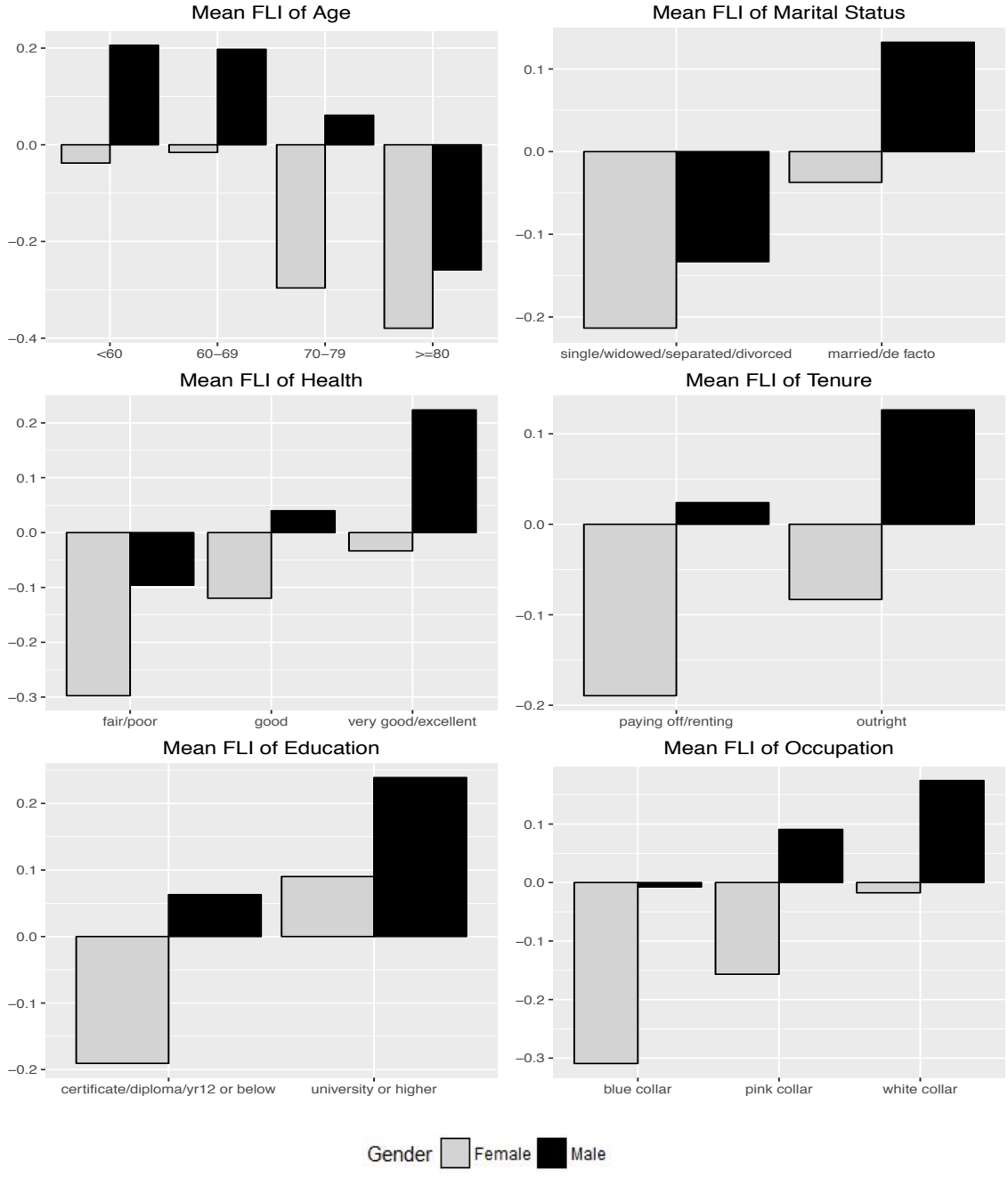

Figure 3.3: Mean FLI of other socio-demographics by *Gender*

As expected, married respondents tend to have higher FLI than unmarried respondents. People in good and better health appear to be more financially literate than those who assessed themselves as fair or poor. Notably, women who are very healthy do not perform as well as men in good health.

A similar pattern is identified in home ownership (*Tenure*). Outright residence owners have financial literacy superior to those who are mortgagors or renting. Females who own their homes outright have even lower FLI than males with mortgages or renting.

Individuals with higher educational attainment and better occupation tend to be well-equipped with adequate financial knowledge and advanced financial skills (higher levels of financial literacy). They can thus make effective investment decisions and enjoy a comfortable retirement life.

This section has measured the financial literacy of elderly Australians and provides a preliminary insight with respect to the relationship between financial literacy and several socio-demographic features. Whether the findings are robust and meaningful will be examined by regression modelling.

3.5.2 Socio-demographic Variable Selections

Lasso regression is utilised to select the socio-demographic variables relevant to financial literacy. The Lasso method outperforms other dimension reduction techniques in selecting explanatory variables: (1) compared to the Ridge regression (Hastie et al., 2013), the Lasso method shrinks some coefficients of the explanatory variables to zero to select a subset as the input variables to interpret the model (Tibshirani, 1996); (2) the Lasso method is able to circumvent the collinearity problem; (3) compared to the Decision Tree analysis (Myles et al., 2004), the Lasso method is applicable to regression problems;

(4) compared to the Artificial Neural Networks, the results of Lasso regression is more interpretable rather than a "black-box". Stepwise regression and Genetic Algorithms are also popular variable reduction techniques; however, the former one is less flexible than the Lasso method (Agostinelli, 2002) and the latter one requires a substantial number of parameters to be set (Johnson et al., 2014). Therefore, Lasso regression is utilised throughout this thesis to select the socio-demographic variables.

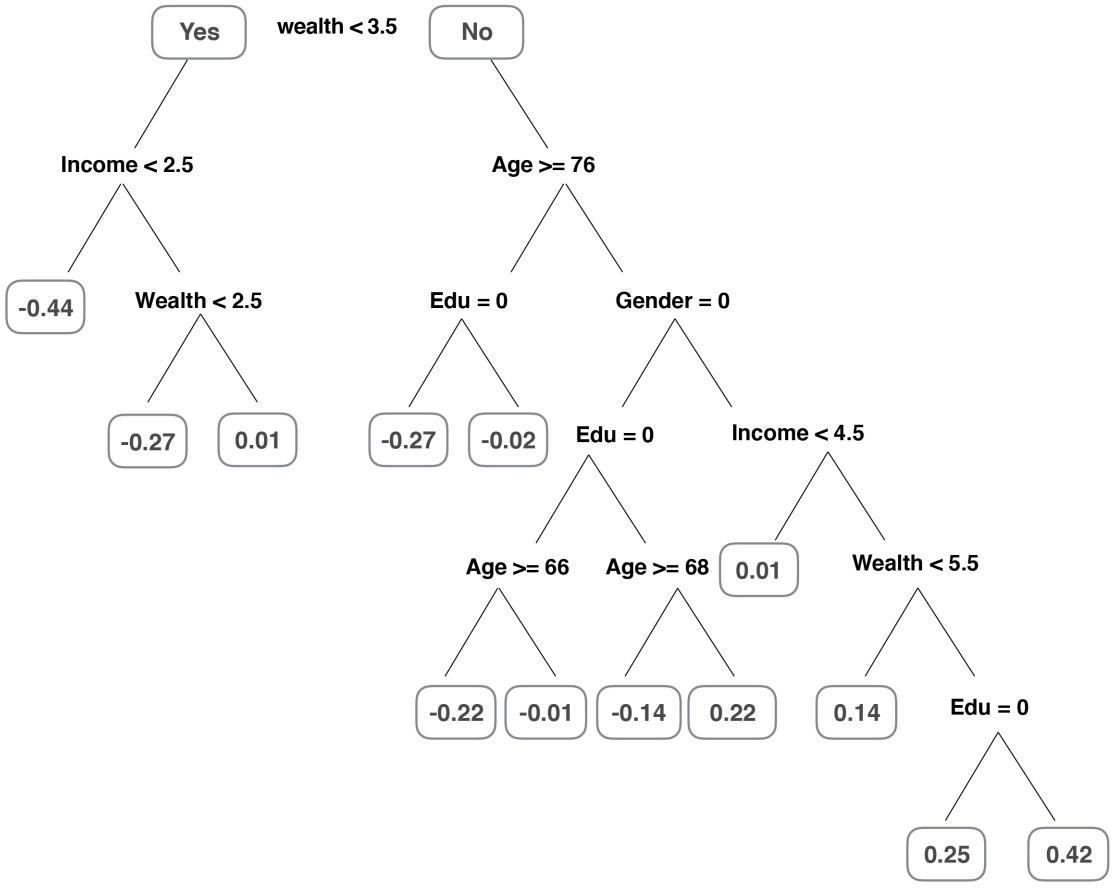

Figure 3.4: Pruned regression tree of all responses

Before implementing the Lasso regression, a regression tree is employed to detect the interaction items. The reasons for using regression tree analysis

are: (1) it is able to discover interactions of multiple dimensions; and (2) no pre-specification of possible interaction items is needed (De'ath and Fabricius, 2000). Figure 3.4 illustrates the pruned tree of all responses. The interactions shown in the pruned tree are summarised in Table 3.3. As listed in Table 3.3, ten interaction items are assessed using a Lasso regression to determine whether they are important enough to remain.

Table 3.3: Main interaction items

Variable	Interact with
$Wealth$	$Income$, Age, Edu and $Gender$
Age	Edu, $Gender$ and $Income$
$Gender$	$Income$ and Edu
$Income$	Edu

Consider the interaction between $Wealth$ and $Income$ for example. Table 3.4 presents the results of the Lasso regression models with and without this interaction item. The Lasso parameter λ chosen is the minimum λ value based on 10-fold cross-validation (CV). It is clear that this interaction ($Wealth*Income$) should be excluded as the coefficient is 0 (Tibshirani, 1996). At the same time, the coefficients of the demographic variables are the same between the two models, suggesting that the interactions between $Wealth$ and $Income$ cannot explain the variability in responses (FLI) and thus should not be included. Similar results are identified for the other 9 interaction items, indicating rejection of all ten potential two-way interactions in the regression models.

The variables with a coefficient of 0 also include $PEarning$ (partner's earnings), $PEmploy2$ (partner's occupation: white collar), $PEmploy1$ (partner's occupation: pink collar), $Health1$ (good), and $Earning$ (annual earnings). It is noted

that *Health*1 is excluded but *Health*2 (very good or excellent) is not. The results suggest re-classifying *Health* and hence this study combines good, very good, and excellent as "Healthy or above".

Table 3.4: Estimations of the Lasso regression

Exclusion order	14 variables		14 variables with interaction item	
	Variable	Coefficient	Variable	Coefficient
1st	*PEarning*	0	*PEarning*	0
2nd	*PEmploy*2	0	*PEmploy*2	0
3rd	*PEmploy*1	0	*Wealth* ∗ *Income*	0
4th	*Health*1	0	*PEmploy*1	0
5th	*Earning*	0	*Health*1	0
6th	*Marital*	0.0287	*Earning*	0
7th	*Age*	-0.0029	*Marital*	0.0287
8th	*Loan*	-0.0103	*Age*	-0.0029
9th	*Retire*	-0.0452	*loan*	-0.0103
10th	*Employ*1	-0.0541	*Retire*	-0.0452
11th	*Health*2	0.0366	*Employ*1	-0.0541
12th	*Income*	0.0054	*Health*2	0.0366
13th	*Employ*2	-0.1398	*Income*	0.0054
14th	*Edu*	0.0470	*Employ*2	-0.1398
15th	*Tenure*	0.1138	*Edu*	0.0470
16th	*Gender*	0.1442	*Tenure*	0.1138
17th	*Wealth*	0.0433	*Gender*	0.1442
18th			*Wealth*	0.0433

With the new *Health* variable, the model is re-estimated without any material changes to other variables. The results show that the coefficients of *PEarning*, *PEmploy*2, *PEmploy*1, and *Earning* are 0, whereas *Health* remains and exhibits a coefficient of 0.0536.

The Lasso regression is used again on the remaining dataset (11 variables). *Retire* (retirement status), *Employ*1 (occupation: pink collar), and *Loan* are excluded as a result. A similar issue occurs: *Employ*1 should be removed but *Employ*2 (occupation: white collar) should not. Following the same approach,

white collar and pink collar are combined, and the model is re-estimated. The estimation results are presented in Table 3.5.

Table 3.5: Re-estimations of the Lasso regression (11 variables)

Exclusion order	Variable	Coefficient
1st	Retire	0
2nd	Loan	0
3rd	Employ	0.0192
4th	Marital	0.0057
5th	Tenure	0.0344
6th	Health	0.0269
7th	Edu	0.0499
8th	Age	-0.0051
9th	Gender	0.1153
10th	Income	0.0117
11th	Wealth	0.0404

The Lasso parameter λ chosen herein is one standard error λ value. The change from using the minimum λ value is because the CV plot is almost flat in the beginning that the minimum λ criterion has little power to make selections, and slight gain in accuracy of using the minimum λ is outweighed by substantially simpler one standard error λ model.

As shown in Table 3.5, *Retire* and *Loan* are excluded. *Employ* remains with a coefficient of 0.0192. The results are consistent after re-estimation. The remaining nine socio-demographic variables are selected in this manner, specifically: $Wealth$, $Income$, $Gender$, Age, Edu (education), $Health$, $Tenure$, $Marital$ (marital status), and $Employ$.

3.5.3 Regression Modelling

A *post hoc* Harman common factor analysis is implemented to examine the common method variance (Chang et al., 2010; Linnenluecke et al., 2015). The

results show that the common factor only explains 19.565% of total variance, implying no common method bias. The nine explanatory variables selected by the Lasso regression are applied to obtain a final model with which to examine the relationship between financial literacy and socio-demographics. The results of the generalised regression model are listed in Table 3.6.

Table 3.6: Estimations of the generalised regression model

Variable	Estimate	Std. Error	t value	Baseline level
Intercept	0.0322	0.1063	0.3025	
Wealth	0.0415	0.0051	8.1548	
Age	-0.0105	0.0014	-7.4326	
Gender	0.1939	0.0264	7.3512	Female
Marital	0.0173	0.0308	0.5598	Unmarried
Health	0.0695	0.0325	2.1427	Unhealthy
Tenure	0.1127	0.0302	3.7322	Not Outright
Income	0.0136	0.0052	2.6302	
Edu	0.0912	0.0257	3.5498	Other
Employ	0.1055	0.0342	3.0817	Blue Collar

People with a higher level of financial literacy are more likely to demonstrate the following characteristics: relatively younger age, married, predominantly male, exhibit greater net wealth and higher income, white or pink collar workers, outright residence owners, in good health, and highly educated.

To facilitate comparisons, Table 3.7 provides a summary of findings of a number of prior studies. It is clear that other than *Age*, all socio-demographic factors are consistent with our results. Reasons for the inconsistency of *Age* are discussed later in this section. This thesis therefore contributes new findings to the existing literature regarding the relationship between financial literacy and self-assessed health as well as home ownership.

Table 3.7: Summary of prior findings

Prior literature	Low level of financial literacy
Volpe et al. (1996)	Young, female
Roy Morgan Research (2003)	Young, less educated, low income, unemployed
Beal and Delpachitra (2003)	Less educated, low income, unemployed
Worthington (2004)	Female
Lusardi and Mitchell (2007, 2008, 2009, 2011a,b)	Young, female, less educated, unmarried, worker
Higgins and Roberts (2011)	Female, less educated

As expected, white or pink collar workers, with greater wealth accumulation and higher income are likely to be financially engaged. Increased participation in financial activities equips them with more advanced financial knowledge and skills, and this ultimately improves their financial literacy. The result is consistent with Roy Morgan Research (2003) and Beal and Delpachitra (2003).

However, the findings regarding the relationship between financial literacy and age are inconsistent with prior research that demonstrates that younger people tend to be the least financially literate (Roy Morgan Research, 2003; Lusardi et al., 2010). This discrepancy is likely due to the fact that the age groups considered in these studies are not congruent with the "younger" age group examined in this study (aged 55 or above, on the verge of retirement or in its early stage).

Younger elderly people are likely to engage in financial products and services more actively because of access to superannuation[2]. However, as they approach older age they are more likely to experience health problems, and are thus less likely to spend much time learning about new financial products or engaging in financial practices. This is why financial literacy levels decrease dramatically upon reaching the age of 80.

Males appear to have a higher level of financial literacy than females. The

[2] The compulsory superannuation guarantee scheme was not introduced until 1992 with senior Australian retirees being not likely to be involved (Drew and Stanford, 2001).

poor financial literacy amongst females is consistent with results in Section 3.5.1 as well as previous studies (Volpe et al., 1996; Bernheim, 1998; Hilgert et al., 2003; Roy Morgan Research, 2003; OECD, 2005; Agnew and Szykman, 2005; Lusardi and Mitchell, 2007, 2008, 2009, 2011a,b).

In addition, married (or de facto) respondents are expected to possess higher levels of financial literacy than unmarried respondents. They tend to integrate the family's financial knowledge to employ suitable financial strategies and decisions. As a result, they are less financially vulnerable than unmarried people. This gap in financial literacy is expected to become increasingly larger as they age.

Those in good health tend to have good lifestyles. People with superior life habits are likely to have more time to spend on learning how to manage their money and searching for financial advice. They are thus more likely to be financially literate.

People renting or paying off their homes are likely to experience financial concerns, while outright residence ownership leads to less financial concerns. It is hence not surprising to find that higher financial literacy ability is associated with outright home ownership.

It is also expected that people who are more educated tend to exhibit a wider range of financial knowledge and how to apply this knowledge to practice, as confirmed by prior studies (Roy Morgan Research, 2003; Beal and Delpachitra, 2003; Lusardi and Mitchell, 2007, 2008, 2009, 2011a,b; Higgins and Roberts, 2011).

3.6 Summary

People within the current pension plan scheme typically take increased responsibility for their pension accounts (Niblock et al., 2017; Clark et al., 2019; Gallagher et al., 2019) and are thus required to be equipped with a higher level of financial literacy. As financial literacy is unobservable, measuring financial literacy is therefore of high importance.

Researchers have applied factor analysis (FA) to create a financial literacy index (FLI) (Lusardi, 2003; Lusardi and Beeler, 2006; Lusardi and Mitchell, 2008; van Rooij et al., 2011b). However, using FA to construct a FLI will lead to information loss (Thompson, 2004). In comparison, one advantage of the item response theory (IRT) model is that it makes use of more information. It also combines characteristics of survey questions themselves and their relationships with financial literacy when obtaining the FLI. The IRT model is thus utilised in this study to create the FLI based on three financial literacy questions in the survey (Higgins and Roberts, 2011).

In addition, regression tree analysis is used to detect the interaction effects amongst socio-demographic factors, while Lasso regression is implemented to determine socio-demographic variables important to financial literacy.

Nine variables are selected, including wealth, age, gender, marital status, self-assessed health, tenure (home ownership), income, education and occupation. It is noteworthy that health and home ownership are rarely analysed in prior literature. This thesis therefore contributes to the existing literature by providing empirical evidence about their relationships with financial literacy.

The empirical results indicate that people with higher levels of financial lit-

eracy are more likely to demonstrate the following characteristics: relatively younger age, married, predominantly male, exhibit greater net wealth and higher income, white or pink collar workers, outright residence owners, in good health, and highly educated.

It is therefore recommended that superannuation, insurance, and other fund providers design customised products for elderly customers, particularly focused on those with low financial literacy level. Personalised products would be much easier to understand and facilitate optimisation of income streams. Detailed and practicable policy recommendations are presented in Section 6.2.

The financial literacy index (FLI) developed in this chapter will be used as a measure to investigate the effects of financial literacy, both by itself and via an interaction with consumption patterns, on financial well-being in Chapter 4. This FLI will be further used to examine how financial literacy affects elderly Australians' decisions regarding adoption of a variety of financial strategies and how financial concerns affect these literacy-strategy nexuses in Chapter 5.

Chapter 4

Financial Well-being amongst Elderly Australians

— The role of financial literacy and consumption patterns

4.1 Introduction

Population ageing is a global trend that challenges the well-being of elderly people, with a longer retirement life requiring increased financial resources (van Rooij et al., 2012; Boisclair et al., 2017). However, in the US, average savings rates are at record lows (Brüggen et al., 2017), implying that elderly people may outlive their savings as they reach older age (Skinner, 2007).

