Keeping up with the Joneses

The impact of reference groups on the subjective financial well-being of Australian retirees

Nicholas Preston

November 2011

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Australian National University

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A thesis submitted in partial fulfilment of the requirements for the degree of Bachelor of Actuarial Studies with Honours in Finance at the Australian National University.

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any University, and, to the best of my knowledge and belief, contains no material published or written by another person, except where due reference is made in the thesis.

Nicholas Preston

4 November 2011

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Abstract

I find that retirees evaluate their subjective financial well-being relative to a reference group. Using endogenously created reference groups, I determine who retirees compare themselves with and how they are affected by these comparisons. Based on my evidence, education is the main consideration in retirees' social comparisons, but former occupation, area of residence and age also play a role. Consistent with relative deprivation theory, retirees who have less wealth than their reference group are more likely to have low subjective financial well-being, irrespective of their absolute level of wealth. I also show that the perceived adequacy of a given level of wealth is dependent on a retiree's life expectancy and whether they have previously experienced major investment losses or involuntary unemployment. Policy implications are discussed.

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1 Introduction

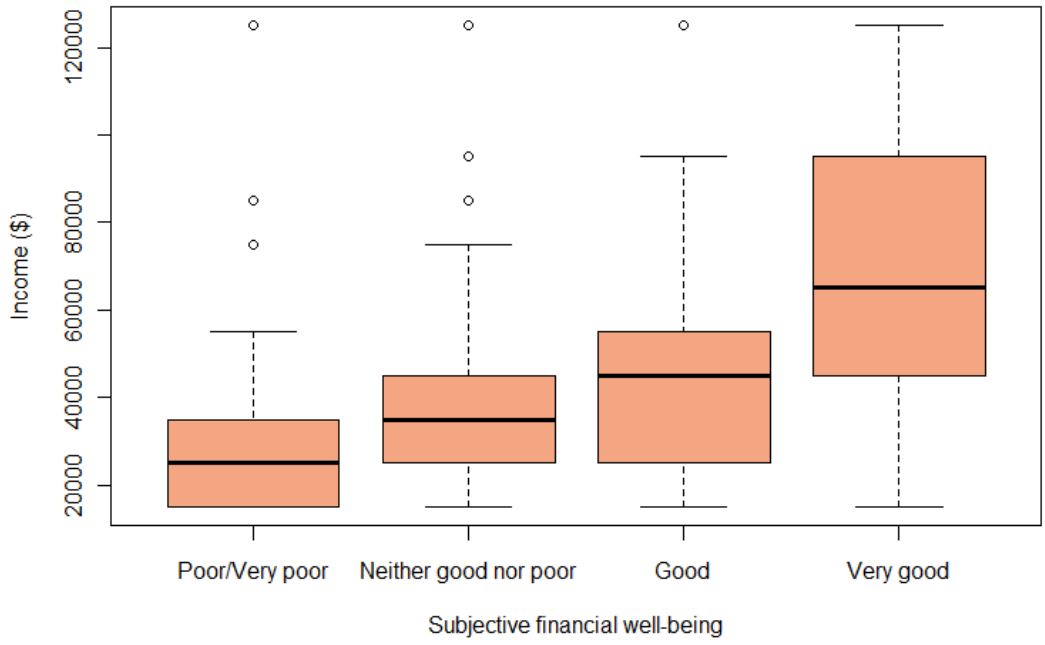
I use endogenously determined reference groups to show how social comparisons affect the subjective financial well-being (SFWB) of Australian retirees. The results indicate that individuals compare themselves with a reference group of 'people like them' – people with whom they share certain characteristics that are associated with social interactions and social comparisons, such as education, occupation, area of residence and age. Rather than pre-specifying distinct reference groups, I allow the model to identify the reference group structure that provides the best fit to the data. This not only demonstrates the existence of a reference group effect, it characterises the types of people retirees compare themselves with. The findings suggest that education is the main consideration in retirees' social comparisons, but former occupation, area of residence and age also play a role. Retirees with less wealth than their reference group are more likely to have low SFWB, irrespective of their absolute level of wealth. In addition, how a retiree evaluates a given level of wealth will depend on their life expectancy and whether they have previously experienced major investment losses or involuntary unemployment.

Financial well-being is an important factor in the overall quality of life of retirees. Ralston and Davis (2010) assert that 'financial wellbeing is about the adequacy of financial resources and support to meet reasonable expenditure needs without excessive concern' (p. 6). While income is an important determinant of financial well-being, there are many other factors that play a role. This claim is supported by Figure 1.1, which shows boxplots of the income distribution for households that report different levels of financial well-being.[1] While households with higher SFWB have higher incomes on average, the degree of overlap suggests that SFWB is more than simply a measure of income. A holistic approach to financial well-being considers both a household's sources of money (wealth and income)

[1] Based on the data presented in Chapter 5.

and its need for money (expenditure requirements specific to that household), as well as subjective influences (such as expectations formed on the basis of reference groups).