Financial well-being is closely related to personal and social welfare. In 2015, innovative income products for retired households were encouraged by the Australian Federal Government, aiming to improve retirees' financial well-being. However, reliable retirement income products are less likely to be identified and selected by the elderly with low financial literacy levels (Chu et al., 2017). Without regular and stable income sources, retirees are more likely to

worry about their living standards and less likely to be financially satisfied (Kausel et al., 2016; Butt et al., 2017; Liao et al., 2017).

Healthy consumption behaviour helps improve people's quality of life and satisfaction with life (Lin et al., 2017); however, consumption patterns change over the course of retirement. Banks et al. (1998) propose the "Retirement Consumption Puzzle", wherein retired households should smooth consumption across time periods but they actually reduce consumption substantially at retirement. People tend to report low levels of financial well-being if their actual consumption cannot meet their consumption needs (Earl et al., 2015). Hence, informed consumption decisions are of high importance for the newly retired to smooth their consumption patterns.

Financial well-being is beneficial on multiple levels. At the individual level, financial well-being is positively related to quality of life and mental and physical health (Blanchflower and Oswald, 2004). It also strengthens interpersonal relationships and improves performance at work (Brüggen et al., 2017). At the organisational level, it facilitates formation of internal culture (stated goals, authority structure, and loyalty) and external reputation (brands, strategic alliances, reliability, and accountability) (Vlachos et al., 2009). At the social level, it reduces societal and economic problems, improves formation of social norms and cultures (Sacks et al., 2012), and enhances social welfare (Malone et al., 2010). Improvement in the financial well-being of the elderly is thus an effective way to improve their living standards and ultimately mitigate adverse consequences generated by population ageing.

In Chapter 3, a financial literacy index (FLI) was developed and used to analyse the relationship between financial literacy and socio-demographic characteristics. The results reveal that financial literacy plays an important role in

retirement life; however, the elderly's financial well-being is still an emerging research area that requires empirical testing (Brüggen et al., 2017). Retirees make involuntary changes to their consumption patterns in terms of retirement, and so the picture of how financial literacy affects the elderly's retirement life is incomplete. Therefore, building and extending on Chapter 3, this chapter applies the newly developed FLI to examine how financial literacy, both by itself and via an interaction with consumption patterns, affects elderly Australians' financial well-being. This will shed more light on the elderly's financial well-being and provide ways to improve retired households' living standards and satisfaction with retirement life.

In prior literature, researchers tend to analyse consumption patterns based solely on actual consumption, ignoring consumption needs. However, it is important to consider consumption needs as part of consumption patterns because consumption is a needs-driven behaviour (Wilk, 2002; Higgins and Roberts, 2011). This chapter takes into account both actual consumption and consumption needs, analysing changes in consumption patterns over the course of retirement and utilising Text Mining (TM) techniques to discover reasons for these changes in consumption. Further, this chapter investigates the effects of changes in consumption patterns on financial well-being across two dimensions, namely basic consumption and non-essential consumption.

This chapter also reveals the relationship between a broader range of socio-demographic characteristics and financial well-being than previously documented in the literature, including empirical evidence that outright residence owners are more satisfied with their financial situation than mortgagors and renters.

4.2 Review of Prior Literature

4.2.1 Financial Well-being

Financial well-being is an emerging research area (Brüggen et al., 2017), although well-being has been broadly analysed from many different perspectives (Iyer and Muncy, 2016; Bobe and Cooper, 2018), such as sociology (Stevenson and Wolfers, 2008; Griggs et al., 2013) and psychology (Diener et al., 2003; Dittmar et al., 2014).

Some prior studies define and measure financial well-being objectively (Gaspart, 1997; Cifuentes et al., 2016), using different objective characteristics as indicators for financial well-being, such as income (Porter and Garman, 1992) and investment performance (Chu et al., 2017). Shim et al. (2009) focus specifically on students' financial well-being, using their level of debt as a measure of financial well-being.

In a recent conceptualization study, financial well-being is defined as "the perception of being able to sustain current and anticipated desired living standards and financial freedom" (Brüggen et al., 2017). This definition underlines the importance of subjective feelings. How people assess their financial well-being mainly depends on their own preferences irrespective of their objective financial situation, and, as such, people with similar socio-demographic characteristics may assess their financial well-being differently (Kapur, 2005).

Subjective assessment of individual financial well-being has also been advocated by other studies (Van Praag et al., 2003; Joo and Grable, 2004; Shim et al., 2009). Malone et al. (2010) report that people may assess their financial well-being differently based on their life stage. Perception of financial well-being also depends on highly individualised benchmarks for comparison (Garman

et al., 2004). Overall, subjective indicators outweigh objective ones in evaluating individual financial well-being (Brüggen et al., 2017).

Managing financial well-being is extremely important as quality of life may be directly and indirectly impacted by how individuals perceive their financial well-being (Joo and Grable, 2004). Positive perception of financial well-being can lead to pleasure, passion, hopefulness, excellent health, and well-developed interpersonal relationships (Judge et al., 2010; Taylor et al., 2011). These physical and mental factors can positively affect performance at work and financial behaviour (Brüggen et al., 2017), which ultimately reduce societal problems and improve social welfare (Griggs et al., 2013). On the other hand, negative perception of financial well-being may cause anxiety, violence, fatigue, and poor health (Bridges and Disney, 2010; Fitzpatrick and Ogden, 2011). Financially destructive behaviour is also likely to emerge, such as paying bills late and foreclosure. Crime, welfare dependency, and other societal problems may thus increase (Sacks et al., 2012).

4.2.2 Consumption and Financial Well-being

Relatively little research has explored the effects of consumption on personal well-being (Markowitz and Bowerman, 2012). There are two conflicting views in the few existing studies. Stutzer and Frey (2010) state that higher consumption level is associated with higher utility and thus higher subjective well-being. On the other hand, however, Markowitz and Bowerman (2012) find that reducing consumption improves individual and societal well-being in the long term. This discrepancy indicates a need for empirical testing on the relationship between consumption and financial well-being.

Consumption is a needs-driven behaviour and consumption needs are thus a key element of consumption patterns (Wilk, 2002) that should not be ignored

in consumption research. However, prior research tends to focus solely on actual consumption; namely, what people have purchased. This approach fails to take into account the fact that people have differing consumption needs. Hence, it is important to view actual consumption in the context of consumption needs.

Consumption needs are unstable, increase with income and consumption level, and are generally above the current actual consumption level (Stutzer, 2004). When people have adapted to a consumption pattern, the effects of additional purchases on their well-being wear off as time passes (Stutzer, 2004). This provides further evidence for why consumption needs, in addition to actual consumption, should be considered when examining the relationship between consumption and financial well-being.

Moreover, consumption generally consists of basic and non-essential components. Retirees, on average, consume relatively more basic goods and services - food, housing, and medical care - to remain happy and healthy (Abdel-ghany and Sharpe, 1997). Additional pleasures are achieved through non-essential consumption, such as alcoholic beverages and travelling (Wilk, 2002).

This chapter considers both actual consumption and consumption needs by forming a new construct: *whether people's actual consumption meets their consumption needs*. The effect of this construct on financial well-being is then examined for basic, non-essential, and all consumption.

4.2.3 Financial Literacy and Financial Well-being

Several of the few existing studies identify a positive relationship between financial literacy and financial well-being (Cheah et al., 2015; Grohmann, 2018); that is, retired households endowed with higher levels of financial literacy are

more likely to be satisfied with their financial situation.

It appears that people with broad financial knowledge and advanced financial skills are more likely to access innovative products, services, and technologies such as Financial Technology (FinTech) that simplify transaction processes, reduce transaction costs, and make financial decisions more effective (Cai, 2018). Retired households that take advantages of FinTech to assist their investment management are more likely to receive higher financial returns and thus have higher levels of financial well-being.

In addition, the mechanisms of how financial literacy affects financial well-being may not be consistent across all circumstances. Consider food consumption and alcohol consumption for example. Food consumption is a basic need that is essential for every person. Inability to meet this basic consumption need would cause stress and potential violence (Lockie et al., 2002), decreasing the level of financial well-being for both financially literate and illiterate people. Hence, financial literacy by itself may improve people's welfare, but it does not drive the effects of meeting food consumption needs on financial well-being.

In contrast, the results may alter with respect to alcohol consumption. Alcohol intake is not essential to ordinary people, and to some extent, could be regarded as leisure consumption (Krause et al., 1997). People start leisure consumption when their basic consumption needs have been covered (Iyer and Muncy, 2016). In this circumstance, financial literacy directly and indirectly improves financial well-being: financial literacy by itself increases financial well-being through higher financial returns by appropriate financial decisions, in addition to modifying and improving consumption decisions that in turn increase financial well-being. In comparison to basic consumption, financially

literate people may benefit more from informed consumption behaviour.

Therefore, the mechanisms of how financial literacy affects retired households' financial well-being in the case of basic consumption and non-essential consumption must be examined separately. It is likely that financial literacy will play a different role in different circumstances as per the examples above.

4.2.4 Socio-demographics and Financial Well-being

Socio-demographic behaviour affects people's financial and psychological well-being (Barnard, 2016). Individual perception of financial well-being varies across age, gender, education, marital status, employment type, and health (Pudney, 2011; Meier and Sprenger, 2013; Degutis and Urbonavicius, 2013; Becchetti et al., 2017; Barnard, 2016).

Blanchflower and Oswald (2004) find a U-shaped relation between age and financial well-being; that is, middle-aged adults appear to be less happy compared to the youth and elderly. Malone et al. (2010) concur with this finding, reporting that middle-aged people are faced with more intensive work, higher living costs, and greater family responsibilities that lead to reduced financial well-being. However, other studies indicate that financial well-being decreases over time, with the elderly reporting the lowest well-being levels (Degutis and Urbonavicius, 2013; Becchetti et al., 2017).

There is also no agreement on the relationship between gender and financial well-being. Alesina et al. (2004) reveal that males tend to be happier than females in the US and European countries, whereas Malone et al. (2010) show that American females are more likely to effectively manage financial well-being. However, Louis and Zhao (2002) find no statistically significant relationship between gender and financial well-being.

Additionally, satisfaction with financial status is positively associated with education (Louis and Zhao, 2002; Blanchflower and Oswald, 2004; Gerrans and Heaney, 2016), marriage (Alesina et al., 2004; Malone et al., 2010), type of work (Helliwell, 2003; Degutis and Urbonavicius, 2013), and health (Dolan et al., 2008). Therefore, it is evident that research on financial well-being should also include a range of socio-demographic factors.

4.2.5 Summary and Contributions

Building on the financial literacy index (FLI) developed in Chapter 3, this chapter applies the FLI to examine how financial literacy, both by itself and via an interaction with consumption patterns, affects elderly Australians' financial well-being. This will shed more light on the elderly's financial well-being and provide practicable ways to improve retired households' quality of life and satisfaction with life. Specifically, this chapter contributes to the existing literature in three key ways.

Firstly, this chapter empirically tests the effects of changes in consumption patterns over the course of retirement on financial well-being. It reports how retirees' actual consumption and consumption needs change after retirement, using Text Mining (TM) techniques to reveal exact reasons for these changes. Both actual consumption and consumption needs are considered by forming a new construct: *whether people's actual consumption meets their consumption needs*. The effect of this construct on financial well-being is then examined for basic consumption (food, housing & utility, household goods & services, and medical care & health expenses) and non-essential consumption (alcohol & tobacco, and gifts & donations), respectively. Notably, researchers fail to take into account consumption needs in empirical consumption literature.

Secondly, financial literacy, both by itself and via an interaction with consumption patterns, is assessed in terms of its effects on financial well-being. The role of consumption plays in the relationship between financial literacy and financial well-being has not yet been investigated in previous studies. This chapter empirically tests relevant mechanisms with regard to the two aforementioned consumption dimensions: basic consumption and non-essential consumption.

Finally, in addition to the socio-demographic factors studied in prior literature, this research also includes home owner status and examines how financial well-being varies across different socio-demographic groups. By covering a wider range of socio-demographic characteristics, the empirical results are likely to provide additional insight into financial well-being.

4.3 Methodology

The financial literacy variable developed in Chapter 3 is a continuous variable, with higher values representing higher financial literacy levels. The *post hoc* Harman common factor results show that the common factor only explains 18.490% of total variance, implying no common method bias (Chang et al., 2010; Linnenluecke et al., 2015).

Consistent with prior literature that states that subjective measures outweigh objective measures in assessing personal financial well-being, measurement of financial well-being in this research is based on a self-assessed Likert-type question. The question asked was:

- How would you rate your current state of financial well-being?

  (1)*Very poor* (2)*Somewhat poor* (3)*Neither good nor poor* (4)*Fairly good* (5)*Very good*.

Responses to this survey question are illustrated in Figure 4.1.[1] In general, the majority of the respondents rated themselves as at or above the average well-being level *"neither good nor poor"*. A total of 494 (14.43%) people evaluated their financial well-being as *"very good"*. Approximately half of all respondents (49.80%) provided a *"fairly good"* assessment.

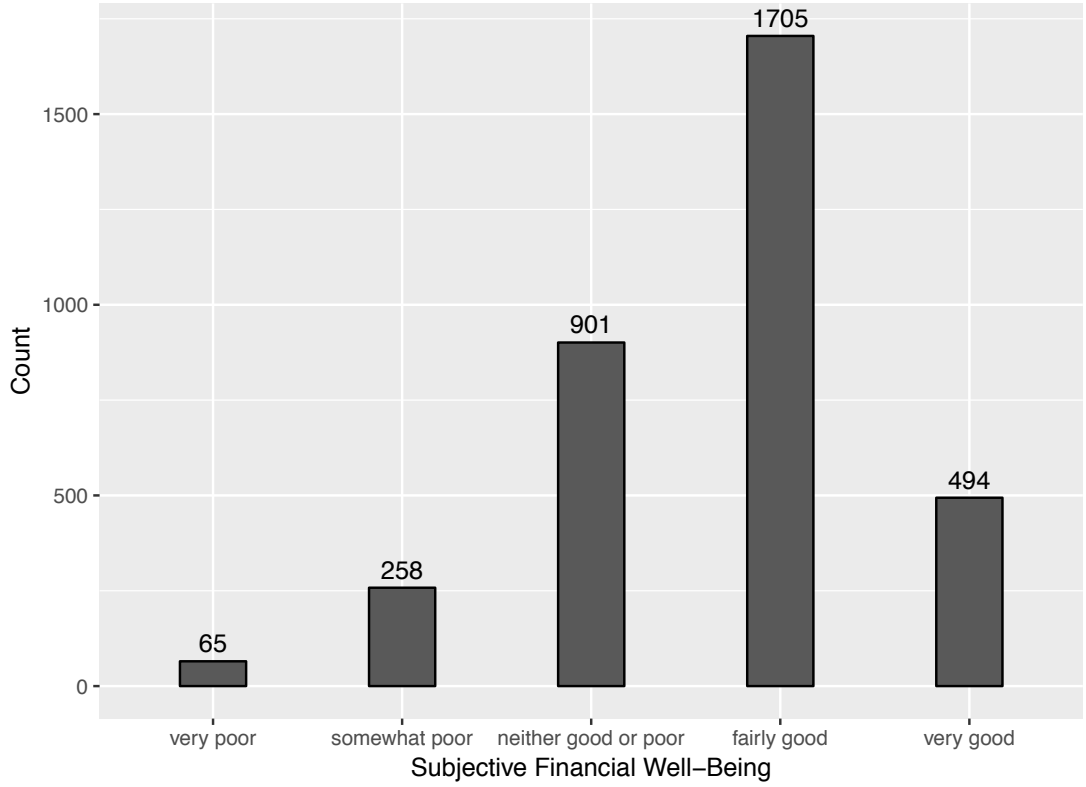

Figure 4.1: Responses to self-assessed financial well-being question

Those who assessed their financial well-being as at the average level accounted for 26.31%, whereas the figures for *"somewhat poor"* and *"very poor"* are only 7.54% and 1.90%, respectively. Taken together, these results indicate an optimistic attitude towards financial well-being amongst elderly Australians.

[1] Unrecognisable and missing responses have been excluded, with a percentage of 1.72%.

4.3.1 Financial Well-being across Socio-demographics

Based on prior research, it is hypothesised that financial well-being (hereafter, FWB) varies with respect to socio-demographic characteristics.[2] Figure 4.2 illustrates mean FWB values based on socio-demographic variables and partitioned by gender (FWB values range from 1=*very poor* to 5=*very good*).

Older respondents tend to report higher FWB levels. The overall pattern of FWB is upward, but there is a clear fluctuation within the female group. After a large drop in their seventies, FWB levels of females increase dramatically in their eighties. Males have higher levels of financial well-being than females before reaching 80 years old.

Consistent with the literature, higher educational attainment is associated with higher FWB (t=7.36, p <0.001[3]). Notably, male respondents with a university degree or higher education background, on average, rated themselves with the highest FWB level amongst all socio-demographic groups. In addition, males tend to report slightly higher FWB levels than females with regard to each education category (t=3.03, p <0.01 for "*Higher Education*"; t=3.25, p <0.001 for "*Other*"). The same finding for gender holds true in the case of marital status, employment type (occupation), self-assessed health, and home ownership.

As expected, and consistent with prior literature, married households are more satisfied with their finances than single households (t=5.75, p <0.001). Compared to blue collar workers, those who are pink or white collar are also more satisfied with their financial situation (t=4.94, p <0.001).

[2] Similar to Chapter 3, a regression tree and Lasso regression are utilised to select the socio-demographic variables for the final model. Seven socio-demographic variables are retained, including *Age*, *Gender*, *Education*, *Marital Status*, *Employment Type*, *Health*, and *Home Ownership*.

[3] A standard two-sample t-test for the mean without assuming constant variance is used.

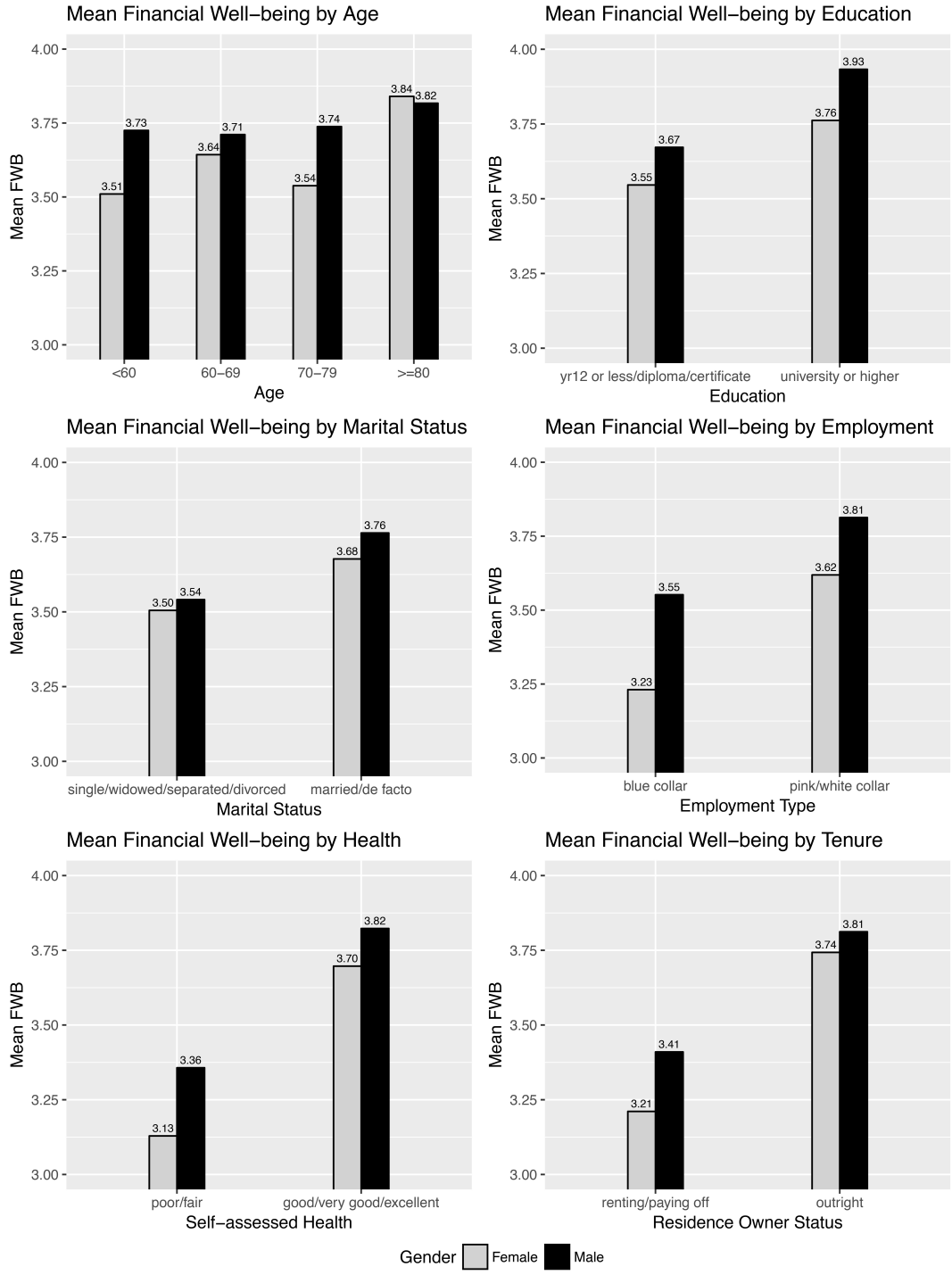

Figure 4.2: Mean financial well-being by *Gender* and by other demographics

A difference is also identified in FWB according to self-assessed health. Respondents in good or above health conditions are prone to hold a much more

optimistic attitude towards their financial situation than those in poor or fair health (t=11.78, p <0.001).

A unique finding concerns the relationship between home owner status and financial well-being. The mean FWB of outright home owners is higher relative to the figure for renters and mortgagors (t=12.04, p <0.001). This is a novel finding that has not been empirically tested in prior research.

The findings in this section give preliminary insights into self-rated FWB and socio-demographic characteristics. The results of regression modelling will generate more in-depth insights.

4.3.2 Changes in Consumption Patterns over Retirement

In the survey, consumption was divided into six sub-categories: food & non-alcoholic beverages; housing & utilities; household goods & services; medical care & health expenses; alcohol & tobacco, and gifts & donations. An explanation of these sub-categories is listed in Appendix B. This research clusters the first four consumption sub-categories as basic consumption and the last two as non-essential consumption. The basic consumption categories are important for retired households, and to some extent, are required in their daily life. However, spending on alcohol & tobacco and gifts & donations is more discretionary and so they are categorised as non-essential consumption.

Two survey questions about actual consumption and consumption needs were asked for each consumption sub-category:

- **Actual consumption:** Does your household purchase approximately the same quantity, more or less now than it did before you retired from paid work?

  (A) *More* (B) *Same* (C) *Less* (D) *Not sure*

- **Consumption needs:** Has your household's consumption need increased, decreased, or stayed the same since before you retired from paid work?

  (A) *More* (B) *Same* (C) *Less* (D) *Not sure*

Changes in Actual Consumption

Table 4.1 summarises responses to consumption questions. To reflect changes in consumption patterns over retirement, only retired respondents were asked. Overall, as shown in column 3 (Actual), retirees consume the same amount as they did before they retired. Therefore, they are able to maintain their consumption standards in retirement. The decrease in consumption associated with the "Retirement Consumption Puzzle" is thus not observed in Australia.

Table 4.1: Responses to actual consumption and consumption needs

Category		Actual(%)	Needs(%)
Basic Consumption:			
Food & non-alcoholic beverages	Decrease	28.0	19.9
	Same	63.6	65.3
	Increase	8.3	14.7
Housing & utilities expenses	Decrease	17.0	13.5
	Same	57.1	50.9
	Increase	25.9	35.6
Household goods & services	Decrease	18.7	13.6
	Same	60.1	54.6
	Increase	21.3	31.8
Medical care & health expenses	Decrease	6.1	4.4
	Same	43.4	40.8
	Increase	50.5	54.7
Non-essential Consumption:			
Alcohol & tobacco	Decrease	43.4	36.8
	Same	52.2	57.6
	Increase	4.4	5.5
Gifts & donations	Decrease	34.5	31.5
	Same	50.7	53.7
	Increase	14.9	14.9

As shown in Table 4.1, most respondents (63.6%) spent approximately the same on food & non-alcoholic beverages as before they retired, while 28.0% reported a decrease in this category. Only about 8% of all respondents stated that they consumed more food & non-alcoholic drinks after retirement.

Changes in expenditure on housing & utilities and household goods & services demonstrate a similar pattern. Around 60% of all respondents maintained the same consumption level, slightly less than 20% decreased, and more than 20% increased their consumption in these categories.

As expected, and consistent with prior research, medical expenses increase rapidly as people age (De Nardi et al., 2010). It is apparent from the table, more than half (50.5%) of retired individuals increased their medical care & health expenses, whereas only 6.1% reported a decline. Those whose medical costs remained unchanged accounted for 43.4%.

Consumption of non-essential categories shows a different pattern compared with basic consumption. Although 52.2% of all respondents kept the same consumption level of alcohol & tobacco as they did before they retired, a large proportion (43.4%) in the sample cut back on this category. Only a minority of people increased their alcoholic and smoking consumption.

A similar pattern can be found in spending on gifts & donations. The percentage of people who provided a *"same"* response is 50.7%. More than one-third of respondents stated that they reduced their spending on gifts & donations, while less than 15% said they increased such spending.

Another question was included in the survey to identify the reasons for consumption changes. The question asked was:

- If you stated that your household purchases less now or more now of the following goods and services than before you retired from paid work, please briefly state why this is the case.

  1) Food & non-alcoholic beverages

  2) Housing & utilities

  3) Medical care and health expenses

Respondents provided text responses to these three categories. Text Mining (TM) techniques are utilised to explore exact reasons for consumption changes over retirement.[4] The reasons with respect to each category are summarised in Appendix C.

The primary reasons for changes in food & non-alcoholic beverages are increasing costs and insufficient funds, both with a percentage of above 20%. The positive association between insufficient funds and consumption decline is consistent with prior studies (Lusardi, 1999; Skinner, 2007). These reasons are followed by eating less, eating out less, and living alone. More than 6% of respondents who provided text responses attributed their food consumption changes to getting older and self-producing (home production). Such a decline in food consumption as a result of home production and cessation of work-related expenses has also been reported in the existing literature (Aguiar and Hurst, 2005; Hurd and Rohwedder, 2008).

The main reason for changes in housing & utilities is increasing costs. Other reasons include using less utilities, increasing needs of repair and maintenance, insufficient funds, and staying at home more. Movement to a retirement village can also lead to a decline in housing & utility consumption.

[4] The package "tm" in R-3.5.1 is applied. It eliminates punctuation, numbers, white space and English common stopwords (e.g., "be", and, "a" etc.) and stems words with the same root.

Changes in medical care and health expenses result from ageing and the associated increase in medical and medication costs, with percentages of 44.82% and 37.10%, respectively. Increasing insurance costs also contribute to this increase. Discount/insurance cover helps reduce medical and health expenses.

Changes in Consumption Needs

Although a sizeable proportion of respondents maintain a similar level of consumption needs as they did before they retired, the proportion who reported an increased need for basic consumption is larger than those who actually purchased more; namely, 14.7% reported increased food & non-alcoholic beverages needs, while only 8.3% reported an actual increase. Interestingly, this difference is relatively small for non-essential categories. Overall, the number of retirees with actual consumption decline is greater than the figure for consumption needs decline.

A considerable number of people (65.3%) did not change their needs for food & non-alcoholic beverages after they retired. Nearly 20% of respondents reported a reduced need in this category. The remaining 14.7% of people needed more food & non-alcoholic drinks after retirement. The pattern of housing & utilities expenses and household goods & services is similar.

Not surprisingly, the need for medical costs increased dramatically after retirement. Fewer than 5% of retirees reported a decline in medical needs.

In contrast, a different pattern is found for changes in non-essential consumption needs. Approximately one-third of respondents required a lower level of non-essential consumption after retirement. The proportions of people who needed increased expenditure on alcohol & tobacco and gifts & donations are

only 5.5% and 14.9%, respectively.

4.3.3 Model Specification

This chapter incorporates actual consumption and consumption needs by forming a new construct: *whether actual consumption meets consumption needs* (*ConsMet*, hereafter), as shown in Table 4.2.

Table 4.2: Classification of "Met" and "Unmet" for *ConsMet* variable

		Actual consumption		
		Increase	Same	Decrease
Consumption needs	Increase	Met	Unmet	Unmet
	Same	Met	Met	Unmet
	Decrease	Met	Met	Met

ConsMet: whether actual consumption meets consumption needs.

ConsMet is a binary variable consisting of two levels: *Met* (coded as 1) and *Unmet* (coded as 0). *ConsMet* is calculated for all six consumption sub-categories. Next, the number of "*Met*"s is aggregated separately for basic consumption and non-essential consumption, creating two aggregated variables: *ConsMet-B* (for basic consumption) and *ConsMet-N* (for non-essential consumption). The corresponding contingency table is shown in Table 4.3.

Table 4.3: Contingency table of variable *ConsMet-B* and *ConsMet-N*

Variable	0	1	2	3	4
ConsMet-B	57 (2.89%)	122 (6.18%)	175 (8.86%)	371 (18.78%)	1250 (63.29%)
ConsMet-N	31 (1.74%)	225 (12.63%)	1526 (85.63%)		

ConsMet-B: How many basic consumption categories were met;
ConsMet-N: How many non-essential consumption categories were met.

An ordinal logistic regression (OLR) model is used to analyse ordered categorical data with a consideration for the ranking order (Larasati et al., 2011). As financial well-being (FWB) is a Likert scale variable with 5 ordered responses, the OLR model is appropriate to examine the effects of financial literacy (FL, hereafter) and *ConsMet* on financial well-being (FWB). The model specifications are as follows:

For **basic consumption** (*ConsMet-B*):

Model (1) (base model):

$$logit(P(FWB_i \leq j)) = \theta_j - (\beta_1 FL + \beta_2 ConsMet\text{-}B + \beta_3 x_1 + ... + \beta_9 x_7)$$

Model (2) (with interaction term added):

$$logit(P(FWB_i \leq j)) = \theta_j - (\beta_1 FL + \beta_2 ConsMet\text{-}B + \beta_3 ConsMet\text{-}B * FL + \beta_4 x_1 + ... + \beta_{10} x_7)$$

For **non-essential consumption** (*ConsMet-N*):

Model (3) (base model):

$$logit(P(FWB_i \leq j)) = \theta_j - (\beta_1 FL + \beta_2 ConsMet\text{-}N + \beta_3 x_1 + ... + \beta_9 x_7)$$

Model (4) (with interaction term added):

$$logit(P(FWB_i \leq j)) = \theta_j - (\beta_1 FL + \beta_2 ConsMet\text{-}N + \beta_3 ConsMet\text{-}N * FL + \beta_4 x_1 + ... + \beta_{10} x_7)$$

where i represents the individual and j is the ordered level of FWB category[5]; $P(FWB_i \leq j)$ follows a logistic distribution[6] and the standard interpretation of coefficients still applies: for $\beta > 0$, an increase in the explanatory variable

[5] $P(FWB_i \leq 5) = 1$, so it is only necessary to model the remaining four (5-1) FWB categories. More detail about the ordinal logistic regression (OLR) model can be found in Agresti (2003).

[6] Taking Model (1) for example:

$$P(FWB_i \leq j) = \frac{exp(\theta_j - (\beta_1 FL + \beta_2 ConsMet\text{-}B + \beta_3 x_1 + ... + \beta_9 x_7))}{1 + exp(\theta_i - (\beta_1 FL + \beta_2 ConsMet\text{-}B + \beta_3 x_1 + ... + \beta_9 x_7))}$$

results in an increased probability of being in a higher financial well-being category. Variables x_1, x_2, ... , x_7 refer to occupation (*Employ*), home ownership (*Tenure*), age (*Age*), gender (*Gender*), marital status (*Marital*), education attainment (*Edu*), and self-assessed health (*Health*), respectively.

4.4 Results

Thus far, this chapter has provided descriptive statistics for FWB, and changes in actual consumption and consumption needs over retirement (and reasons for those changes). This section analyses the ordinal logistic regression (OLR) results for basic consumption (Section 4.4.1) and non-essential consumption (Section 4.4.2).

4.4.1 FL, Basic Consumption Needs, and FWB

Table 4.4 shows the results for the ordinal logistic regression (OLR) model in terms of basic consumption (*ConsMet-B*). Consistent with the existing literature (Schmeiser and Seligman, 2013; Brüggen et al., 2017), financial literacy significantly improves financial well-being. However, the interaction between *ConsMet-B* and FL in model (2) is not statistically significant at conventional levels, implying that financial literacy by itself has a direct effect on financial well-being but has no bearing on the relationship between meeting basic consumption needs and financial well-being.

Respondents appear to be more financially satisfied when basic consumption needs are met. This positive effect is consistent across model (1) and model (2), indicating a direct effect for *ConsMet-B*. Interpretations and comparisons with non-essential consumption (*ConsMet-N*) are discussed in Section 4.4.3.

where θ_j varies with j (j=1,2,3,4) and βs are invariant across the four categories.

Table 4.4: OLR results for basic consumption

Variable	Model (1)	Model (2)
FL	0.47***	0.82***
ConsMet-B	0.28***	0.28***
ConsMet-B*FL		-0.11
Employ (1=pink/white collar)	0.19	0.20
Tenure (1=outright)	1.11***	1.11***
Age	0.02***	0.02***
Gender (1=male)	-0.12	-0.12
Marital (1=married)	0.27**	0.27**
Edu (1=university or higher)	0.34***	0.35***
Health (1=healthy)	0.89***	0.89***

Dependent variable: financial well-being (FWB).
***: p<0.001; **:p<0.01; *:p<0.05

Consistent with prior research (Degutis and Urbonavicius, 2013), the effect for employment type is not statistically significant. Because all respondents analysed in this chapter were retired, this result is likely to be explained by the effects of different work types on FWB gradually wearing off over time.

This research makes a contribution to the literature by being the first to provide empirical evidence concerning the relationship between home ownership and financial well-being. The results demonstrate that outright home owners appear to be more satisfied with their financial situation than renters or mortgagors. This may result from the fact that outright owners are less likely to worry about rent or mortgage repayments.

Although the relationship between age and financial well-being is statistically significant, the effect is limited with a coefficient only slightly greater than 0. This indicates that amongst elderly Australians, relatively older people are slightly more likely to be satisfied with their financial status. This concurs with the descriptive statistics that financial well-being generally increases with age, as older adults are more likely to benefit from greater financial experiences

(Asher et al., 2017).

The lack of statistically significant results for gender is consistent with the literature (Louis and Zhao, 2002) and reflects the complexity of gender differences in financial well-being. On the one hand, males tend to be more financially knowledgeable than females (Lusardi and Mitchell, 2007, 2011b; Bucher-Koenen et al., 2017) and females are thus more financially insecure (Bucher-Koenen and Lusardi, 2011). However, on the other hand, most household purchasing decisions in married households are controlled by women (Qualls, 1987) and they are therefore more experienced in handling financial losses (Parks-Yancy et al., 2007). The mixed findings regarding gender may also result from differences in risk aversion and the fact that women in the sample typically live longer than men.

Marital status is significantly and positively associated with financial well-being. Marriage provides people with financial security (Dew, 2009) since "two heads are better than one in money management" (Blinder and Morgan, 2005, pp.801). Married households integrate the family's financial information and are hence more likely to take low-cost debts and make informed financial decisions (Lusardi and Tufano, 2015). As a result, their financial situation is often better than that of unmarried people.

Consistent with the majority of extant studies, more educated people tend to report higher financial well-being levels, as education can improve an individual's abilities of financial management (Gerrans and Heaney, 2016), precautionary financial planning (Eugster, 2017), and other related skills.

Not surprisingly, healthier people are more satisfied with their financial status. Elderly people who are in good health condition are able to spend more time

collecting financial information, attending financial education programs, engaging in financial practices, and learning financial technology, which hence leads to increased satisfaction with their financial situation and improved living standards. In contrast, those who are unhealthy are likely to perceive the looming financial liability of long-term healthcare costs and lost income, therefore, they are less satisfied with their financial situation.

4.4.2 FL, Non-essential Consumption Needs, and FWB

Table 4.5 presents the OLR estimates for non-essential consumption (*ConsMet-N*). *ConsMet-N* significantly improves FWB, suggesting that people who are capable of meeting more of their non-essential consumption needs are more satisfied with their financial situation.

Table 4.5: OLR results for non-essential consumption

Variable	Model (3)	Model (4)
FL	0.52***	0.77***
ConsMet-N	0.60***	0.61***
ConsMet-N*FL		0.38*
Employ (1=pink/white collar)	0.18	0.17
Tenure (1=outright)	1.10***	1.11***
Age	0.02**	0.02**
Gender (1=male)	-0.14	-0.14
Marital (1=married)	0.11	0.10
Edu (1=≥uni.)	0.32***	0.31***
Health (1=healthy)	0.88***	0.87***

Dependent variable: financial well-being (FWB).
***: p<0.001; **:p<0.01; *:p<0.05

The direct and positive effect of financial literacy on financial well-being is apparent from Table 4.5. Notably, the interaction effect (*ConsMet-N*FL*) is positive and significant. Taken together, the results indicate that financial literacy helps strengthen the effects of meeting non-essential consumption needs on

financial well-being. This effect is in addition to the direct effect of financial literacy on improving financial well-being, suggesting that financially literate people are more likely to smooth and modify their consumption behaviour and reap greater benefits from meeting more of their non-essential consumption needs.

Aside from marital status, the results for socio-demographic variables are consistent with the findings for basic consumption. As shown in Table 4.5, marriage does not lead to a significant increase in FWB. It is notable that the coefficient of *ConsMet-N* is considerably larger than the figure for *ConsMet-B*. Accordingly, the effect for marital status is absorbed by the effect for *ConsMet-N*. In a practical sense, married households are more likely to be satisfied with their financial situation compared to unmarried people when only basic consumption needs are considered (or when household consumption level is low). The power of marriage in determining household financial well-being is transitory. It gradually diminishes as people increasingly meet additional material consumption needs. This explains the lack of statistical significance for marital status when more non-essential consumption needs are met.

4.4.3 Discussion

As part of this research, an ordinal logistic regression (OLR) model is estimated for the initial six consumption sub-categories individually. The results are consistent with main findings.[7] It is important to note that endogeneity problems, caused by omitted variables and reversed causality, may exist in this research (Schultz et al., 2010; Gippel et al., 2015; Kramer, 2016), challenging the credibility of our estimates. To address these problems, several approaches are employed. Firstly, other socio-demographic variables are added to the final model, including wealth and income, and the models are re-estimated.

[7] The results are presented in Appendix D1 through Appendix D6.

The main results regarding the relationship between financial literacy, basic and non-essential consumption needs and financial well-being remain robust when additional socio-demographic variables are added. Secondly, it is possible to use logic to rule out reverse causality between financial literacy and financial well-being because a person's financial well-being is the consequence of their financial literacy rather than the antecedent. Hence, there is no evidence of endogeneity problems and the results are robust.

Basic and Non-essential Consumption Needs on Financial Well-being

This research finds that meeting basic consumption needs and meeting non-essential consumption needs both improve elderly Australians' financial well-being. Prior research is conflicted about the relationship between consumption and well-being (Stutzer and Frey, 2010; Markowitz and Bowerman, 2012). Thus, the findings in this chapter contribute to the literature by taking into account consumption needs and empirically showing the positive nexus between meeting consumption needs and financial well-being. The results further show that the positive effect is strongest for non-essential consumption.

The Role of Financial Literacy

The empirical results clearly show that financial literacy by itself improves the elderly's financial well-being, as well as via an interaction with consumption patterns. In either case of basic or non-essential consumption, financial literacy by itself is a statistically significant and positive driving force of financial well-being. Furthermore, in the non-essential consumption case, the interaction effect is statistically significant and positive, implying that financial literacy helps strengthen the positive nexus between meeting non-essential consumption needs and financial well-being. Therefore, high financial literacy can help smooth and modify retired individuals' consumption patterns, and hence help them reap increased benefits from meeting more of their non-

essential consumption needs. Taken together, the results provide empirical evidence that improving retired households' financial literacy is key to enhancing their financial well-being.

4.5 Summary

Building on the financial literacy index (FLI) developed in Chapter 3, this chapter applies the FLI to examine how financial literacy, by itself and via an interaction with consumption patterns, affects retired households' financial well-being. In doing so, more light is shed on the importance of financial literacy regarding the elderly's financial well-being.

This chapter finds that overall, elderly Australians hold an optimistic attitude towards their financial well-being. Changes in actual consumption and consumption needs over the course of retirement are explored, demonstrating that elderly Australians are able to maintain their consumption standards after retirement and that the "Retirement Consumption Puzzle" is not observed in Australia. Notably, although consumption is a needs-driven behaviour (Wilk, 2002), consumption needs are rarely considered in prior consumption research.