Figure 1.1. Boxplots of the income distribution for each level of subjective financial well-being



Such a holistic approach is generally not recognised in the growing body of literature on the determinants of happiness. While contributions come from different disciplines (mostly economics, psychology and sociology) and many different terms are used (happiness, subjective well-being, quality of life, life satisfaction, utility, subjective welfare),[2] most researchers attempt to answer the same question: what personal characteristics and circumstances lead people to be happy? One of the core areas of interest is the relationship between money and happiness. However, the vast majority of research into this relationship has only focused on income, rather than broader measures of financial well-being.

A thorough analysis of the money/happiness relationship should consider two distinct questions. First, what characteristics and behaviours are associated with financial well-being? Second, how important is financial well-being relative to other components of overall

[2] These terms are assumed to mean the same thing for the purposes of this thesis.

well-being? It is particularly important to use other measures of financial well-being in addition to income when evaluating the quality of life of older people. For example, the adequacy of a given level of income or wealth should be considered in the context of whether or not a person is retired and how much longer they expect to live.

The conceptual model proposed by Campbell, Converse and Rodgers (1976) for evaluating life satisfaction can be applied to financial well-being (Porter & Garman, 1993). According to this model, how an individual assesses a particular attribute of financial well-being (such as income, debt or rent) will depend on the standard against which they judge that attribute. This standard may be influenced by a number of factors including reference group levels, which Campbell, Converse and Rodgers (1976) describe as 'what he believes to be true of the situations of others with whom he identifies, such as friends and family or others of his income, race, or occupation' (p. 14).

Using data from a recent survey of older Australians,[3] I examine the household characteristics and circumstances that predict the SFWB of retirees. In particular, I measure the impact of reference groups using a new method that endogenously determines their composition. I also examine the role of savings in the SFWB of retirees and how wealth shocks influence their perceptions of wealth adequacy. The results may assist policy makers in understanding the determinants of financial well-being, giving them greater capability to improve the quality of life of retirees.

[3] Details of this survey are provided in Section 5.1.1.

2 Background

Financial well-being is important because of its role in overall well-being (or happiness). Accordingly, this chapter begins with an overview of the documented relationship between income and happiness (Section 2.1). This is followed by a discussion of what is known about the concept of relative deprivation and the effect of reference groups (Section 2.2), as well as other factors found to be associated with subjective financial well-being (SFWB) (Section 2.3). Finally, I identify how this thesis complements the existing literature (Section 2.4).

2.1 Can money buy happiness?

A major finding of the happiness literature is that relative income is a more important predictor of happiness than absolute income. Easterlin (1974) found that while there is a significant relationship between happiness and income within countries at a given time, this relationship is not observed between countries or across time. This observation has come to be known as the 'Easterlin paradox'. While there is debate about the accuracy of his specific findings (Stevenson & Wolfers, 2008), it is generally accepted that relative income plays an important role, particularly once income has reached a certain basic level (Boyce, Brown, & Moore, 2010; Clark, Frijters, & Shields, 2008; Diener, Sandvik, Seidlitz, & Diener, 1993; Easterlin, 2001, 2003; Frank, 2005; McBride, 2001). The utility an individual receives from a particular level of income is subject to changeable standards derived from expectancies, habituation levels and social comparisons (Campbell, et al., 1976; Clark, et al., 2008; Diener, et al., 1993). It can be concluded that people in different societies and at different points in time will have different perceptions about the adequacy of any given level of income.

2.2 Relative deprivation and the effect of reference groups

Not only will people frame their income in the context of the country they live in, but also in the context of reference groups within society. Such reference groups may affect an

individual's SFWB by creating feelings of relative deprivation. Runciman (1966) defines relative deprivation as the situation where a person does not have some good that others have, yet they desire that good and believe it to be realistically attainable. No matter how fortunate an individual's circumstances are, if they perceive those around them to be better off, they will consider themselves relatively deprived.

I first address some issues of language and research design. Some of the studies mentioned here model subjective well-being, rather than the more specific concept of subjective financial well-being. Since financial well-being is a component of overall well-being, reference group effects found in both types of studies are likely to reflect the same phenomenon. In addition, many authors do not use the term relative deprivation (one alternative is to view income as a positional good (Alpizar, Carlsson, & Johansson-Stenman, 2005; Carlsson, Johansson-Stenman, & Martinsson, 2007)).[4] This preference may be due to the implication that relative deprivation is an inherently asymmetric concept – those that are deprived of a certain good are more dissatisfied by its absence than those that have the good are satisfied by its presence. In the case of income, this asymmetry implies a different effect for those at the bottom of their reference group's income distribution compared to those at the top. While most studies choose to ignore this asymmetry, those that consider it tend to observe a much stronger reference group effect for those at the bottom of the income distribution (Boyce, et al., 2010; Card, Mas, Moretti, & Saez, 2010; Clark, et al., 2008; Duesenberry, 1949; Ferrer-i-Carbonell, 2005; Van Praag & Ferrer-i-Carbonell, 2008).

The most common method used to demonstrate the effect of reference groups is to model SFWB as a function of an individual's own income, as well as their 'comparison income'. This comparison income is intended to reflect the income of 'someone like them' and is calculated in a number of ways. One method is to first estimate a regression model of

[4] A positional good is one where the satisfaction it provides is partly derived from its scarcity or exclusivity. Regarding income, satisfaction is provided simply through having more income than others.

income using certain demographic characteristics, and then use the predicted values from this model as comparison income in a model of SFWB. Clark and Oswald (1996) and Delaney, Newman and Nolan (2006) identify significant reference group effects using this method. The most common approach, however, is to divide the sample into distinct reference groups on the basis of one or more characteristics. A person's comparison income is then usually defined as the mean income of their reference group. McBride (2001) finds a significant reference group effect based on five year age bands; Card, Mas, Moretti and Saez (2010) find that people have lower income satisfaction when their co-workers are paid more, and several authors find significant effects using geographic regions (both small local areas and broader regions) as reference groups (Graham & Felton, 2006; Knies, 2011; Knight, Song, & Gunatilaka, 2009; Luttmer, 2005; Ravallion & Lokshin, 1999, 2001, 2002; Stutzer & Lalive, 2004). Ferrer-i-Carbonell (2005) documents a significant effect based on the mean income of reference groups constructed by dividing her sample into 50 subgroups on the basis of five education categories, five age categories and two geographic regions. Clark, Frijters and Shields (2008) and Van Praag and Ferrer-i-Carbonell (2008) provide further surveys of the reference group literature. The segregation into distinct reference groups imposes the assumption that people compare themselves equally to all members of their reference group, and do not compare themselves to people outside this reference group (which is somewhat arbitrarily defined on the basis of demographic characteristics). Despite this relatively restrictive assumption, numerous studies have documented reference group effects on the basis of age, education and geographic areas.

A more flexible and theoretically rigorous framework for analysing reference groups is Van Praag and Ferrer-i-Carbonell's (2008) 'social filter theory', which draws on a range of earlier work (Hagenaars & Van Praag, 1985; Van de Stadt, Kapteyn, & Van de Geer, 1985; Van Praag, 1971; Van Praag & Kapteyn, 1973). Social filter theory assumes that an individual assigns a 'social weight' to each other member of society, and predominantly compares themselves with those to whom they have assigned a high weight. In this

formulation, all of society is considered to be in the individual's reference group, but some people carry more weight than others (and many people are likely to have little or no weight). Up to this point, the framework is general and intuitively appealing. However, further assumptions are required to allow the theory to be tested empirically. Van Praag and Ferrer-i-Carbonell's (2008) study provides a method for identifying reference groups, but does not measure the impact of reference group income on SFWB. They assume that an individual will assign weights on the basis of income, as well as their own 'focal point' and level of 'social myopia'. These quantities reflect the individual's perception of a typical income level and the width of the income distribution respectively. An individual will place high weights on people with incomes close to their focal point, and the weights placed on people far from their focal point depend on their social myopia. An individual's focal point and social myopia are influenced by their own income, as well as other demographic characteristics. The resulting weight distribution can be interpreted as representing a person's reference group. Van Praag and Ferrer-i-Carbonell (2008) find that individuals with higher incomes have higher focal points (they have wealthier people in their reference group), and individuals with more education tend to have less social myopia (their reference groups are broader). Social filter theory provides a general framework for considering reference groups, but in its current form it is not readily applied to measuring the impact of reference groups on SFWB.

The method presented in Chapter 4 of this thesis has some similarities with social filter theory. In particular, it assumes that people have indefinite reference groups where the prominence of each member is determined by a set of weights. Rather than determining these weights on the basis of income, I determine them on the basis of demographic characteristics (those that are identified in the literature to characterise reference groups). The relative importance of each of these characteristics is endogenously determined through the estimation of a model of SFWB. This simultaneously provides an estimate of who retirees compare themselves with and how they are affected by these comparisons.

Not only can people feel deprived relative to their reference group, they can also feel deprived relative to their past circumstances or the circumstances they feel they are entitled to. This effect may be particularly pronounced for retirees, who can no longer rely on their human capital to provide income. By asking respondents how their present circumstances compare with the past, several studies have found this type of relative deprivation to be associated with lower SFWB, particularly among older people (Clark, et al., 2008; Davis & Helmick, 1985; Hayo & Seifert, 2003; Hsieh, 2001, 2004; Liang & Fairchild, 1979; Liang, Kahana, & Doherty, 1980). Delaney, Newman and Nolan (2006) further demonstrate this effect using longitudinal data. In their study, households whose income had increased or stayed the same were more likely to report a high level of financial satisfaction than those whose income had declined (after controlling for current income). People are likely to have lower SFWB if they cannot maintain the standard of living they are accustomed to, regardless of how their current standard of living compares to others.