In the survey used, consumption comprised six categories. Text Mining (TM) techniques were utilised to reveal reasons for changes in actual consumption. It shows that increasing costs and insufficient funds result in changes in food and non-alcoholic beverages consumption. Increasing costs also limit consumption capacity regarding housing and utilities. Changes in medical care and health expenses are mainly attributed to ageing problems and increasing medical/medication costs.

The six categories are grouped into basic and non-essential consumption. This

research considers both actual consumption and consumption needs by forming a new construct: *whether people's actual consumption meets their consumption needs*. The effect of this construct on financial well-being is then examined for basic and non-essential consumption, respectively. The distinct roles of financial literacy in these relationships are also assessed.

Results using ordinal logistic regressions (OLR) clearly show that meeting both basic and non-essential consumption needs significantly improves financial well-being. This positive effect is strongest for non-essential consumption. Financial literacy by itself significantly improves financial well-being. Financial literacy also helps strengthen the positive effects of meeting non-essential consumption needs on financial well-being. The results indicate that advanced financial knowledge and skills can help smooth and modify retirees' consumption patterns, and hence help them improve their financial well-being from meeting more of their non-essential consumption needs. Taken together, the findings provide evidence that improving retired households' financial literacy is key to enhancing their financial well-being.

In addition, people who are relatively older, more educated, healthier, and outright home owners are more likely to be satisfied with their financial situation. The finding that outright home owners are more satisfied with their financial situation than renters or mortgagors represents the first, to our knowledge, empirical evidence on the relationship between home ownership and financial well-being. This chapter also finds that the effect of marriage on financial well-being gradually diminishes as consumption levels increase. Aside from these socio-demographic factors, employment type and gender have no bearing on the elderly's financial well-being. Effective and practicable solutions for the elderly to improve their financial well-being are provided in Section 6.2.

Chapter 5

Financial Literacy and Financial Decision-making

— The mediating role of financial concerns

5.1 Introduction

Current pension schemes create a possibility of higher financial returns but also generate substantial uncertainty, particularly for those with low financial literacy levels. Today's retirees take more responsibility for making their own financial decisions. This engagement in financial practices challenges retired households' financial literacy because the investment risk has been shifted from employers to employees.

Another issue posing threats to retired households is longevity risk, which has brought about population ageing related problems (Lutz et al., 2008). With the advancement of medical care and subsequent decline of health risks, retired individuals live longer and hence experience longer retirement spans. This increases the probability of financial concerns, such as inflation eroding savings, unaffordable medical care, and insufficient savings to maintain current living

standards (Orth, 2006; Tomlinson et al., 2008; Higgins and Roberts, 2011).

Therefore, how retired people choose their financial strategies to minimise the likelihood of outliving their savings becomes pertinent. Chapter 3 reveals that financially literate people are able to accurately assess their financial situation and are well-equipped with advanced financial knowledge and skills (Lusardi and Mitchell, 2011a; Lusardi et al., 2017). They are hence more likely to select well-informed financial strategies that generate a reliable and flexible source of retirement income to guarantee their financial security and manage their financial concerns.

In this chapter, the financial literacy index (FLI) developed in Chapter 3 is applied to analyse how financial literacy affects individuals' decisions regarding adoption of a variety of financial strategies. Each financial strategy is quantified and the effects of financial literacy on selecting specific financial strategies are empirically tested.

An understanding of the relationship between financial literacy and financial strategies without considering financial concerns is distorted. Multiple mediator models with bootstrap techniques are used to identify the mediating mechanisms of financial concerns that transmit the effects of financial literacy on specific financial strategies. This chapter finds support for mediation effects of financial literacy through financial concerns onto specific financial strategies. This chapter also provides evidence that causal inference without a consideration of mediating mechanisms may lead to spurious and incomplete implications.

The empirical results not only shed light on how financially literate and illiterate elderly Australians react to their financial concerns when a variety of

financial strategies are available, but also provide guidance for professional financial advisors and robo-advisor developers alike on how to take into account different financial concerns of elderly clients when recommending financial advice.

5.2 Review of Prior Research

5.2.1 Financial Literacy and Financial Decision-making

The realization that financial literacy is critical to financial decision-making has led to a proliferation of studies on how financial literacy affects people's investment and saving strategies (Lusardi and Mitchell, 2007; Bruine de Bruin et al., 2010; Meier and Sprenger, 2013; Kramer, 2016). With increasingly easier access to financial services, products, and technologies, the elderly are faced with diversified investment and saving strategies (Lusardi, 2012). The way to identify appropriate financial strategies is hence of high importance.

Taylor et al. (2011) find that individuals with low levels of financial literacy are prone to high-cost mortgages and unprofitable investment strategies. They are hence more likely to experience asset loss. Even worse, a large proportion of pre-retired and retired households are not aware of the vulnerability of their finances and stick to deficient financial strategies (van Rooij et al., 2011b). In effect, financially illiterate people tend to follow rule-of-thumb financial advice suggested by their friends or relatives, rather than financial professionals (Bodie, 2003). Even the few financially illiterate people who consult with professional advisors tend to blindly follow the recommended strategies to make decisions, even though some of them may be misleading (Bodie, 2003).

In contrast to the financially illiterate, financially literate people are more likely to manage superannuation accounts profitably, select reliable retire-

ment income products, and identify appropriate life annuities, and thus receive higher investment returns (Xiao et al., 2014; Chu et al., 2017).

Accordingly, financial literacy acts as a key determinant of identifying effective financial strategies. How to improve financial literacy and make well-informed financial decisions is therefore of prime importance to the elderly. This chapter includes a variety of financial strategies and analyses the determining power of financial literacy on the choice of specific strategies.

5.2.2 Financial Concerns as Mediating Mechanisms

The positive nexus between financial literacy and financial decision-making has been proposed in a number of prior studies (Lusardi et al., 2010; Foster et al., 2015; Ali et al., 2015). However, with increasing average lifespan (Costa, 2003; Lutz et al., 2008), the picture of the financial literacy-strategy nexus is incomplete if financial concerns are ignored.

Concerns arise with increasing life and retirement spans because of a more uncertain and unpredictable future (Griggs et al., 2013). Retired households are faced with an increasing possibility of insufficient financial resources to maintain current living standards and ultimately outliving their finances (Orth, 2006). Health problems gradually occur as people age (Katsarava et al., 2018), which requires greater wealth accumulation. Individuals are thus increasingly concerned about funds for their medical expenses as they reach an advanced age. The elderly who are not in good health may have greater concerns about being unable to afford long-term health care.

Retirees also express concerns about inflation erosion (Higgins and Roberts, 2011). Inflation eroding savings is the top concern amongst elderly Americans (Abkemeier, 2010), with fears about whether their savings can be guaranteed if

inflation rises unexpectedly (Chen et al., 2014). Higher inflation will weaken the purchasing capacity of retired households and lead to a decline in long-term wealth accumulation. With less savings left at older age, the elderly are less likely to leave sufficient bequests to their children or other heirs (Higgins and Roberts, 2011).

Another financial risk that worries a large number of retired households is investment returns risk caused by instability of financial markets (Bekaert and Hoerova, 2014). Both poor performance of financial markets and negative economic shocks damage people's investment returns. Without advanced financial skills and adequate financial knowledge, individuals tend to be more concerned about the consequences of their investments (van Rooij et al., 2011b).

Therefore, financial concerns may be highly associated with financial literacy: the more financially literate, the less concerned. As documented in Chapter 3, financially illiterate people are more likely to display characteristics such as low education attainment, less income, and less net wealth. They thus arguably have more reasons to be concerned than the financially literate. Even worse, financially illiterate individuals tend to be overconfident with their savings, which makes their financial outlook more insecure (Xia et al., 2014). Hence, financial literacy may act as the antecedent of financial concerns.

To manage different concerns, retired households may take different financial actions. Those who are concerned about maintaining their current living standards are likely to reduce spending. Those who intend to leave sufficient bequests for their heirs may choose to seek more job opportunities after they have retired. As such, adoption of specific financial strategies is likely to be caused by certain financial concerns. In other words, financial strategies may be the consequence of financial concerns.

Taken together, financial concerns permeate retirement lives and play an important role in the literacy-strategy nexus. This chapter aims to unravel the mediating mechanisms of financial concerns that transmit the effects of financial literacy onto specific financial strategies. Empirical results based on a consideration of four broad types of financial concerns are expected to provide a more comprehensive understanding of how people with different levels of financial literacy make their decisions when faced with different financial concerns.

5.2.3 Summary and Contributions

Research on the relationship between financial literacy and financial decision-making has recently received growing scholarly attention. Previous research, however, has provided little direct evidence on the effects of financial literacy on specific financial strategies. In addition, research on financial concerns remains scarce, which may be due in large part to the difficulty of quantitative measurement of financial concerns. Moreover, the role of financial concerns in the literacy-strategy nexus is rarely considered, which renders the mechanisms linking financial literacy and financial strategies incomplete. Furthermore, prior research utilises simple regression modelling to examine the effects of financial literacy on financial decision-making (i.e., Bodie, 2003; Kramer, 2016) and so cannot identify the comprehensive mechanisms involved in the financial literacy-strategies nexuses.

In contrast to prior research, this research utilises multiple mediator models with bootstrap techniques, taking into account the mediating role of specific financial concerns and aggregate concerns to examine the relationship between financial literacy and financial decision-making. This chapter contributes to the existing literature in several ways. Firstly, a large number of

specific financial strategies are quantitatively measured and analysed. People normally make financial decisions using a variety of financial strategies and so the effects of financial literacy on specific strategies vary. The current research includes sixteen financial strategies, providing an in-depth assessment that contributes to financial decision-making research.

Secondly, financial concerns are quantitatively measured using a Likert-type scale survey question with four ordered options: *not at all concerned*, *not too concerned*, *somewhat concerned*, and *very concerned*. The eight survey questions about financial concerns are grouped into four main areas of financial concerns using categorical principal component analysis (CPCA).

Thirdly, the mediating role of specific financial concerns and aggregate financial concerns in the financial literacy-strategies nexuses is examined. People with different financial literacy levels express different degrees of financial concerns and so they are more or less likely to take specific financial strategies. The mediation analysis not only demonstrates a more nuanced and complete understanding of the effects of financial literacy on specific financial strategies, but also provides evidence that causal analysis without mediation effects may lead to spurious and incomplete implications.

Fourthly, multiple mediator models with bootstrap techniques are used to examine total and specific mediation effects of financial literacy through financial concerns. The non-parametric estimation technique avoids the often-violated multivariate normality assumptions[1] and allows examination of how financial literacy by itself affects people's financial decision-making and how

[1] The necessary assumptions for the implementation of conventional mediator models are multivariate normality of the paths (i.e. financial literacy to financial concerns, and financial concerns to financial strategies) and of the indirect effects (i.e. the effects of financial literacy on financial strategies through financial concerns) (Preacher and Hayes, 2008). This is discussed in more detail in Section 5.3.5.

specific and aggregate financial concerns transmit the effects of financial literacy onto different financial strategies.

Finally, this research focuses specifically on the elderly that constitute the most financially illiterate and vulnerable population segment. As a result, they are more likely to have financial concerns and make poor financial decisions (Lusardi and Mitchell, 2007, 2011a). A large number of financial strategies regarding elderly people are examined in this chapter. Therefore, it is of vital importance to analyse how financially literate and illiterate elderly people react to their concerns when a variety of financial strategies are available.

5.3 Methodology

The financial literacy index (FLI) developed in Chapter 3 is applied to examine the effects of financial literacy on financial decision-making. A *post hoc* Harman single factor analysis is implemented to test whether a strong correlation between the variables used in this chapter is created by a common source. The results show that only 21.885% of total variance in the data is attributed to a common factor, suggesting no common method bias.

5.3.1 Measures of Financial Concerns

The respondents were asked eight specific financial concerns that may affect their retirement life. These questions were:

How concerned are you that...

C1: You might not have enough money to pay for a long stay in a nursing home or a long period of nursing care at home.

C2: You might not have enough money if your spouse or partner requires a nursing home or long term care at home.

C3: Your spouse/partner may not be able to maintain the same standard of

living after your death, if you should die first.

C4: You might not be able to keep the value of your savings and investments up with inflation.

C5: You might not be able to maintain a reasonable standard of living for the rest of your life.

C6: You might not be able to afford to stay in your current home for the rest of your life.

C7: You might not be able to leave money to your children or other heirs.

C8: You might outlive your savings.

Responses to each question were:

A. *Very concerned*, **B.** *Somewhat concerned*, **C.** *Not too concerned*, **D.** *Not at all concerned*.

Table 5.1 presents responses to these eight questions.[2] The biggest financial concern of the elderly is inflation erosion (C4), with 42.11% and 23.40% of respondents expressing moderate and great concern about this risk, respectively. Only 8% reported *"not at all concerned"*.

Table 5.1: Responses to financial concerns

Concern	Not at all Concerned (%)	Not too Concerned (%)	Somewhat Concerned (%)	Very Concerned (%)	Proportion of Somewhat and Very Concerned (%)
C1	12.09	36.41	35.43	16.07	51.50
C2	21.68	29.49	33.08	15.75	48.83
C3	29.37	32.70	25.40	12.54	37.94
C4	8.67	25.83	42.11	23.40	65.51
C5	9.40	33.02	37.85	19.73	57.58
C6	21.00	39.76	24.77	14.47	39.24
C7	37.36	38.62	15.97	8.06	24.03
C8	15.35	33.51	30.97	20.17	51.14

Other major concerns include maintaining reasonable living standard (C5), nursing home affordability (C1), and depleted assets (C8). More than half of

[2] Unrecognisable and missing responses have been excluded, with a percentage of approximately 1% for all concerns.

all respondents were somewhat or very concerned about these possibilities. A close fifth concern is partner's nursing home affordability, with 48.83% expressing this concern.

In addition, nearly 40% reported worries about home ownership (C6) and maintaining partner's standard of living (C3). In contrast to the above concerns, most respondents were not concerned about insufficient bequest (C7).

These findings reflect retired households' concerns about their uncertain financial future. This uncertainty is even greater within current private pension schemes as the elderly have to make investment and saving decisions on their own. Therefore, selecting sound financial strategies can provide an effective conduit to mitigate financial concerns of older adults (Li et al., 2015).

Classification of Financial Concerns

Since some concerns have common characteristics and reflect similar financial worries, categorical principal component analysis (CPCA) is utilised to classify the original eight concerns. The reason for using CPCA is that each concern variable is a Likert scale with 4 ordinal responses (categorical variable).

Table 5.2: Results for categorical principal component analysis of financial concerns

Concern	Dimension 1	Dimension 2	Dimension 3
C1	-0.2815	0.1089	-0.0010
C2	-0.2644	0.1926	-0.0367
C3	-0.2513	0.1159	-0.0810
C4	-0.2579	-0.0201	0.1487
C5	-0.2810	-0.0763	0.1008
C6	-0.2582	-0.1092	-0.0615
C7	-0.2140	-0.1405	-0.2053
C8	-0.2743	-0.0942	0.0856

Table 5.2 presents the results. Based on the signs of the coefficients of the first three dimensions (Nishisato, 1993), the original eight concerns can be classified into three groups: C1, C2, and C3 (group 1); C4, C5, and C8 (group 2); and C6 and C7 (group 3). To confirm these classification results, 3D plots are assessed, which clearly show that C6 (green) and C7 (blue) should be grouped separately as the distance between them is large relative to the in-group distances of other groups from all six views.[3] Therefore, the original eight financial concerns are re-classified into four new groups. Table 5.3 shows the re-classification results for financial concerns. The re-classified four groups reflect four major areas of the elderly's financial concerns, and can be summarised as: long-term care (CN1), investment performance (CN2), current home affordability (CN3), and bequest (CN4).[4]

Table 5.3: Re-classification of financial concerns

Concern group	Concerns included	Reflecting concerns about
CN1	C1, C2 and C3	long-term care
CN2	C4, C5 and C8	investment performance
CN3	C6	current home ownership
CN4	C7	insufficient bequest

As mentioned, the original concern variable is on a 4-point scale, where 1=*not at all concerned* and 4=*very concerned*. For each re-classified concern group, the highest value of all original concerns within this group is selected as the new value of the group. The breakdown of responses to the four new concerns based on socio-demographic characteristics is provided in Appendix F1 through Appendix F4.[5]

[3] 3D plots are illustrated in Appendix E.

[4] The classifications and definitions of the four re-classified concerns were validated by consultations with multiple finance experts.

[5] Similar to Chapter 3 and Chapter 4, a regression tree and Lasso regression are utilised to select the socio-demographic variables. Six socio-demographic variables are retained, including *Age*, *Gender*, *Education*, *Marital Status*, *Health*, and *Home Ownership*.

Appendix F1 illustrates concerns about unaffordable household long-term nursing care (CN1) based on socio-demographic factors. It shows that this concern increases slightly with age, but there is a drop as respondents enter their 80s. This drop may result from reduced life expectancy and better understanding of medical outlays and consumption patterns.

Drops with increased age are also observable for other concerns. For those who were very concerned, Appendix F2 and F3 both demonstrate a downward trend, suggesting that concerns about investment performance (CN2) and home equity (CN3) gradually diminish with increasing age. There is a fluctuation in the insufficient bequest concern (CN4), with new retirees (<60 years old) and those in their 70s worrying more.

Males appear to worry more about their finances. Historically, males have shorter life expectancy than females (Holden, 1987) and so it is not surprising that males may express more concern about their partner's future life quality after their death.

In general, as shown in Appendix F1 through Appendix F4, financial concerns are associated with less education achievement, poorer health condition, and renters/mortgagors. Education attainment has a positive association with wealth and employment type (Lusardi and Mitchell, 2007), and so people who are more educated are more likely to accumulate more savings and are less likely to worry about their finances.

Respondents who assessed themselves as being in above-average health (from good to excellent) tend to have an optimistic expectation of their healthcare expenses and so express less financial worries than those in poor health. Not-

withstanding the overall similar pattern, investment performance concerns (CN2) demonstrate a slightly different result. For those somewhat concerned about this risk, there is a greater proportion of healthy compared to unhealthy people. This is explicable by the fact that healthier retirees do have some worries about outliving their finances as they may have a longer life expectancy.

Retirees who are outright residence owners are less concerned than renters and mortgagors. Those who completely own their residence do not need to worry about rents and mortgage repayments. In contrast, retirees who are renting or paying off their residence are normally in poor financial circumstances and so they are less confident in their financial outlook.

Single households express more concerns about investment performance (CN2), residence ownership (CN3), and insufficient bequest (CN4). Married households make decisions through shared financial information and a relatively comprehensive discussion strengthened by greater social networks (Blinder and Morgan, 2005). However, there is no clear pattern in concerns about household long-term health care (CN1). This may reflect the fact that married households have to take into account health problems of two people. As a result, they are likely to have higher medical outlays than one-person households.

5.3.2 Measures of Financial Strategies

Access to financial instruments has become much easier due to the increasing deregulation of financial markets (Bolton et al., 2016; Novotnỳ and Urga, 2017) and the rise of FinTech (Cai, 2018). These diversified financial products and services have also introduced uncertainty, challenging people's financial knowledge and skills. This uncertainty is even greater if the elderly are endowed with lows level of financial literacy (Von Gaudecker, 2015). Therefore,

choosing appropriate financial strategies to manage financial risks is of high importance to retired households (Cocco et al., 2005).