Forced retirement, either due to ill-health or job loss, can be a major factor in determining whether people are able to maintain their standard of living in retirement. Not only will it reduce the total amount of income earned (and saved), but it will also increase the number of years the retiree's savings must last. Barret and Kecmanovic (2011) and Bonsang and Klein (2011) find that experiencing a forced retirement is associated with lower reported levels of financial security and well-being. Experiencing a forced retirement, like other events that adversely affect retirement wealth, will influence the ability of retirees to maintain their accustomed standard of living in retirement.

2.3 Other correlates of subjective financial well-being

This thesis is primarily concerned with how different types of relative deprivation affect the SFWB of Australian retirees. However, it is important to consider these effects in the context of the other factors that contribute to the financial well-being of retirees.

Income, health and age are consistently identified as being important predictors of SFWB. SFWB is positively related to income and negatively related to health (both of which have clear direct effects on financial well-being). Most studies that consider samples covering the entire life-cycle find the relationship between SFWB and age to be either U-shaped (Hayo & Seifert, 2003; Headey & Wooden, 2004; Penn, 2009; Vera-Toscano, Ateca-Amestoy, & Serrano-Del-Rosal, 2006) or increasing (Delaney, et al., 2006; Hsieh, 2001). Accordingly, studies that focus solely on older people also find SFWB to be positively related to age (Hansen, Slagsvold, & Moum, 2008; Hsieh, 2004). However, this positive relation is likely to be partly due to the accumulation of assets and diminution of debt associated with ageing (Hansen, et al., 2008; Plagnol, 2011). Studies that include the effects of assets and debt find them to be significantly related to SFWB. In particular, Headey and Wooden (2004) claim that net wealth is a more important predictor of SFWB than income. The positive relation between age and SFWB that remains after controlling for accumulated wealth implies that older people are more satisfied with a given level of savings than younger people. Since the purpose of savings is to provide for future consumption, this observation is consistent with older people having less expected future consumption and, thus, requiring less savings to meet their lifetime consumption needs. To my knowledge, the only study to consider this directly is that of Mullis (1992), which uses a measure of wealth that includes the annuitised value of respondents' wealth (which is the annual amount of consumption their savings could provide if it were spent evenly for the remainder of their expected life). It is possible that age only affects SFWB indirectly through the evaluation of savings adequacy.

Many studies of SFWB report conflicting results regarding the effects of marital status and household composition. This is because these variables affect SFWB in a number of ways. For example, a married couple will have higher costs than a single person (although less than double due to economies of scale), but will have the added financial security of an additional wage earner (or pension recipient). This difference in expenditure needs is often controlled for through the use of equivalence scales, which adjust household income

according to household size and composition. There are a variety of different equivalence scales used, which make different assumptions about the economies of scale achieved by households of different sizes (Hsieh, 2004; Stewart, 2002, 2009; Van Praag & Ferrer-i-Carbonell, 2008). Of the studies that use equivalence scales, there is some consensus that married couples tend to have higher SFWB than single people (Headey & Wooden, 2004; Hsieh, 2004; Ravallion & Lokshin, 1999, 2002), and that people who have been widowed or divorced tend to have lower SFWB than those who were never married (Hsieh, 2004; Ravallion & Lokshin, 1999, 2001, 2002).

2.4 Contribution

I aim to contribute to the literature in two ways. First, I demonstrate a new method for measuring the relationship between reference groups and SFWB (or any other subjective measure of well-being). Unlike current approaches, this method does not require the ex-ante specification of distinct reference groups. By estimating a set of parameters that determine the structure of reference groups simultaneously with a cumulative link model of SFWB, I identify who retirees compare themselves with and how they are affected by these comparisons. Second, I provide further insight into the financial well-being of retirees: I present a new way of considering how savings and age affect SFWB, and examine how retirees are impacted by relative deprivation.

3 Hypothesis development

The hypotheses tested in this thesis have been selected to extend the findings of the literature on financial well-being to the context of Australian retirees, and to offer further insight into social comparisons and how they affect self-evaluation. Specifically, I hypothesise that:

1. subjective financial well-being (SFWB) is positively related to the value of assets and negatively related to debt (the assets and debt hypothesis, Section 3.1)
2. age is only related to SFWB indirectly through its role in the evaluation of savings adequacy (the mental annuitisation hypothesis, Section 3.2)
3. retirees suffer from relative deprivation as a result of certain adverse events leading to a lower standard of living than was previously experienced or expected (the wealth shock hypothesis, Section 3.3).