The respondents in the sample were also asked their actions when considering sixteen specific financial strategies:

To protect yourself financially, have you or do you plan to

S1: Cut back on spending

S2: Work longer

S3: Obtain professional financial advice

S4: Buy a life annuity or other product to provide guaranteed income for life

S5: Increase contributions to superannuation

S6: Increase savings outside superannuation

S7: Move assets to more conservative assets

S8: Take out or increase reverse mortgage or home refinancing

S9: Take out or increase other debt (e.g. credit cards, personal loans)

S10: Completely pay off mortgage

S11: Pay off all credit cards and personal loans

S12: Buy real estate or invest in property (including upsizing or renovations)

S13: Move to a smaller home/less expensive area

S14: Sell household goods, investment property or other material assets

S15: Approach others for financial support/loan

S16: Increase insurance cover (life, disability, trauma, accident or private health)

Responses to each question were:

A. *Already done*, **B.** *Plan to do in future*, **C.** *No plans*, **D.** *Don't know/unsure*.

Table 5.4 presents responses to these questions.[6] More than 60% of all respondents have completely paid off their mortgage, credit cards, and personal loans (S10 and S11), suggesting that elderly Australians are currently main-

[6] Unrecognisable and missing responses have been excluded, with an average percentage of approximately 10% for all strategies.

taining a reasonable financial outlook. Responses to S8, S9, and S15 provide additional support for this conclusion as only less than 5 % have increased their debts.[7]

Table 5.4: Responses to financial strategies

Strategies	No plans	Plan to do	Already done	DK/Unsure
S1: Cut back on spending	20.55	21.18	52.21	6.06
S2: Work longer	52.99	10.02	17.25	19.75
S3: Obtain professional financial advice	23.45	11.77	56.49	8.30
S4: Buy a life annuity	54.48	5.83	23.05	16.65
S5: Increase contributions to superannuation	53.16	6.72	28.56	11.57
S6: Increase savings outside superannuation	44.92	13.61	29.88	11.60
S7: Move assets to more conservative assets	45.09	11.65	27.70	15.56
S8: Take out/increase reverse mortgage	81.89	2.73	3.47	11.91
S9: Take out/increase other debt	86.68	0.95	4.13	8.24
S10: Completely pay off mortgage	12.74	17.80	61.68	7.78
S11: Pay off all credit cards and personal loans	10.22	19.60	63.32	6.86
S12: Buy real estate/invest in property	62.34	7.78	19.46	10.42
S13: Move to a smaller home	48.39	23.88	15.67	12.06
S14: Sell household goods or investment property	67.11	15.50	7.52	9.87
S15: Approach others for financial support/loan	88.98	1.46	1.18	8.38
S16: Increase insurance cover	79.25	2.15	10.42	8.18

Reduction in spending (S1) and professional financial advice consultation (S3) are also popular amongst the elderly, suggesting that elderly Australians are somewhat concerned about their future finances and are not confident in their financial literacy. Planned reduction in spending and planned downsizing of their residence may also reflect their financial concerns as more than 20% considered these possibilities.

It can be inferred from responses to S5-S7 that the investment strategy of the elderly is not conservative. Only a minority of them (less than one-third) chose to save or preferred conservative assets. The lower planning rates observed also support these results.

[7] Responses to S14 also offer support for these results as only 7.52% of all respondents have already sold their household goods or investment property.

Buying a life annuity (S4) and increasing insurance cover (S16) are strategies with regard to insurance. Approximately 23% of all respondents stated that they already had a life annuity and less than 6% expressed a willingness to buy. The low proportion of life annuity purchase is likely to reveal that the annuity market in Australia is not well-developed. It is thus not surprising that around 17% of all respondents chose *"don't know"* or were *"unsure"* about S4. Around 10% of elderly Australians reported an increase in their insurance cover (S16) and only 2.15% stated a planned increase. The low proportion of increased insurance cover and planned increase may be due to either stable insurance cover level or a failure to meet increased insurance needs due to financial constraints.

Given that the respondents are elderly, they are more likely to have health problems and are therefore less likely to work longer (S2) and buy/invest in property (S12). Lastly but more importantly, on average, more than 10% of all respondents provided *"don't know"* or *"unsure"* responses about these strategies, possibly implying a lack of financial literacy amongst elderly Australians as reflected by Chapter 3.

5.3.3 Model Specification

Theoretical Model

Prior studies have examined the relationship between financial literacy and financial decision-making, but studies on how financial literacy affects the decision-making process remain scarce, despite there being a clear need. Financial concerns permeate retirees' retirement lives and may act as intervening variables that mediate the financial literacy-strategy nexus. Figure 5.1 illustrates the theoretical model of this research.

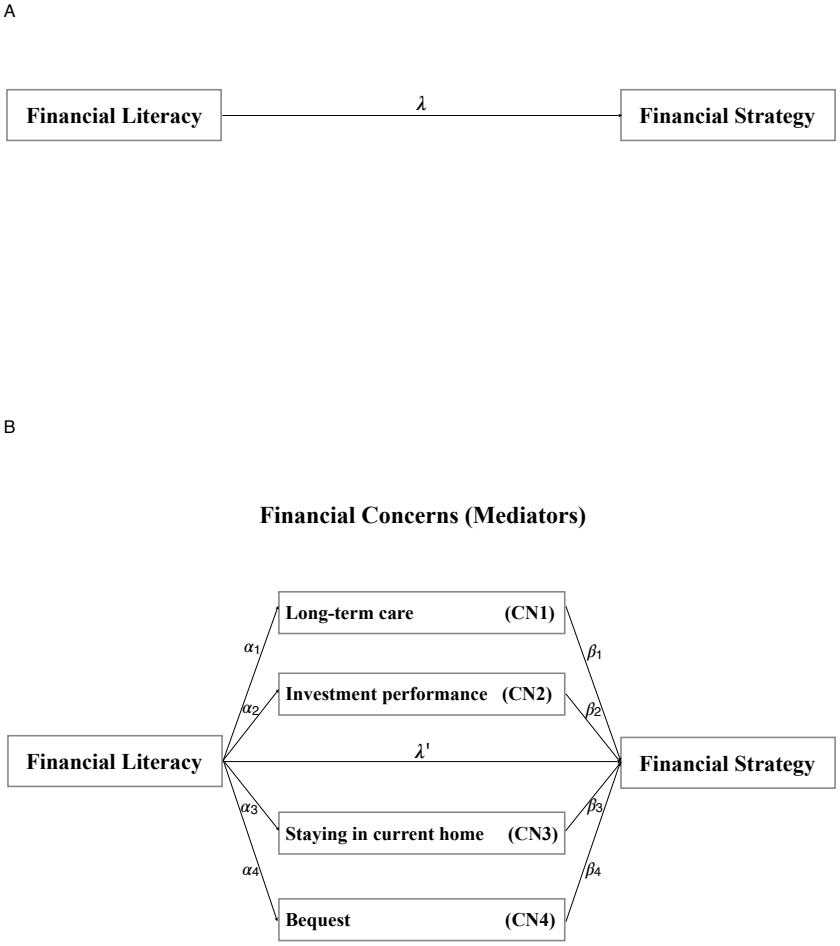

Figure 5.1: Illustration of the conceptual model

The total effects of financial literacy on specific financial strategy (λ, panel A) can be apportioned into direct effects ($\lambda^{'}$, panel B) and indirect effects (αs and βs, panel B). $\lambda^{'}$ represents the direct effects of financial literacy on financial

strategy after partialling out the effects through other intervening variables (mediators). The indirect effects represent the effects through which financial literacy can exert influences on financial strategies via other variables.

Specifically, the aforementioned four broad financial concerns are considered as potential mediators, including concerns about long-term nursing care (CN1), investment performance (CN2), staying in current home (CN3), and insufficient bequest (CN4). αs represent the effects of financial literacy on financial concerns (mediators) and βs represent the effects of financial concerns on specific financial strategy. The products of αs and βs are the indirect effects or mediating effects; for example, $\alpha_1\beta_1$ represents the effects of financial literacy on specific financial strategy through concerns about long-term care (CN1). Therefore, the total indirect effects of financial literacy on this financial strategy through financial concerns are $\sum_{n=1}^{4} \alpha_i\beta_i$ and total effects (λ) = direct effects ($\lambda^{'}$) + indirect effects ($\sum_{n=1}^{4} \alpha_i\beta_i$).[8]

Multiple Mediator Models with Bootstrap Techniques

Several methods have been proposed to estimate the (multiple) mediation effects, including causal steps (Baron and Kenny, 1986), difference in coefficients (Freedman and Schatzkin, 1992), and product of coefficients (Sobel, 1982).[9]

Although the causal steps (normally four steps) method has been widely used in testing moderation and mediation effects (Judd and Kenny, 1981; Baron and Kenny, 1986; MacKinnon et al., 2002; Martins et al., 2016; Hu et al., 2018), there are two major shortcomings: first, it assumes that the paths (i.e. financial literacy to financial concerns α, and financial concerns to financial strategies β) have to follow a normal distribution, but the normality assumption is rarely

[8] This is the conceptual model for one financial strategy, not for all, so the model is applied 16 times, once for each financial strategy.

[9] MacKinnon et al. (2002) provide an overview of a dozen approaches of estimating mediation effects and comparisons of these models.

satisfied in practice (Shrout and Bolger, 2002); second, it fails to take into account the total (aggregate) mediation effects, in other words, only individual mediation path(s) are included without consideration for all mediation effects as a whole (Preacher and Hayes, 2008). Failure to incorporate multiple mediators as a whole will increase the probability of parameter bias related to omitted predictors (Preacher and Hayes, 2008).

The normality assumption remains in other approaches such as difference in coefficients and product of coefficients (Preacher and Hayes, 2008; Hayes, 2017). Although these two methods enable the estimation of total mediation effects, the total and specific mediation paths have to follow a multivariate normal distribution that is also rarely satisfied (Preacher and Hayes, 2008).

Multiple mediator models using bootstrap techniques outperform other mediation testing approaches in overcoming the above problems. The multivariate normality assumption is not required because bootstrap is a non-parametric estimation technique that creates a larger dataset by re-sampling with replacement from the original sample; as a result, an original observation may occur zero, one, or more times in the new sample. The mediation path parameters (αs and βs) will be estimated based on the new sample and the estimation process will be implemented n times using n different new samples produced by the replacement process.[10] The n estimates are then sorted and yield an ordered sampling distribution, and so given the significance level, the lower and upper confidence limit will be the $\frac{\alpha}{2}n$th and $(1-\frac{\alpha}{2})n$th value of the ordered distribution (Preacher and Hayes, 2008). As the confidence limits are constructed using the ordered sampling distribution rather than assuming a multivariate normal distribution, the model overcomes the biased distribution problem and improves the accuracy of parameter estimations (Preacher

[10] The commonly-used number of n is 1,000 and 5,000.

and Hayes, 2008; Zhao et al., 2010; Hayes, 2017).

Overall, multiple mediator models using bootstrap techniques enable the examination of how specific financial concerns transmit the effects of financial literacy on financial strategies, as well as how aggregate financial concerns mediate the effects without the multivariate normality assumption. As such, the results for the causal mechanisms are more accurate and reliable.

5.4 Results

Multiple mediator models using bootstrap techniques with n = 5,000 are used.[11] Table 5.5 shows the total effects of financial literacy on financial strategies (λ).

Table 5.5: Total effects of financial literacy on financial strategies (λ)

Dependent variable	Total effects	Std.err	t value	P value
S1: Cut back on spending	-.1902	.0241	-7.8992	<.001***
S2: Work longer	.0429	.0266	1.6152	.1064
S3: Obtain professional financial advice	.2998	.0255	11.7717	<.001***
S4: Buy a life annuity	.1511	.0279	5.4097	<.001***
S5: Increase contributions to superannuation	.3217	.0278	11.5680	<.001***
S6: Increase savings outside superannuation	.2151	.0276	7.7958	<.001***
S7: Move assets to more conservative assets	.2773	.0280	9.9131	<.001***
S8: Take out/increase reverse mortgage	-.0286	.0127	-2.2452	.0248*
S9: Take out/increase other debt	-.0419	.0127	-3.3076	.0010**
S10: Completely pay off mortgage	.1973	.0215	9.1892	<.001***
S11: Pay off all credit cards and personal loans	.1567	.0202	7.7578	<.001***
S12: Buy real estate/invest in property	.1769	.0251	7.0578	<.001***
S13: Move to a smaller home	-.0434	.0235	-1.8442	.0653
S14: Sell household goods or investment property	.0142	.0190	.7439	.4570
S15: Approach others for financial support/loan	-.0223	.0076	-2.9240	.0035**
S16: Increase insurance cover	-.0295	.0194	-1.5191	.1288

***:p<0.001; **:p<0.01; *:p<0.05.

[11] Given the original sample size is 3,484, n = 5,000 rather than 1,000 is chosen to improve the estimation accuracy as repetition frequency is normally required to be larger than the original sample size (Preacher and Hayes, 2008).

Overall, financially literate people are more likely to seek professional financial advice, purchase a life annuity, increase savings to/outside superannuation, invest more conservatively, pay off debts, and buy real estate. In contrast, the elderly with lower levels of financial literacy are more likely to reduce spending, take out debts, and look for financial support. The total effects of financial literacy on working longer, downsizing or selling residence/investment property, and increasing insurance cover are not statistically significant.

5.4.1 Mediation Effects

Table 5.6 provides results for mediation effects generated by specific financial concerns and aggregate financial concerns. Given the estimation process is repeated 5,000 times, a strict significance criteria of 1% significance level is used. The bootstrap confidence interval is bias-corrected to reduce the likelihood of type I errors.[12] To make the results clearer and more readable, the identified mediation effects are summarised in Table 5.7 and the identified detailed mediation path αs and βs are illustrated in Figure 5.2.

The total mediation effects via all financial concerns are statistically significant in eleven out of sixteen financial literacy-strategy nexuses, indicating that overall, financial concerns mediate/transmit the effects of financial literacy on financial strategies. The elderly with lower financial literacy levels are more likely to be financially concerned and are thus more or less likely to take specific financial actions due to these concerns.

Specifically, financial illiterate people are more likely to worry about long-term health care, investment performance, and staying in their current home. As a result, they are more likely to reduce spending (S1) to protect themselves financially.

[12] Exact process about bias-corrected confidence interval introduced by Preacher and Hayes (2008) has been applied in this research.

Table 5.6: Results for mediation effects ($\alpha_i\beta_i$ and $\sum_{n=1}^{4}\alpha_i\beta_i$)

Dependent variable	Mediators	Mediation	Boot SE	Boot LLCI	Boot ULCI
S1: Cut back on spending	Total	-.0492**	.0092	-.0735	-.0258
	CN1	-.0210**	.0050	-.0353	-.0101
	CN2	-.0144**	.0048	-.0289	-.0034
	CN3	-.0105**	.0039	-.0219	-.0016
	CN4	-.0032	.0024	-.0103	.0026
S2: Work longer	Total	-.0253**	.0062	-.0422	-.0098
	CN1	-.0060	.0043	-.0191	.0043
	CN2	-.0083**	.0036	-.0188	-.0012
	CN3	-.0040	.0038	-.0153	.0059
	CN4	-.0069**	.0031	-.0165	-.0006
S3: Obtain professional financial advice	Total	.0020	.0037	-.0072	.0122
	CN1	-.0038	.0040	-.0150	.0067
	CN2	-.0049	.0028	-.0142	.0010
	CN3	.0087	.0040	-.0007	.0212
	CN4	.0020	.0025	-.0045	.0103
S4: Buy a life annuity	Total	.0064	.0040	-.0036	.0169
	CN1	-.0065	.0042	-.0193	.0035
	CN2	.0032	.0029	-.0036	.0122
	CN3	.0052	.0044	-.0062	.0170
	CN4	.0046	.0032	-.0032	.0141
S5: Increase contributions to superannuation	Total	.0068	.0039	-.0029	.0171
	CN1	.0024	.0045	-.0095	.0146
	CN2	-.0043	.0033	-.0143	.0038
	CN3	.0066	.0047	-.0058	.0201
	CN4	.0022	.0028	-.0052	.0101
S6: Increase savings outside superannuation	Total	.0205**	.0051	.0082	.0342
	CN1	-.0026	.0045	-.0150	.0091
	CN2	.0023	.0031	-.0058	.0120
	CN3	.0180**	.0054	.0058	.0337
	CN4	.0028	.0031	-.0051	.0119
S7: Move assets to more conservative assets	Total	.0046	.0042	-.0064	.0159
	CN1	-.0041	.0051	-.0189	.0083
	CN2	-.0050	.0035	-.0155	.0032
	CN3	.0117	.0050	-.0005	.0271
	CN4	.0019	.0030	-.0056	.0106
S8: Take out/increase other debt	Total	-.0059**	.0023	-.0125	-.0001
	CN1	.0035	.0025	-.0025	.0109
	CN2	-.0023	.0015	-.0068	.0010
	CN3	-.0067**	.0025	-.0139	-.0011
	CN4	-.0005	.0016	-.0048	.0039

**:p<0.01.
Total: aggregate financial concerns;
CN1: concerns about long-term care;
CN2: concerns about investment performance;
CN3: concerns about affordability to stay in current home;
CN4: concerns about insufficient bequest.
Boot LLCI: lower limit of 99% bootstrap confidence interval;
Boot ULCI: upper limit of 99% bootstrap confidence interval;
If the confidence interval includes 0, the mediation effect is not statistically significant at 1% level; otherwise, it is significant.

Table 5-6: Results for mediation effects (continued)

Dependent variable	Mediators	Mediation	Boot SE	Boot LLCI	Boot ULCI
S9: Take out/increase reverse mortgage	Total	-.0102**	.0027	-.0177	-.0038
	CN1	-.0016	.0023	-.0082	.0046
	CN2	-.0027	.0016	-.0075	.0007
	CN3	-.0057	.0025	-.0127	.0004
	CN4	-.0001	.0016	-.0044	.0040
S10: Completely pay off mortgage	Total	.0163**	.0041	.0066	.0275
	CN1	.0008	.0037	-.0091	.0110
	CN2	-.0006	.0022	-.0068	.0054
	CN3	.0103**	.0037	.0019	.0215
	CN4	.0058	.0028	-.0002	.0141
S11: Pay off all credit card and personal loans	Total	.0161**	.0037	.0070	.0264
	CN1	.0048	.0034	-.0038	.0141
	CN2	-.0040	.0025	-.0117	.0011
	CN3	.0097**	.0035	.0017	.0202
	CN4	.0055	.0025	-.0001	.0130
S12: Buy real estate/invest in property	Total	.0277**	.0051	.0157	.0421
	CN1	.0155**	.0049	.0043	.0305
	CN2	-.0037	.0029	-.0124	.0030
	CN3	.0118**	.0044	.0022	.0247
	CN4	.0041	.0025	-.0016	.0119
S13: Move to a smaller home	Total	-.0153**	.0042	-.0269	-.0056
	CN1	-.0106**	.0043	-.0227	-.0002
	CN2	-.0042	.0028	-.0130	.0021
	CN3	-.0022	.0036	-.0124	.0067
	CN4	.0017	.0025	-.0052	.0091
S14: Sell household goods or investment property	Total	-.0141**	.0039	-.0247	-.0050
	CN1	-.0005	.0031	-.0087	.0079
	CN2	-.0072**	.0027	-.0158	-.0014
	CN3	-.0035	.0031	-.0124	.0043
	CN4	-.0030	.0024	-.0103	.0026
S15: Approach others for financial support/loan	Total	-.0067**	.0017	-.0117	-.0029
	CN1	-.0014	.0012	-.0049	.0015
	CN2	-.0004	.0007	-.0025	.0015
	CN3	-.0037**	.0015	-.0081	-.0003
	CN4	-.0012	.0011	-.0044	.0014
S16: Increase insurance cover	Total	-.0065	.0031	-.0148	.0010
	CN1	-.0038	.0033	-.0130	.0049
	CN2	-.0026	.0021	-.0093	.0025
	CN3	.0032	.0033	-.0055	.0121
	CN4	-.0033	.0024	-.0100	.0027

**:p<0.01.
Total: aggregate financial concerns;
CN1: concerns about long-term care;
CN2: concerns about investment performance;
CN3: concerns about affordability to stay in current home;
CN4: concerns about insufficient bequest.
Boot LLCI: lower limit of 99% bootstrap confidence interval;
Boot ULCI: upper limit of 99% bootstrap confidence interval;
If the confidence interval includes 0, the mediation effect is not statistically significant at 1% level; otherwise, it is significant.

Financial literacy is highly associated with wealth (Smith, 2006; Yoong, 2010). People with higher financial literacy levels tend to accumulate greater wealth and thus have sufficient funds to afford long-term nursing care for their households and maintenance and repairs for their current residence. They are also more likely to be equipped with advanced financial skills and make well-informed investment decisions. As a result, reduction in spending is not necessary.

Table 5.7: Summary of identified mediation effects

Identified relationship
Financial Literacy → Total, CN1, CN2 & CN3 → S1: Cut back on spending (-)
Financial Literacy → Total, CN2 & CN4 → S2: Work longer (-)
Financial Literacy → Total, CN3 → S6: Increase savings outside superannuation (+)
Financial Literacy → Total, CN3 → S8: Take out/increase other debt (-)
Financial Literacy → Total → S9: Take out/increase reverse mortgage (-)
Financial Literacy → Total, CN3 → S10: Completely pay off mortgage (+)
Financial Literacy → Total, CN3 → S11: Pay off all credit card and personal loans (+)
Financial Literacy → Total, CN1 & CN3 → S12: Buy real estate/ invest in property (+)
Financial Literacy → Total, CN1 → S13: Move to a smaller home (-)
Financial Literacy → Total, CN2 → S14: Sell household goods or investment property (-)
Financial Literacy → Total, CN3 → S15: Approach others for financial support/loan (-)

Total: aggregate financial concerns;
CN1: concerns about long-term care;
CN2: concerns about investment performance;
CN3: concerns about affordability to stay in current home;
CN4: concerns about insufficient bequest.