The final hypothesis, which is the main focus of this thesis, is that

4. retirees suffer from relative deprivation due to comparisons with a reference group, and these reference groups are formed on the basis of education, former occupation, area of residence and age (the reference group hypothesis, Section 3.4).

3.1 The assets and debt hypothesis

It is hypothesised that subjective financial well-being will be positively related to savings and housing wealth, and negatively related to having a mortgage or other personal debt. The few studies that have considered financial resources other than income have all found them to have a significant effect on SFWB. Indeed, Headey and Wooden (2004) claim that net worth is actually a stronger predictor of well-being than income. Hansen, Slagsvold and Mourn (2008) and Plagnol (2011) find that different types of assets and debt have different effects on financial satisfaction, concluding that it is important to treat these effects separately rather than simply considering net wealth. They postulate that the positive relation

between financial well-being and age observed in other studies can be partially explained by the accumulation of assets and diminution of debt. This thesis only considers retirees, whose varying income arrangements mean that reported income is unlikely to be a consistent and complete measure of financial resources (this issue is discussed in Section 5.5). It is important, therefore, to also consider measures of financial resources other than reported income.

Formally, the null and alternative forms of the assets and debt hypothesis are:

H_0^1: SFWB will not be positively related to savings and housing wealth, and not negatively related to having a mortgage or other personal debt.

H_A^1: SFWB will be positively related to savings and housing wealth, and negatively related to having a mortgage or other personal debt.

3.2 The mental annuitisation hypothesis

The next hypothesis posits that the primary effect of age on SFWB is through a process of mental annuitisation – retirees evaluate the adequacy of their savings based on the level of income those savings could provide over their remaining lifetime. Most studies have found SFWB to have either a positive or U-shaped relation with age (Delaney, et al., 2006; Hansen, et al., 2008; Hayo & Seifert, 2003; Hsieh, 2001; Penn, 2009; Vera-Toscano, et al., 2006). However, Hansen, Slagsvold and Moum (2008) and Plagnol (2011) argue that a large part of this effect can be explained by the accumulation of assets and diminution of debt as people get older. In addition, Plagnol (2011) found that the positive effect of assets on SFWB is stronger for older people. This could be due to the shortened life expectancy of older people, which means that there are fewer years that their savings are required to provide for. If people do evaluate the adequacy of their savings in the context of their life expectancy, then it is reasonable to consider the effect of the annuitised value of households' savings (the level of annual income that their savings could provide for their lifetime) as an

alternative to treating wealth and age as separate effects. Indeed, Mullis (1992) found that a measure of economic well-being that included annuitised net worth was a better predictor of psychological well-being than net wealth alone (even after controlling for age). The annuitisation method interacts savings and age in a non-linear way due to the time and mortality discounting of cash flows. The alternative of including a standard wealth × age interaction term, as in Plagnol (2011), is a more simplistic approach that does not accurately reflect the proposed relationship. It is hypothesised that age only effects SFWB indirectly through the mental annuitisation of savings. Specifically, after controlling for annuitised savings, age will not be related to SFWB.[5]

Formally, the null and alternative forms of the annuitised savings hypothesis are:

H_0^2: SFWB is related to age after controlling for annuitised savings.

H_A^2: SFWB is not related to age after controlling for annuitised savings.

3.3 The wealth shock hypothesis

It is hypothesised that experiencing a wealth shock in the form of significant investment losses or a forced retirement will cause people to report lower levels of FWB due to feelings of deprivation relative to their past or expected circumstances.

One aspect of relative deprivation theory states that people evaluate their current circumstances in the context of their past. For a given level of current income, an individual who had higher income in the past will consider themselves worse off than a similar individual whose income had been stable over time. Several studies find such relative deprivation effects in analyses of how people view their current economic circumstances relative to their circumstances in the past (Clark, et al., 2008; Davis & Helmick, 1985; Hayo

[5] Age could plausibly be related to SFWB through a generational effect – people of different generations may have different attitudes to wealth (for example, those alive during the depression may be more tolerant of a low income than those who were not). However, it seems unlikely that this will have a material effect and one study that considered the possibility of a generational effect using longitudinal data did not find a significant generational effect (Plagnol, 2011).

& Seifert, 2003; Hsieh, 2001, 2004; Liang & Fairchild, 1979; Liang, et al., 1980). In addition, Delaney, Newman and Nolan (2006) used longitudinal data to show that the time derivative of income is positively related to current financial satisfaction. This implies that for a given level of current income, people are more financially satisfied if their income has increased than if it has decreased or remained constant over time. Perceived deprivation relative to past self, as well as a decline in income, has been demonstrated to influence people's evaluations of their well-being.

Two specific types of adverse events that could cause retirees to experience a similar type of relative deprivation are considered in this thesis. Retirees who experience a 'wealth shock', such as a substantial reduction in the value of investment assets, will be required to adjust their consumption downward to reflect the lower annual income their savings can provide. Similarly, those who are forced to retire earlier than expected will experience a two-fold shock to their retirement income – not only will they accumulate less wealth due to lost earnings, their savings will be required to support a longer retirement (unless their retirement was due to an unexpected deterioration of health that also reduces their life expectancy).

Formally, the null and alternative forms of the wealth shock hypothesis are:

H_0^3: Having experienced major investment losses or a forced retirement in the last five years does not affect retirees' SFWB (after controlling for current income and wealth).

H_A^3: Having experienced major investment losses or a forced retirement in the last five years does affect retirees' SFWB (after controlling for current income and wealth).

3.4 The reference group hypothesis

Another aspect of relative deprivation theory states that people evaluate their own circumstances relative to those of a 'reference group'. The reference group hypothesis, which is the main focus of this thesis, consists of two parts. The first part postulates that an

individual's SFWB is negatively affected by deprivation relative to a reference group consisting of 'people like them'. The second part predicts that education, former occupation, area of residence and age will all be important factors in the composition of a retiree's reference group.

As discussed in Section 2.2, many studies find that reference groups affect people's subjective assessments. In particular, the income of an individual's reference group is shown to have a significant impact on their subjective financial and overall well-being. These studies tend to find that an individual's (financial) well-being is negatively related to their 'comparison income', which is a measure of the level of income typical of 'someone like them'. As predicted by relative deprivation theory, the observed effect tends to be asymmetrical – the disutility experienced from being below your comparison income is much greater than the utility gained from being above it (Boyce, et al., 2010; Card, et al., 2010; Clark, et al., 2008; Duesenberry, 1949; Ferrer-i-Carbonell, 2005; Van Praag & Ferrer-i-Carbonell, 2008).

It is expected that retirees who have wealthier reference groups will report lower levels of financial well-being, and this effect will be stronger for those whose own wealth is below what is typical of their reference group.

Formally, the null and alternative forms of the first part of the reference group hypothesis are:

$H_0^{4.1}$: SFWB is not negatively related to the wealth of a retiree's reference group.

$H_A^{4.1}$: SFWB is negatively related to the wealth of a retiree's reference group. This effect is more pronounced for retirees whose wealth is less than that of other members of their reference group.

The second part of the reference group hypothesis relates to the characteristics that determine the composition of an individual's reference group. It is reasonable to assume that

people compare themselves to those they consider to be peers. I consider four characteristics – education, occupation, place of residence and age (these correspond to characteristics identified in the literature to be related to reference group composition). In forming their reference groups, people will consider those who they have direct contact with, such as their former classmates, co-workers and neighbours, as well as broader perceptions of 'people like them' based on information gained through education, employment and the observation of people in their neighbourhood or region. This thesis will determine what combination and weighting of comparison characteristics yields the strongest reference group effect.

It is expected that education plays a major role in the determination of reference groups. This is because a person's level of education is readily measured and is a defining feature for many people, affecting their friendship circles, career trajectory and social awareness. It is also expected that geographic location is an important factor. Where you live has long been seen as an indicator of social status, made possible through the conspicuous nature of housing wealth. In addition, people living in metropolitan areas are likely to make different social comparisons to those living in rural areas. Age is also likely to shape people's reference groups. This is because people of different generations will have lived through different economic and social environments. They are more likely to relate to people of their own generation and the social comparisons they make will reflect this.

While occupation is likely to have a large influence on people's comparisons in reality, this may not be fully reflected in this research. In any empirical study, the observed reference group effect will depend on the ability of the data to reflect the actual social phenomenon. The broad occupation categories of the data set used for this thesis do not provide accurate reflections of social class or interaction (for example corporate executives, retail managers and farmers are all included in the same category). In addition, as this is a study of retirees, respondents are likely to have less contact with other members of their occupation than the

rest of the population. Despite this, occupation is still expected to play at least a minor role in the composition of the observed reference groups.

Formally, the null and alternative forms of the second part of the reference group hypothesis are:

$H_0^{4.2}$: Education, former occupation, place of residence and age will not all influence the composition of retirees' reference groups – one or more of them will be irrelevant in determining who retirees compare themselves with.

$H_A^{4.2}$: Education, former occupation, place of residence and age will all influence the composition of retirees' reference groups – they will all be important in determining who retirees compare themselves with.

4 Method

Cumulative link models with subjective financial well-being (SFWB) as the response are used to test the hypotheses developed in the previous chapter. This chapter begins with a review of cumulative link models (Section 4.1). This is followed by a description of the variable selection process and link functions used to test the assets and wealth, mental annuitisation, and wealth shock hypotheses (Section 4.2). The method for testing the reference group hypothesis is introduced in Section 4.3. This requires the calculation of a comparison wealth variable (Section 4.4) through the estimation of a number of parameters that determine the composition of households' reference groups (Section 4.5).