Financially illiterate people with concerns about their investment performance (CN2) and insufficient bequest (CN4) are more likely to work longer (S2). Young retirees and senior retirees who worry about outliving their savings tend to seek job opportunities after they have retired (Vigtel, 2018), and the same holds true for those with a bequest motive (Chiang and Tsai, 2016).

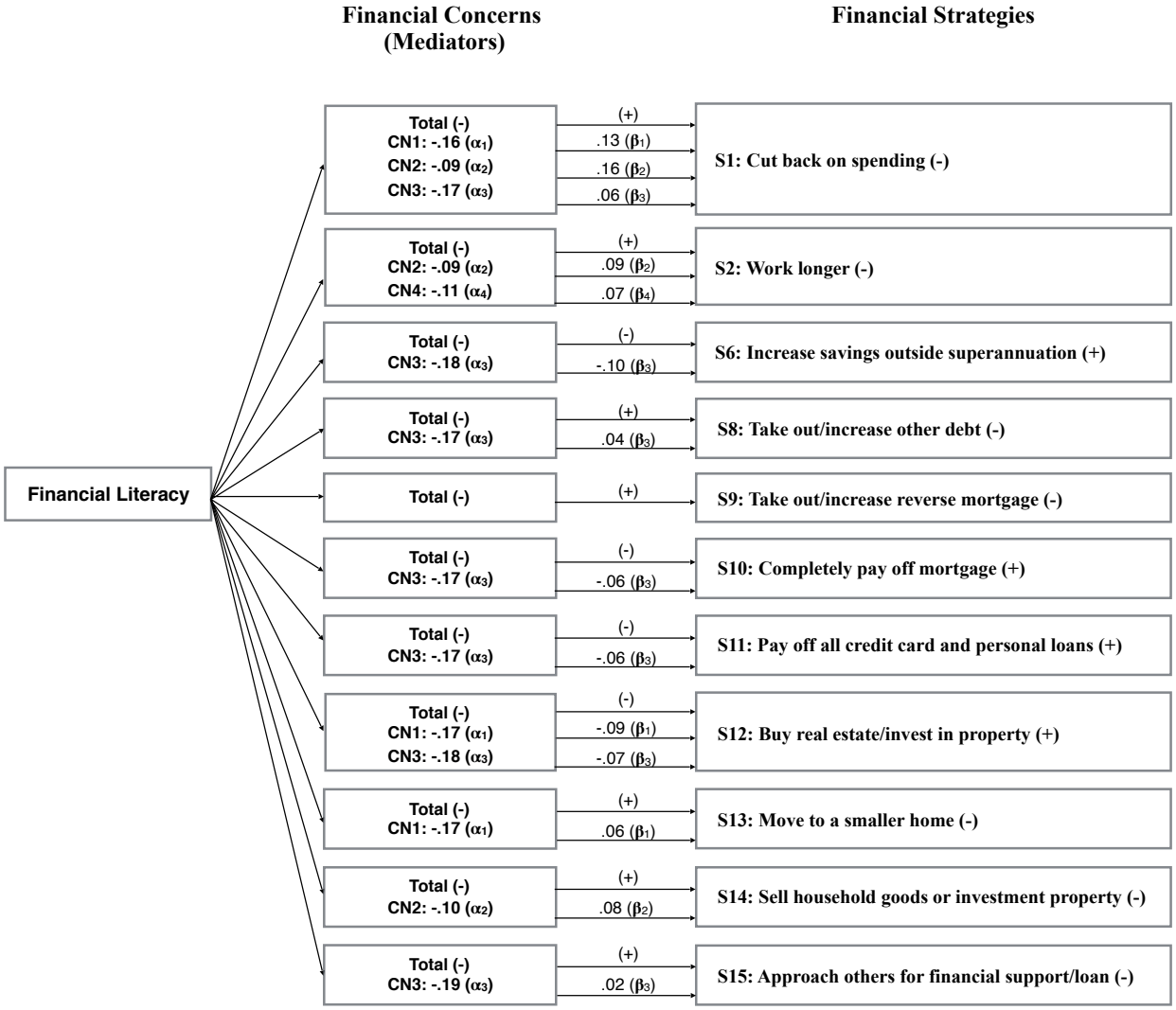

Figure 5.2: Illustration of identified mediation effects

Health problems occur as people age, and so retired individuals are gradually unable to perform housework by themselves and have to pay maintenance and repair fees. Affordability of housing, utility, and household service expenses (CN3) also becomes more challenging with increasing age. This is even problematic for those with lower levels of financial literacy. As such, they are more likely to borrow from financial intermediaries (S8, S9) or relatives (S15), and are less likely to increase savings (S6) or pay off their mortgage (S10), credit cards and loans (S11). Similarly, financially illiterate individuals with concerns about insufficient funds for nursing care (CN1) are more likely to downsize their residence (S13).

In contrast, financially literate households are less likely to be concerned about long-term care (CN1) and staying in their current residence (CN3), and thus they can spend more time collecting financial information and engaging in financial practice, such as property investment (S12). The elderly with lower financial literacy levels, however, are not well-equipped with financial skills and so they appear to be more concerned about their investment performance (CN2) (van Rooij et al., 2011b), and they are therefore more likely to sell their fixed assets (S14).

5.4.2 Direct Effects

Of much greater importance is to correct some spurious conclusions indicated by the results for total effects, which again highlights the importance of a consideration of financial concerns as mediators in the relationship between financial literacy and financial strategies.

Table 5.8 presents the results for direct effects of financial literacy on financial

strategies. Compared to the results shown in Table 5.5, two major differences in terms of statistical significance are observed: the effects of financial literacy on working longer (S2) and taking out/increasing reverse mortgage (S8).

Table 5.8: Direct effects of financial literacy on financial strategies ($\lambda^{'}$)

Dependent variable	Direct effects	P value
S1: Cut back on spending	-.1410	<.001***
S2: Work longer	.0682	.0095**
S3: Obtain professional financial advice	.2978	<.001***
S4: Buy a life annuity	.1447	<.001***
S5: Increase contributions to superannuation	.3148	<.001***
S6: Increase savings outside superannuation	.1946	<.001***
S7: Move assets to more conservative assets	.2727	<.001***
S8: Take out/increase reverse mortgage	-.0227	.0759
S9: Take out/increase other debt	-.0318	.0123*
S10: Completely pay off mortgage	.1810	<.001***
S11: Pay off all credit cards and personal loans	.1406	<.001***
S12: Buy real estate/invest in property	.1492	<.001***
S13: Move to a smaller home	-.0281	.2332
S14: Sell household goods or investment property	.0283	.1368
S15: Approach others for financial support/loan	-.0156	.0411*
S16: Increase insurance cover	-.0230	.2406

***:p<0.001; **:p<0.01; *:p<0.05.

Although the total effects of financial literacy on working longer (S2) are not statistically significant, the direct effect for financial literacy is significant at the 1% level. Results for mediation effects help explain this difference; namely, the significant, positive direct effect of financial literacy on working longer is offset by the significant, negative indirect effects (mediation effects), yielding insignificant total effects. Therefore, financial literacy affects the elderly's decision to seek job opportunities through both financial literacy itself and through the mediating mechanisms of financial concerns. Therefore, the insignificant relationship between financial literacy and working longer (total

effects) is spurious and incomplete.

The effect of financial literacy on increasing reverse mortgage (S8) reveals a different story; namely, the total effects are statistically significant but the direct effect is not. As can be inferred from Table 5.6 and Figure 5.2, the significant, negative total effects are mainly attributed to the significant, negative mediation effects rather than the direct effect generated by financial literacy itself. Accordingly, the significant relationship between financial literacy and reverse mortgage increase is again incomplete and somewhat misleading as it is likely to misinterpret this significant total effect as a direct effect. These findings highlight the importance and necessity of considering medication effects in causal analysis.

In addition, as can be summarised by Table 5.7 and Table 5.8, financially literate people are more likely to seek professional financial advice (S3), purchase a life annuity (S4), contribute more to their superannuation account (S5), and invest more conservatively (S7) regardless of their financial concerns.[13] This may, to some extent, reflect the phenomenon that people with higher financial literacy levels tend to invest more cautiously and select more reliable (retirement) products.

5.4.3 Discussion

Similar to Section 4.4.3, endogeneity problems are assessed in terms of omitted variables and reverse causality. Consistent with the literature (Lusardi and Mitchell, 2011a,b; Kramer, 2016), this research attempts to solve endogeneity problems sourced from omitted variables by taking into account more socio-demographic information. The models are re-estimated with additional socio-demographic variables added, including wealth, employment type, partner's

[13] The direct effects of financial literacy on these strategies are statistically significant at 1% level whereas the indirect effects are not.

employment type, and retirement status. The main findings regarding financial literacy, financial concerns and financial strategies are consistent when additional control variables are added individually or as an aggregate.

The results also likely suffer from reverse causality bias. The strategy "obtain professional financial advice" (S3) is a likely driving force of financial literacy. The advice received from professional financial advisors may help improve people's financial literacy level (Lusardi and Mitchell, 2007), equipping advised individuals with broader financial knowledge and more advanced financial skills than the non-advised (Kramer, 2016). Reverse causality bias is assessed by collecting additional information regarding respondents' frequency of seeking professional advice from the survey. The question asked was: "how often do you consult with professionals to assist with your financial decision making?"[14] The frequency of professional consultation is processed as a categorical variable with 1=*never* and 6=*Fortnightly, weekly, or more often than weekly*, and the models are re-estimated to examine the effects of financial literacy on the frequency of seeking financial advice. The effects are statistically significant and negative (-0.6148, p <0.001), suggesting that financially literate people are less likely to frequently consult with financial professionals. The results provide evidence to reject the possibility of reverse causality that seeking more financial advice can improve retired households' financial literacy level.

The results remain robust when taking into account omitted variables and reverse causality bias. Therefore, interpretations of empirical results in this chapter are validated and reliable.

[14] Further detail about this question is provided in Appendix G.

5.5 Summary

This chapter proposes an integrative mediation model to examine how financial literacy affects the elderly's decisions when faced with a variety of financial strategies and investigate the mediation mechanisms of specific financial concerns and aggregate financial concerns that transmit the effects of financial literacy on these financial strategies.

Multiple mediator models using bootstrap techniques are utilised to examine the issue, avoiding the often-violated multivariate normality assumption. The empirical results demonstrate three important findings. Firstly, financial concerns do indeed mediate most financial literacy-strategy nexuses. Financially illiterate people are more likely to have financial concerns, and are more likely to reduce spending, seek more job opportunities, increase debts, and downsize or sell their residence as a result. The findings also reveal that people with different financial concerns adopt different strategies. Secondly, financially literate people are more likely to seek professional financial advice, purchase a life annuity, contribute more to superannuation, and invest in more conservative assets regardless of their financial concerns.

Lastly but more importantly, results for the causal relationship between financial literacy and financial strategies may be misleading if the mediation effects of financial literacy through financial concerns are ignored. There are two possible spurious implications. Firstly, the overall relationship between financial literacy and a specific financial strategy is not observed, indicating that financial literacy by itself does not influence adoption of this strategy. In fact, the direct effect of financial literacy is statistically significant but offset by the opposite mediation effects, and so as a whole, financial literacy is not significant despite it playing a key role. Secondly, the significant total effects

of financial literacy on a specific financial strategy are generated by the indirect effects (mediation effects), not by financial literacy itself. Based on the total effects, it is possible to conclude that financial literacy by itself does affect adoption of such a strategy; however, in fact, the total effects are produced by the mediation effects of financial literacy via financial concerns. This highlights the importance and necessity of considering mediating variables.

Future studies on causal inference should therefore take into account and test for the mediation effects. Multiple mediator models not only demonstrate a more nuanced understanding of how an antecedent variable affects a subsequent variable, but also help correct spurious and incomplete implications. Additionally, the use of bootstrap techniques in multiple mediator models overcomes the multivariate normality assumption that is rarely satisfied in practice. Therefore, the use of bootstrap techniques in exploring mediating mechanisms is recommended, particularly for studies with small sample sizes.

Professional financial advisors may wish to identify and take into account consumers' personal financial concerns when providing financial advice. With the rise of Fintech, robo-advisors - an innovative financial service that automatically provides financial advice based on the customer's personal circumstances - are becoming more popular in financial practice. Although risk preferences and desired target returns are included, in order to make the recommended financial advice more effective and reliable, robo-advisor developers can also benefit from taking into account an individual's financial concerns. Detailed policy recommendations regarding financial advisors are provided in Section 6.2.

Chapter 6

Conclusions and Future Work

6.1 Conclusions

Population ageing is a global trend that poses a challenge to the elderly and society at large(Griggs et al., 2013), as increased financial resources are required to support longer life spans (Jacobs-Lawson and Hershey, 2003; van Rooij et al., 2012). With a well-informed retirement plan, retired households are more likely to maintain a reasonable standard of living and enjoy a well-off retirement life (Yuh et al., 1998; Lusardi and Mitchell, 2007; van Rooij et al., 2011a).

However, individuals with low financial literacy levels are less likely to plan sufficiently for their retirement (Lusardi and Mitchell, 2011a). Worryingly, a large body of research has reported a widespread lack of financial literacy (Lusardi and Mitchell, 2008, 2011b; Meier and Sprenger, 2013; Fernandes et al., 2014; Drexler et al., 2014; Kramer, 2016), particularly amongst the elderly (Lusardi and Mitchell, 2007; Bucher-Koenen and Lusardi, 2011; Finke et al., 2016).

The current defined contribution pension schemes have shifted complex fin-

ancial decisions towards retired individuals (Niblock et al., 2017; Clark et al., 2019; Gallagher et al., 2019). Financially illiterate people are more likely to make financial mistakes and are less likely to identify reliable retirement income products, and hence may outlive their savings as they age (Aguila et al., 2011; Xue et al., 2018).

Therefore, it is necessary to improve the financial literacy of the elderly and ultimately mitigate negative consequences generated by population ageing. The primary aim of this research is to provide effective and practicable policy recommendations for elderly Australians to improve their living standards in retirement. As a consequence of the aim, this thesis has addressed three main research questions:

- **Research Question 1:** Is it possible to construct a financial literacy index as a measurement of the financial literacy of elderly Australians? If so, what are the socio-demographic characteristics of the financially literate and the financially illiterate?
- **Research Question 2:** Are elderly Australians satisfied with their financial situation? What are the roles of financial literacy and consumption patterns in determining their financial well-being?
- **Research Question 3:** How does the financial literacy of elderly Australians affect their financial decision-making? How do financial concerns mediate the relationship between financial literacy and financial decision-making?

Chapter 3 provides answers to **Research Question 1**. Using national survey data of 15,000 elderly Australians, an Item Response Theory (IRT) model was used to construct a financial literacy index (FL) based on financial literacy questions. Prior studies attempt to utilise Factor Analysis (FA) to create a FLI (Lusardi, 2003; Lusardi and Beeler, 2006; Lusardi and Mitchell, 2008; van

Rooij et al., 2011b). However, using FA to construct a FLI leads to information loss (Thompson, 2004). In comparison, an advantage of the IRT model is that it makes use of information repeatedly throughout the iteration algorithm (Zheng and Rabe-Hesketh, 2007). It also combines survey question difficulty and their relationships with financial literacy when obtaining the FLI. Therefore, the IRT model was selected to construct the FLI to measure the financial literacy of elderly Australians and its use represents an advancement of the literature.

In addition, regression tree analysis and Lasso regression were used to detect and determine socio-demographic variables important to financial literacy. Nine variables were selected, including wealth, age, gender, marital status, self-assessed health, home ownership, income, education, and employment type. It is worth noting that health and home ownership are rarely analysed in prior literature. This thesis reveals that elderly Australians with higher levels of financial literacy are more likely to demonstrate the following characteristics: relatively younger age, married, predominantly males, exhibit greater net wealth and higher income, white or pink collar workers, outright residence owners, in good health, and highly educated.

The financial literacy index (FLI) developed in Chapter 3 was then used in Chapter 4 as a measure to investigate the effects of financial literacy, both by itself and via an interaction with consumption patterns, on financial well-being. It was also used in Chapter 5 to examine how financial literacy affects elderly Australians' decisions regarding adoption of a variety of financial strategies and how financial concerns affect these literacy-strategy nexuses.

Chapter 4 addresses **Research Question** 2. Building and extending on the FLI developed in Chapter 3, this measure is applied to examine how financial

literacy, both by itself and via an interaction with consumption patterns, affects retired households' financial well-being. Specifically, this chapter firstly reported that overall, elderly Australians hold an optimistic attitude towards their financial status. This chapter also presented changes in actual consumption and consumption needs over the course of retirement, demonstrating that elderly Australians are able to maintain their consumption standards after retirement and that the "Retirement Consumption Puzzle" that their consumption drops substantially after retirement is not observed in Australia. Notably, although consumption is a needs-driven behaviour (Wilk, 2002), consumption needs are rarely considered in prior consumption research.

Text Mining (TM) techniques were utilised to reveal reasons for changes in actual consumption for each of the six consumption sub-categories in the survey. This reveals that increasing costs and insufficient funds result in changes in food and non-alcoholic beverages consumption. Increasing costs also limit consumption capacity regarding housing and utilities. Changes in medical care and health expenses are mainly attributed to ageing problems and increasing medical/medication costs.

The six categories were clustered into basic consumption and non-essential consumption. Both actual consumption and consumption needs were considered by forming a new construct: *whether people's actual consumption meets their consumption needs*. The effect of this construct on financial well-being was then examined for basic and non-essential consumption, respectively. The distinct roles of financial literacy in these relationships were also examined.

Results from ordinal logistic regressions (OLR) indicate that meeting both basic and non-essential consumption needs significantly improves financial well-being. This positive effect is strongest for non-essential consumption.

Financial literacy by itself significantly improves financial well-being. Financial literacy also helps strengthen the positive effects of meeting non-essential consumption needs on financial well-being. The results suggest that advanced financial knowledge and skills can help smooth and modify retired individuals' consumption patterns, and hence help them reap greater benefits from meeting more of their non-essential consumption needs. Taken together, the findings provide empirical evidence that improving retired households' financial literacy is key to enhancing their financial well-being.

In addition, people who are relatively older, more educated, healthier, and outright home owners are more likely to be satisfied with their financial situation. The effect of marriage on financial well-being is found to gradually diminish as consumption levels increase. Aside from these socio-demographic factors, employment type and gender have no bearing on the elderly's financial well-being.

Chapter 5 presents solutions to **Research Question 3**. This chapter proposed an integrative mediation model to examine how financial literacy affects the elderly's decisions when faced with a variety of financial strategies and investigate the mediation mechanisms of specific financial concerns and aggregate financial concerns that transmit the effects of financial literacy on these financial strategies.

Multiple mediator models using bootstrap techniques were implemented to examine the issue, avoiding the often-violated multivariate normality assumption. This chapter finds that financial concerns do indeed mediate most financial literacy-strategy nexuses. Financially illiterate people are more likely to express financial concerns and are more likely to cut back on spending, seek more job opportunities, increase debts, and downsize or sell their residence as

a result. The results also reveal that people with different financial concerns adopt different strategies. In addition, financially literate people are more likely to seek professional financial advice, purchase a life annuity, contribute more to superannuation, and invest in more conservative assets regardless of their financial concerns.

Importantly, this chapter provides evidence that the causal relationship between financial literacy and financial strategies may be misleading if the mediation effects of financial literacy through financial concerns are ignored. Therefore, it is suggested future studies on causal analysis take into account and test for potential mediation effects using (multiple) mediator models with bootstrap techniques, particularly for studies with small sample sizes.

To sum up, this thesis is able to leverage big data techniques to construct a more reliable and robust financial literacy index that measures how well elderly Australians manage their assets. This thesis further provides empirical evidence that financial literacy is of vital importance for elderly Australians to improve their financial well-being. Financial literacy is also a driving force in improving elderly Australians' financial decision-making ability in order to mitigate their financial concerns. Based on these empirical findings, effective and practicable policy recommendations are discussed in the next section.