4.1 Cumulative link models

Cumulative link models are used in this thesis to investigate the relation between SFWB and various explanatory variables. A cumulative link model, also known as an ordinal regression model, is appropriate when the response variable consists of ordered categories. In this case the response is SFWB, which has categories 'Very good', 'Good', 'Neither good nor poor' and 'Poor/Very poor'. Common cumulative link models include the ordered probit, order logit (proportional odds) and complementary log-log (proportional hazards) models.

The functional form of a cumulative link model can be developed as follows. Suppose that an ordinal response variable Y has N ordered categories. Let π_{ij} denote the probability that the response of individual i falls into the jth category, and let γ_{ij} denote the corresponding cumulative probability that i falls into one of first j categories. This can be expressed symbolically as

$$\pi_{ij} = \Pr(Y_i = j) \quad \text{and} \quad \gamma_{ij} = \Pr(Y_i \leq j) = \pi_{i1} + \cdots + \pi_{ij}.$$

Now, let $g\colon (0,1) \to (-\infty, \infty)$ be a link function that maps probabilities to the real line. Cumulative link models assume that the transformed cumulative probabilities are a linear function of the explanatory variables, taking the form

$$g(\gamma_{ij}) = \alpha_j - x_i'\beta. \tag{1}$$

Here α_j is a constant that relates to the baseline probability of being in category j or below, x_i is the vector of observed values of the explanatory variables for individual i, and β is a parameter vector specifying the effect of the explanatory variables on the cumulative probabilities.

This formulation is equivalent to assuming the existence of a continuous unobserved latent variable and a set of thresholds that map it to the ordered categories of the observed response. Specifically, for the ordinal variable Y (with categories $1,2,\dots,N$), if Y^* is the corresponding continuous latent variable, and $\alpha_1, \dots, \alpha_{N-1}$ the thresholds, then

$$Y = \begin{cases} 1 & \text{if} \quad Y^* \leq \alpha_1 \\ 2 & \text{if} \quad \alpha_1 < Y^* \leq \alpha_2 \\ & \vdots \\ N & \text{if} \quad \alpha_{N-1} < Y^*. \end{cases}$$

It is assumed that the latent variable Y^* follows the linear model

$$Y_i^* = x_i'\beta + \varepsilon_i,$$

where the error term ε_i has cumulative distribution function (CDF) $F(\varepsilon_i)$.

From this it follows that

$$\gamma_{ij} = \Pr(Y_i \leq j) = \Pr(Y_i^* \leq \alpha_j) = \Pr(x_i'\beta + \varepsilon_i \leq \alpha_j) = F(\alpha_j - x_i'\beta),$$

which reduces to (**1**) if we choose the link function as the inverse CDF of the error term.

$$g(\gamma_{ij}) = F^{-1}(\gamma_{ij}) = \alpha_j - x_i'\beta.$$

The link function can thus be interpreted in two ways. First, as the transformation that

converts the linear combination of explanatory variables into predicted probabilities. And second, as specifying the error distribution of the underlying latent variable.

Different link functions correspond to different assumptions about the structure of the data and will provide different model fits.[6] Generalised link functions exist that can provide different functional forms depending on a parameter λ. The Aranda-Ordaz link function (Aranda-Ordaz, 1983), which is defined for $\lambda \in (0,1]$, equals the logit link when $\lambda = 1$ and approaches the log-log link as $\lambda \to 0$. The log-gamma link function (Genter & Farewell, 1985), which is defined for $\lambda \in [-1,1]$, equals the complementary log-log link when $\lambda = -1$, the probit link when $\lambda = 0$ and the log-log link when $\lambda = 1$. The logit and probit link functions are symmetrical, whereas the complementary log-log and most forms of the Aranda-Ordaz and log-gamma link functions are asymmetrical. An asymmetrical link function will favour either high or low response categories. In previous studies of subjective well-being, authors have tended to use only ordered probit models without discussing the appropriateness of their choice of link function. This research primarily uses the log-gamma and Aranda-Ordaz link functions due to their flexibility (the analysis is replicated using the more conventional probit and logit links for robustness). The choice of link function affects how the observed values of the explanatory variables are transformed to provide predicted probabilities of the response categories.

The `R` package `ordinal` (Christensen, 2011) allows the fitting of general cumulative link models by maximum likelihood estimation using the `clm` function.

4.2 Variable and link selection

The assets and debt, mental annuitisation and wealth shock hypotheses are tested by including the relevant variables in cumulative link models of SFWB. The variables of interest and criteria for rejecting each of the null hypotheses are described in Table 4.1.