6.2 Policy Recommendations

This thesis recommends that superannuation, insurance, and other fund providers design tailored and customised products for elderly customers, with a particular focus on those with low financial literacy levels. Consider superannuation funds for example. Australia's superannuation scheme, introduced in 1992, requires employers to contribute a proportion of their employees' salaries into employees' superannuation funds. At present, the total superannu-

ation assets of Australia are worth AUD$ 2,782.6 billion (APRA, 2019). The default option of superannuation investment strategy is the Lifecycle Investment Strategy, which is featured by gradually decreasing risk. Without a reasonable level of financial literacy, elderly Australians are less likely to actively manage their superannuation fund, and hence adopt the default investment option at the cost of higher management fees (Iskra, 2012). In addition to high level of management charges, the complexity of current superannuation funds system makes financially illiterate people less likely to understand and manage effectively (Niblock et al., 2017). Therefore, low-cost and simple-to-implement superannuation products, such as Single Diversified Investment Strategy from MySuper[1] (MySuper, 2019), would be much easier to understand and facilitate optimisation of Australian retirees' income streams.

A number of studies recommend financial education programs to improve people's financial literacy (Gerrans and Heaney, 2016; Boisclair et al., 2017). However, those who are much older and facing declining health are less likely to engage in such education programs. Instead, access to user-friendly financial tools is recommended for this demographic, such as a superannuation, retirement income, and insurance needs calculator, in addition to budget and spending planners. The challenge is to have a simple user-interface without compromising on accurate, individualised calculations in the background. It is clear that elderly Australians are engaging with technology. A 2017 survey (Statista, 2017) reveals that 64 percent of Australians aged between 50 and 64 own a tablet, 75 percent a smartphone, 55 percent a laptop, and 66 percent own a desktop computer. Therefore, freely available online and mobile apps that are specifically designed to engage elderly Australians, and that gamify learning how to invest and choose retirement income products properly are likely to be beneficial. One example would be to extend the Brand (2017) in-

[1] MySuper products have experienced rapid growth in recent years, with total assets of AUD$ 713.3 billion (APRA, 2019).

teractive app that won the South Australian Premier's Ageing Well Challenge in 2017 to incorporate a financial literacy dimension.

The rapid rise of FinTech is another means of providing effective and practicable ways to improve the elderly's financial literacy. Consider robo-advisors for instance. They automatically recommend investment strategies and wealth management strategies based on the consumer's characteristics and risk preferences. For financially illiterate people, they now have a clear list of candidate financial strategies rather than being uncertain or blind about numerous and fast-changing financial services and products. For literate individuals, they now have more information to help them make and modify their financial decisions. Importantly, elderly consumers, particularly those with health problems, can benefit from taking advantage of the financial advice recommended by robo-advisors because they do not have to visit a professional in person.

Blockchain, well-known for its decentralised transparency and security, is a key component of FinTech (Cai, 2018). The recent launch of "mutual insurance"(Xianghu Bao), a blockchain-based online insurance product that operates via the Alipay Express Payment platform, is a potential game changer (CBNEditor, 2018). It allows Alipay users with a certain credit level (650 Sesame Credit points or greater) to apply for free.[2] Insurees share risks and expenses of 100 major illnesses such as cancer. The entire lump sum payment will be covered by all users collectively if an insuree falls ill. The estimated payment is approximately 0.1 yuan (AUD$ 0.02) per insuree per case and 200 yuan (AUD$ 40) per insuree per year. With the application of blockchain, the payment record is transparent and secure because every payment is shared, recorded, open, and protected by cryptographic algorithms. Overall, this mutual insurance is a FinTech product with characteristics of low entry require-

[2] The current policy is applied to people with a medical certificate documenting that the insuree has no major illness.

ments, risk sharing, transparency, and security. It provides an informed way to mitigate concerns about medical care payments. Therefore, it is recommended that fund providers make use of FinTech to develop customised FinTech-based products and services for elderly consumers to improve their financial well-being.

Further, it is recommended that robo-advisors and professional financial advisors identify and take into account people's personal financial concerns when providing financial advice. Although robo-advisors make recommendations based on the customers' risk preferences, desired target returns, and other personal characteristics, it is also necessary to take into account and incorporate consumers' specific financial concerns.

Finally, for working Australians, particularly for pre-retirees, financial education is an efficient way to improve financial knowledge, such as a greater understanding of superannuation. Such education will enable subsequent planning for retirement and hence a more comfortable retirement life. Therefore, policy-makers should consider allocating more resources to designing and promoting financial education programs so that the next generation of elderly Australians have improved financial literacy.

6.3 Future Work

This thesis investigates the financial literacy of elderly Australians and the effects of financial literacy on financial well-being and financial decision-making based on a cross-sectional survey dataset. To further expand on the dynamics and changes of financial literacy, a follow-up survey of elderly Australians is planned. In addition to questions included in the current survey, a module regarding FinTech will be added. This will facilitate the analysis of three major research questions:

(1) Has the financial literacy of elderly Australians improved?

(2) Does the use of FinTech improve the financial well-being and financial decision-making of elderly Australians?

(3) Is FinTech use an effective way to protect elderly Australians financially, including resilience to unexpected financial events and a means of defence against online fraud and scams?

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Appendices

Appendix A: Socio-demographic survey questions

Q7.2: Which of the following occupation groups most closely matches your primary occupation for the majority of your paid working life? (leave this blank if you never participated in paid work)

- Manager (e.g. chief executive, general managers and legislators, farmers and farm managers, specialist managers, hospitality, retail and service managers)
- Professional (e.g., arts and media, business, human resource, marketing, design, engineering, science, transport, education, health, information and communication technology, legal, social and welfare professionals, etc...)
- Technician and Trades worker (e.g., engineering, information and communication technology, science, automotive and engineering, construction trades, telecommunications, food trades, skilled animal and horticultural workers)
- Community and Personal Service worker (e.g., health and welfare support, carers and aides, hospitality, protective services, sports and personal service workers)
- Clerical and Administrative worker (e.g., office managers, personal assistants and secretaries, general clerical, inquiry clerks and receptionists, clerical and office support workers)
- Sales worker (e.g., sales representatives and agents, sales assistants and salespersons, sales support workers)
- Machinery operator and drivers (e.g., machine and plant operators, road and rail drivers, storepersons)
- Labourer (e.g., cleaner and laundry workers, construction and mining labourers, factory process workers, farm, forestry and garden workers, food preparation assistants)

- Other (please specify) [text response]

Q7.12: Which of the following occupation groups most closely matches your spouse or partner's primary occupation for the majority of your paid working life? (leave this blank if you never participated in paid work)

- Manager (e.g. chief executive, general managers and legislators, farmers and farm managers, specialist managers, hospitality, retail and service managers)
- Professional (e.g., arts and media, business, human resource, marketing, design, engineering, science, transport, education, health, information and communication technology, legal, social and welfare professionals, etc...)
- Technician and Trades worker (e.g., engineering, information and communication technology, science, automotive and engineering, construction trades, telecommunications, food trades, skilled animal and horticultural workers)
- Community and Personal Service worker (e.g., health and welfare support, carers and aides, hospitality, protective services, sports and personal service workers)
- Clerical and Administrative worker (e.g., office managers, personal assistants and secretaries, general clerical, inquiry clerks and receptionists, clerical and office support workers)
- Sales worker (e.g., sales representatives and agents, sales assistants and salespersons, sales support workers)
- Machinery operator and drivers (e.g., machine and plant operators, road and rail drivers, storepersons)
- Labourer (e.g., cleaner and laundry workers, construction and mining labourers, factory process workers, farm, forestry and garden workers, food preparation assistants)
- Other (please specify) [text response]

Q8.3: In the 2008/2009 financial year, what was your total household income, before taxes? Household income is income from all sources from all members of your household.

- Don't know
- Less than $20,000
- $20,000 to $29,999

- $30,000 to $39,999
- $40,000 to $49,999
- $50,000 to $59,999
- $60,000 to $69,999
- $70,000 to $79,999
- $80,000 to $89,999
- $90,000 to $99,999
- $100,000 or more
- I do not want to answer this question

Q8.4: In the 2008/2009 financial year, what were your earnings from paid work, before taxes?

- Don't know
- Less than $20,000
- $20,000 to $29,999
- $30,000 to $39,999
- $40,000 to $49,999
- $50,000 to $59,999
- $60,000 to $69,999
- $70,000 to $79,999
- $80,000 to $89,999
- $90,000 to $99,999
- $100,000 or more
- I do not want to answer this question

Q8.5: In the 2008/2009 financial year, what were the earnings of your spouse/-partner from paid work, before taxes?

- Don't know
- Less than $20,000

- $20,000 to $29,999
- $30,000 to $39,999
- $40,000 to $49,999
- $50,000 to $59,999
- $60,000 to $69,999
- $70,000 to $79,999
- $80,000 to $89,999
- $90,000 to $99,999
- $100,000 or more
- I do not want to answer this question

Q9.1: In total, about how much money would you say you (and your partner, if you have one) currently have in savings and investments, including investment or holiday properties and money in superannuation, but excluding your home?

- Don't know
- Less than $25,000
- $25,000 to less than $50,000
- $50,000 to less than $100,000
- $100,000 to less than $200,000
- $200,000 to less than $300,000
- $300,000 to less than $400,000
- $400,000 to less than $500,000
- $500,000 to less than $750,000
- $750,000 to less than $1 million
- $1 million or more
- I do not want to answer this question

Q9.2: Apart from any mortgage(s) that you may have over your own residence, what is the total amount of money you (and your partner, if you have one) owe, on all personal loans, credit cards, investment property loans, etc.?

- Don't know
- Less than $25,000
- $25,000 to less than $50,000
- $50,000 to less than $100,000
- $100,000 to less than $200,000
- $200,000 to less than $300,000
- $300,000 to less than $400,000
- $400,000 to less than $500,000
- $500,000 to less than $750,000
- $750,000 to less than $1 million
- $1 million or more
- I do not want to answer this question

Q9.3: Do you or your family own your own residence outright, are you paying it off, or are you renting?

- Own outright
- Paying off
- Renting
- Other (please specify) [text response]

Q10.1: What is your year of birth?

Q10.2: Sex

- Male
- Female

Q10.3: What best describes your current marital status?

- Single
- Married
- De facto
- Widowed

- Separated or divorced

Q10.6: What is your highest level of education that you have completed?

- University degree or higher
- Trade certificate or apprenticeship
- Other certificate or diploma
- Year 12 or equivalent
- Year 10 or 11
- Year 9 or below
- Never attended school
- Other (please specify) [text response]

Q10.7: In general, would you say your health is:

- Excellent
- Very good
- Good
- Fair
- Poor

Appendix B: Explanation of consumption categories in the survey

Category	Explanation
Basic Consumption:	
Food & non-alcoholic beverages	This includes food and non-alcoholic beverages for meals at home and meals out, including restaurants, clubs, fast food and takeaway.
Housing & utilities expenses	This includes housing costs: e.g. rent and mortgage repayments, house and contents insurance, rates, land tax, repairs and maintenance (R&M), and body corporate payments. It also includes utilities, such as electricity and gas. It excludes expenditure on household goods and services besides R&M.
Household goods & services	This includes household goods: e.g. kitchen and laundry appliances, air-conditioners, furniture, floor covering, paintings, linen, glassware, tableware, utensils, phones, tools, telephones. It also includes household non-durables such as garden plants, other gardening products, and cleaning products, telephone and mobile charges, household services such as pest control, gardening, housekeeping and cleaning, home help, security, and R&M of household durables.
Medical care & health expenses	This includes accident and health insurance, fees, pharmaceuticals, therapeutic equipment, hospital and nursing home charges.
Non-essential Consumption:	
Alcohol & tobacco	All alcoholic beverages and tobacco and tobacco products, such as cigarettes, pipes, etc.
Gifts & donations	Donations/Cash or other gifts to charity, family or friends.

Note: This explanation is similar to that shown in Higgins and Roberts (2011).

Appendix C: Reasons for consumption change determined by text mining

Food and non-alcoholic beverages		Housing and utilities		Medical care and health expenses	
Reason	Percentage (%)	Reason	Percentage (%)	Reason	Percentage (%)
increasing costs	20.80	increasing costs	46.31	health problems as ageing	44.82
insufficient funds	20.38	using less	12.85	increasing medical/medication costs	37.10
eating less	12.15	repair&maintenance needs	12.29	increasing insurance costs	12.78
eating out less	10.14	insufficient funds	9.36	discount/insurance cover	9.43
living alone	9.29	staying at home more	6.90	good health	1.95
getting older	6.86	moving to retirement village	3.97	only one person to cover	1.40
self-producing	6.44	living alone	2.74		
dependent leaving	4.75	new home/appliances	1.51		
no work-related	2.65				
socialising more	2.43				

Note: The summation of each column is not equal to 100 (%) because some people provided multiple responses.

Appendix D1: OLR results for Food & non-alcoholic beverages

Panel A: base model Variable	Coefficient	Std.Error	t-value	
FL	0.5025	0.0894	5.6202	***
ConsMet-B	0.3821	0.1024	3.7324	***
Employ (1=pink/white collar)	0.1720	0.1463	1.1762	
Tenure (1=outright)	1.1015	0.1525	7.2210	***
Age	0.0194	0.0058	3.3288	***
Gender (1=male)	-0.1359	0.1128	-1.2053	
Marital (1=married)	0.1957	0.1225	1.5973	
Edu (1=≥uni.)	0.3481	0.1077	3.2324	**
Health (1=healthy)	0.9370	0.1206	7.7717	***
Panel B: with interaction item added Variable	Coefficient	Std.Error	t-value	
FL	0.6362	0.1598	3.9812	***
ConsMet-B	0.3667	0.1035	3.5410	***
ConsMet-B*FL	0.1699	0.1699	0.9999	
Employ (1=pink/white collar)	0.1747	0.1464	1.1937	
Tenure (1=outright)	1.1014	0.1526	7.2196	***
Age	0.0194	0.0058	3.3274	***
Gender (1=male)	-0.1339	0.1128	-1.1870	
Marital (1=married)	0.1975	0.1226	1.6112	
Edu (1=≥uni.)	0.3527	0.1078	3.2723	**
Health (1=healthy)	0.9396	0.1206	7.7910	***

Dependent variable: financial well-being (FWB).
***: $p<0.001$; **:$p<0.01$; *:$p<0.05$

Appendix D2: OLR results for Housing & utilities expenses

Panel A: base model Variable	Coefficient	Std.Error	t-value	
FL	0.5027	0.0906	5.5481	***
ConsMet-B	0.3364	0.1004	3.3486	***
Employ (1=pink/white collar)	0.1668	0.1487	1.1219	
Tenure (1=outright)	1.0986	0.1553	7.0741	***
Age	0.0176	0.0059	2.9714	**
Gender (1=male)	-0.1014	0.1142	-0.8882	
Marital (1=married)	0.2128	0.1246	1.7076	
Edu (1=≥uni.)	0.3414	0.1090	3.1320	**
Health (1=healthy)	0.9384	0.1223	7.6697	***
Panel B: with interaction item added Variable	Coefficient	Std.Error	t-value	
FL	0.5958	0.1648	3.6153	***
ConsMet-B	0.3350	0.1011	3.3141	***
ConsMet-B*FL	0.0207	0.1670	0.1239	
Employ (1=pink/white collar)	0.1669	0.1487	1.1224	
Tenure (1=outright)	1.0984	0.1553	7.0715	***
Age	0.0176	0.0059	2.9737	**
Gender (1=male)	-0.1019	0.1143	-0.8915	
Marital (1=married)	0.2128	0.1246	1.7081	
Edu (1=≥uni.)	0.3421	0.1092	3.1344	**
Health (1=healthy)	0.9385	0.1223	7.6706	***

Dependent variable: financial well-being (FWB).
***: $p<0.001$; **:$p<0.01$; *:$p<0.05$

Appendix D3: OLR results for Household goods & services

Panel A: base model Variable	Coefficient	Std.Error	t-value	
FL	0.4854	0.0903	5.3769	***
ConsMet-B	0.4797	0.0979	4.8974	***
Employ (1=pink/white collar)	0.2017	0.1481	1.3623	
Tenure (1=outright)	1.0950	0.1534	7.1368	***
Age	0.0190	0.0059	3.2294	**
Gender (1=male)	-0.0995	0.1136	-0.8763	
Marital (1=married)	0.1942	0.1241	1.5654	
Edu (1=≥uni.)	0.3681	0.1086	3.3895	***
Health (1=healthy)	0.9032	0.1227	7.3593	***
Panel B: with interaction item added Variable	Coefficient	Std.Error	t-value	
FL	0.6069	0.1648	3.6826	***
ConsMet-B	0.4732	0.0985	4.8032	***
ConsMet-B*FL	0.0993	0.1601	0.6200	
Employ (1=pink/white collar)	0.2029	0.1481	1.3698	
Tenure (1=outright)	1.0946	0.1535	7.1332	***
Age	0.0192	0.0059	3.2568	**
Gender (1=male)	-0.1001	0.1136	-0.8815	
Marital (1=married)	0.1938	0.1241	1.5618	
Edu (1=≥uni.)	0.3711	0.1087	3.4136	***
Health (1=healthy)	0.9019	0.1228	7.3473	***

Dependent variable: financial well-being (FWB).
***: p<0.001; **:p<0.01; *:p<0.05

Appendix D4: OLR results for Medical care & health expenses

Panel A: base model Variable	Coefficient	Std.Error	t-value	
FL	0.5196	0.0895	5.8035	***
ConsMet-B	0.2334	0.1264	1.8462	
Employ (1=pink/white collar)	0.1402	0.1457	0.9625	
Tenure (1=outright)	1.0931	0.1519	7.1970	***
Age	0.0173	0.0058	2.9823	**
Gender (1=male)	-0.0842	0.1123	-0.7497	
Marital (1=married)	0.1606	0.1224	1.3124	
Edu (1=≥uni.)	0.3336	0.1077	3.0982	**
Health (1=healthy)	0.9361	0.1207	7.7581	***
Panel B: with interaction item added Variable	Coefficient	Std.Error	t-value	
FL	0.6323	0.1593	3.9692	***
ConsMet-B	0.2355	0.1268	1.8576	
ConsMet-B*FL	0.0470	0.2117	0.2222	
Employ (1=pink/white collar)	0.1422	0.1459	0.9742	
Tenure (1=outright)	1.0942	0.1520	7.1993	***
Age	0.0174	0.0058	2.9845	**
Gender (1=male)	-0.0849	0.1123	-0.7562	
Marital (1=married)	0.1614	0.1224	1.3178	
Edu (1=≥uni.)	0.3336	0.1077	3.0974	**
Health (1=healthy)	0.9356	0.1207	7.7516	***

Dependent variable: financial well-being (FWB).
***: $p<0.001$; **:$p<0.01$; *:$p<0.05$

Appendix D5: OLR results for Alcohol & tobacco

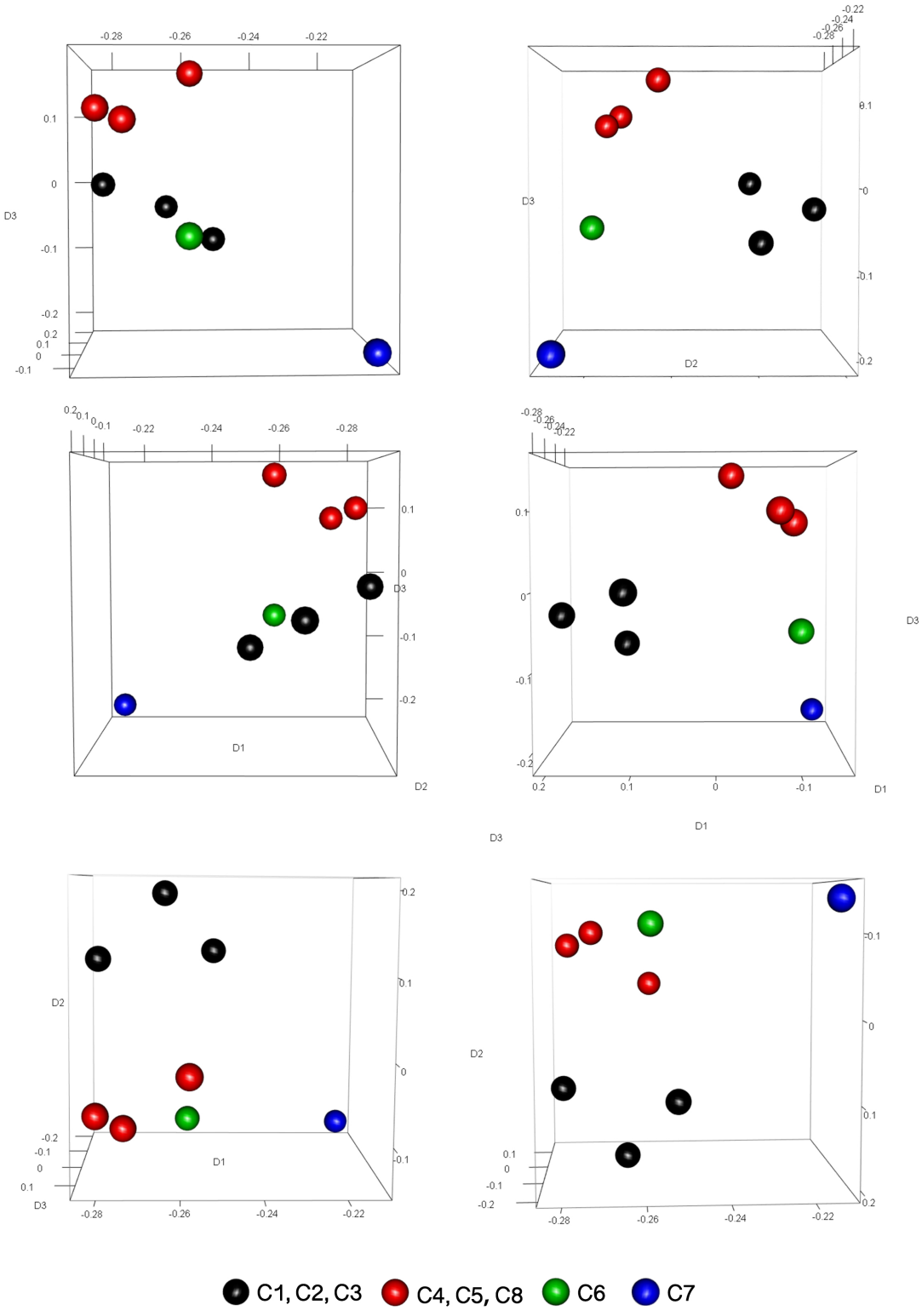
Panel A: base model Variable	Coefficient	Std.Error	t-value	
FL	0.5095	0.0952	5.3540	***
ConsMet-N	0.5822	0.1422	4.0937	***
Employ (1=pink/white collar)	0.1686	0.1556	1.0836	
Tenure (1=outright)	1.0856	0.1658	6.5486	***
Age	0.0172	0.0062	2.7895	***
Gender (1=male)	-0.1773	0.1213	-1.4611	*
Marital (1=married)	0.1691	0.1345	1.2572	**
Edu (1=≥uni.)	0.3300	0.1139	2.8974	***
Health (1=healthy)	0.8606	0.1312	6.5620	***
Panel B: with interaction item added Variable	Coefficient	Std.Error	t-value	
FL	0.9703	0.5004	1.9392	**
ConsMet-N	0.5814	0.1422	4.0882	***
ConsMet-N*FL	0.2235	0.1082	2.0656	*
Employ (1=pink/white collar)	0.1713	0.1556	1.1011	
Tenure (1=outright)	1.0883	0.1657	6.5671	***
Age	0.0169	0.0062	2.7328	***
Gender (1=male)	-0.1756	0.1213	-1.4469	*
Marital (1=married)	0.1673	0.1345	1.2443	*
Edu (1=≥uni.)	0.3273	0.1139	2.8727	***
Health (1=healthy)	0.8585	0.1311	6.5465	***

Dependent variable: financial well-being (FWB).
***: $p<0.001$; **:$p<0.01$; *:$p<0.05$

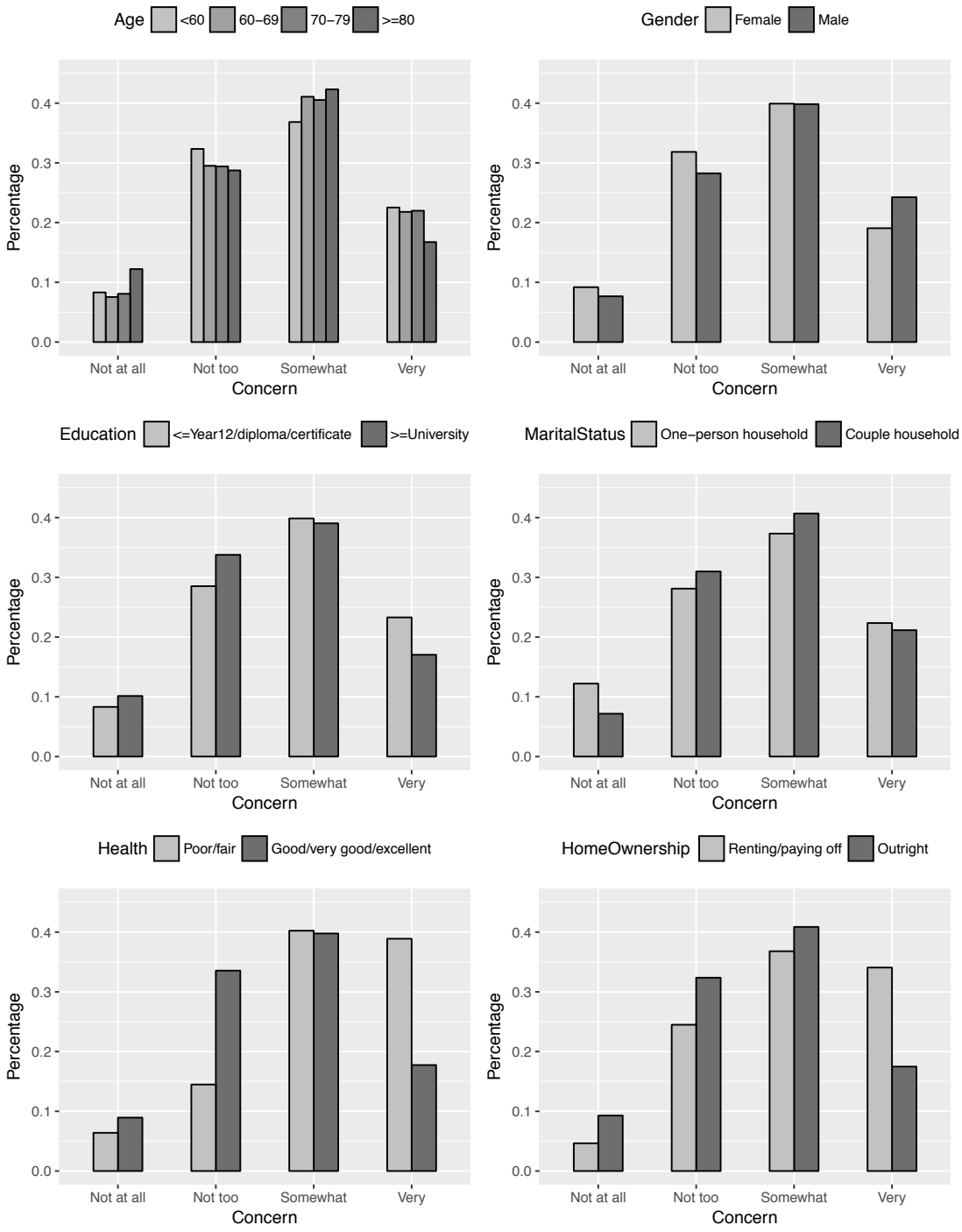
Appendix D6: OLR results for Gifts & donations

Panel A: base model Variable	Coefficient	Std.Error	t-value	
FL	0.5204	0.0910	5.7193	***
ConsMet-N	0.6075	0.1479	4.1076	***
Employ (1=pink/white collar)	0.2342	0.1491	1.5712	
Tenure (1=outright)	1.1067	0.1550	7.1402	***
Age	0.0169	0.0059	2.8618	**
Gender (1=male)	-0.0971	0.1139	-0.8523	
Marital (1=married)	0.1332	0.1247	1.0682	
Edu (1=≥uni.)	0.3207	0.1089	2.9457	**
Health (1=healthy)	0.9432	0.1232	7.6565	***
Panel B: with interaction item added				
Variable	**Coefficient**	**Std.Error**	**t-value**	
FL	1.3972	0.5093	2.7433	**
ConsMet-N	0.6075	0.1474	4.1227	***
ConsMet-N*FL	0.4295	0.1978	2.1714	*
Employ (1=pink/white collar)	0.2240	0.1491	1.5018	
Tenure (1=outright)	1.1066	0.1550	7.1409	***
Age	0.0169	0.0059	2.8631	**
Gender (1=male)	-0.1063	0.1140	-0.9323	
Marital (1=married)	0.1263	0.1248	1.0119	
Edu (1=≥uni.)	0.3259	0.1090	2.9915	**
Health (1=healthy)	0.9355	0.1232	7.5948	***

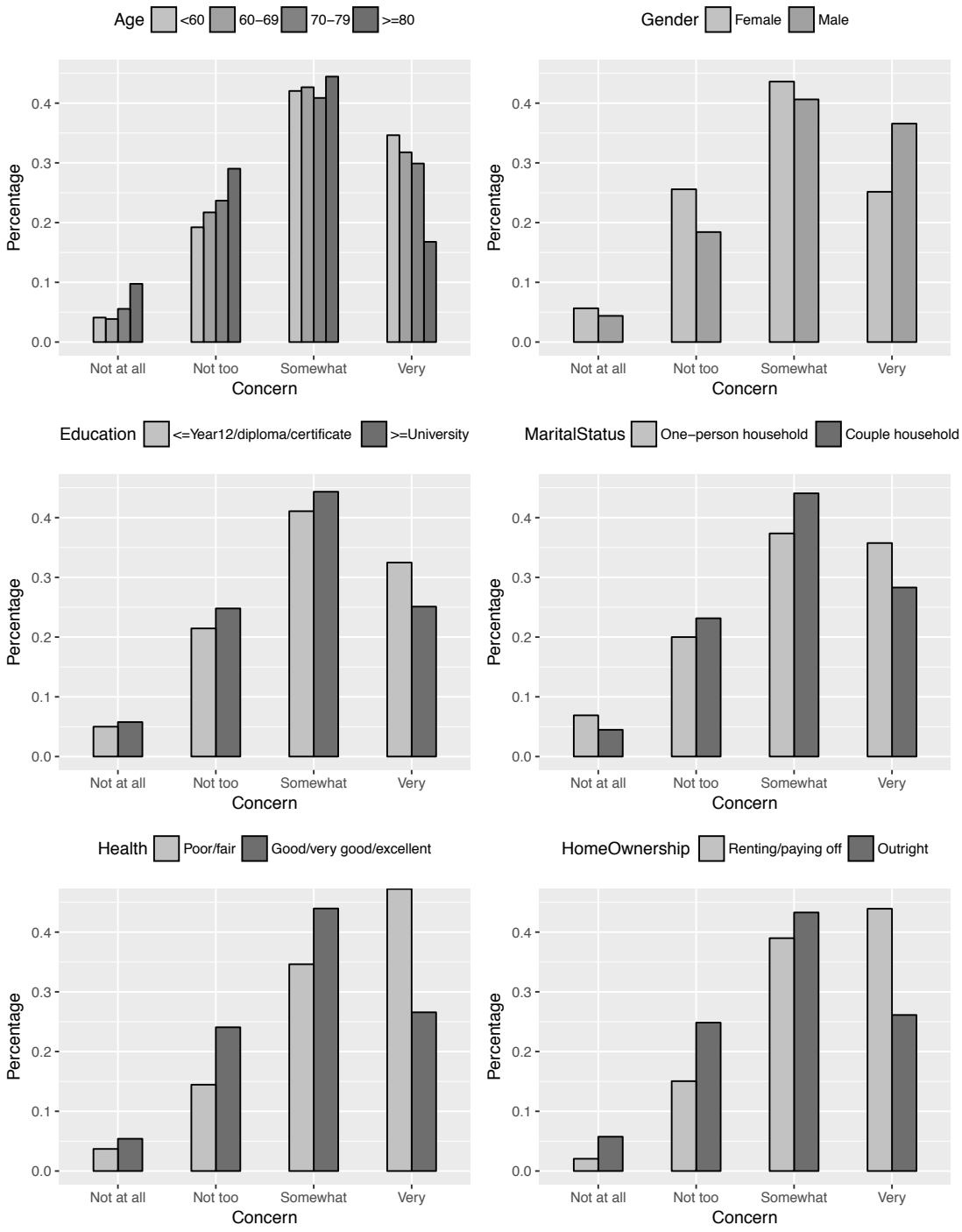
Dependent variable: financial well-being (FWB).
***: $p<0.001$; **:$p<0.01$; *:$p<0.05$



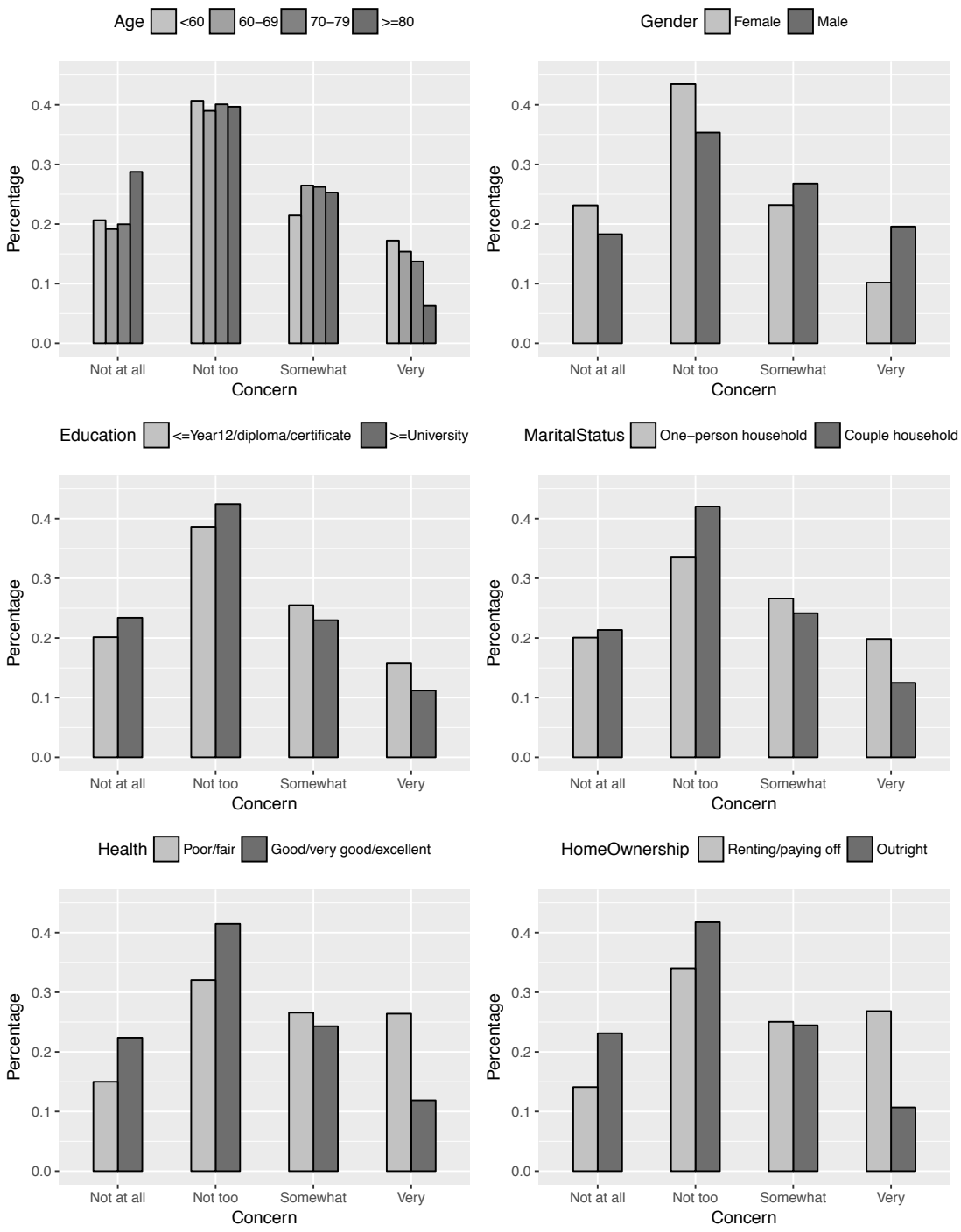
Appendix E: 3D plots of the classifications of financial concerns



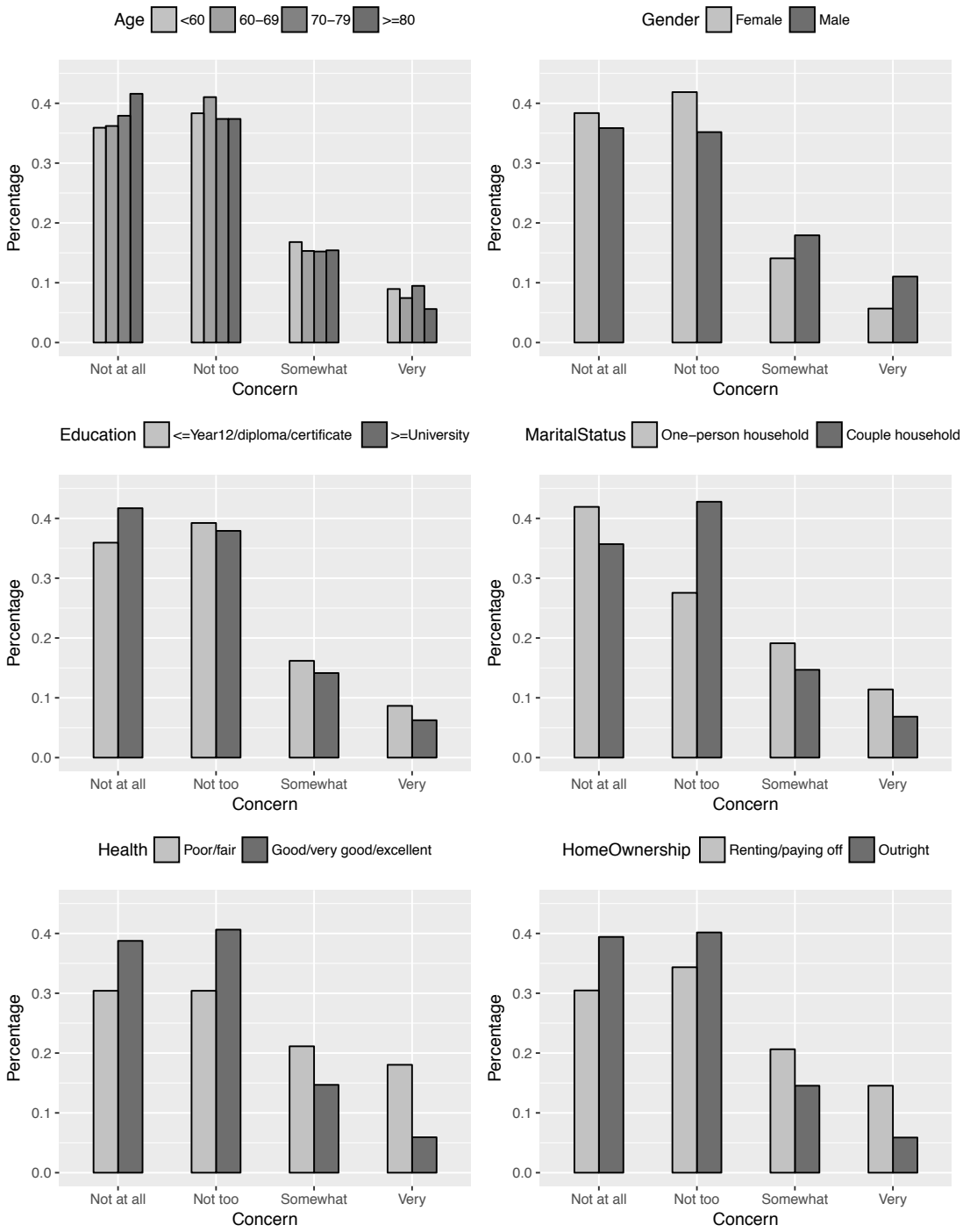
Appendix F1: Responses to concerns about long-term care (CN1) by demographics



Appendix F2: Responses to concerns about investment performance (CN2) by demographics



Appendix F3: Responses to concerns about current home ownership (CN3) by demographics



Appendix F4: Responses to concerns about insufficient bequest (CN4) by demographics

Appendix G: Frequency of professional consultation survey question

Q6.10: Individuals may consult with professionals to assist their financial decision-making. Professionals may include: accountants or taxation specialists, mortgage brokers, stock brokers, insurance brokers, bank managers or employees, or financial planners or advisers. How often, if at all, do you consult with any of these professionals to assist with your financial decision-making?

- Fortnightly, weekly or more often than weekly
- Monthly or quarterly
- About once a year
- About once every two years
- Every three years or less often
- Never