[6] See McCullagh (1980) and McCullagh and Nelder (1989) for further discussion of link functions and cumulative link models.

Table 4.1: Criteria for rejecting null hypotheses

Hypothesis	Criteria for rejecting null hypothesis
Assets and debt	Savings, house value, mortgage and non-mortgage debt are significant predictors of SFWB.
Mental annuitisation	After controlling for annuitised savings, SFWB is not dependent on age and savings, and including savings and age as separate effects does not provide a significantly better model fit.
Wealth shock	SFWB is significantly and negatively related to indicators of whether the respondent (or their partner) lost employment involuntarily and whether their household suffered major financial losses from poor performing investments in the last five years.

Pecuniary quantities such as income, savings, house value and mortgage value are included in logged form and a range of control variables are also included in the models.[7] The full list of variables considered is provided in Section 5.2.

A number of different models are fitted to test these hypotheses. This is to ensure the results are robust to over-fitting and because testing the mental annuitisation hypothesis requires alternative variable combinations. First, a full model including all possible controls is estimated. However, this model is likely to suffer from over-fitting due to the large number of variables under consideration. To resolve this issue, a stepwise variable selection method based on the Akaike information criterion (AIC) is applied to generate a restricted model.[8] As no pre-existing stepwise variable selection methods exist for `clm` models in `R`, one was created specifically for this research. The algorithm also identifies the optimal link function to use at each iteration. It consists of repeating the following three steps until a stable model is reached:

[7] The practice of using logged values for these variables is consistent with the existing literature. Logs are taken because these variables tend to have skewed distributions, and increases and decreases are usually considered in percentage terms. In results not reported in this thesis, the logged variables always provide a better model fit than their unlogged equivalents.

[8] The AIC is a measure of relative goodness of fit that involves a trade-off between the likelihood function and the number of variables included in the model (with smaller models being preferred) (Akaike, 1974).

1. For each variable not currently included in the model, calculate the resulting AIC if it were to be included. Update the current model to include the variable that provides the greatest improvement (reduction) to the AIC. Maintain the current model if no new variable provides an improvement to the AIC.
2. For each variable currently included in the model, calculate the resulting AIC if it were to be removed. Update the model to exclude the variable whose omission provides the greatest improvement to the AIC. Maintain the current model if no improvement can be made by removing variables.
3. Identify the λ values that minimises the AIC for both the log-gamma and Aranda-Ordaz link functions. This is done using the `optimize` function in `R`. Update the current model by employing the optimal link function and λ.

The assets and debt, mental annuitisation and wealth shock hypotheses are tested by assessing the significance of the relevant variables in both full and restricted cumulative link models.

4.3 Reference group overview

The reference group hypothesis is tested by calculating each household's 'comparison wealth' and including it in a cumulative link model with SFWB as the response. Comparison wealth is defined as the median wealth of a household's reference group, where wealth is a composite measure of income and savings (see Equation (**2**)). An interaction with an indicator variable of whether the household's own wealth is above their comparison wealth is also included.

A major innovation of this thesis is that, unlike other studies, which typically create reference groups exogenously based on specific criteria, the structure of the reference groups considered in this thesis is endogenously determined. While it is assumed that the composition of a household's reference group depends on their education, occupation, age and where they live, these characteristics are not necessarily equally important. For the

model used in this thesis, the relative contributions made by these variables are specified by a set of parameters, which are estimated simultaneously with the standard model parameters by maximum likelihood estimation. This results in the set of parameters that correspond to the strongest relation between SFWB and the comparison wealth that is calculated from the resulting reference group.

The first part of the reference group hypothesis is confirmed if SFWB is significantly negatively related to comparison wealth, and the interaction term signifies that this effect is stronger for those whose own wealth is below their comparison wealth. The second part of the reference group hypothesis is tested through the parameter values associated with the variables that contribute to reference group formation. By endogenously creating reference groups, both the existence and nature of a reference group effect can be identified simultaneously.

Of the models described in Section 4.2, the one with the best AIC is used as the basis for testing the reference group hypothesis. Variables that are likely to determine people's social comparisons are not included in the model. These include education, occupation, age and neighbourhood characteristics.[9] Instead, these variables are used to calculate the comparison wealth variable.[10] Details of how comparison wealth is calculated are provided in Section 4.4.

A composite measure of wealth is used to simplify the analysis of the reference group effect. Wealth is defined as the weighted sum of log annuitised savings and log household income.

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[9] Any one of these variables may affect SFWB in multiple ways – possibly through both a social comparison effect and various direct effects. For example, a certain high status occupation might result in the person having a high standard to compare themselves against, but it may also have direct financial costs and/or benefits that are not reflected in other variables (such as free health or life insurance, or a car). If the resulting comparison wealth variable has much greater predictive power than the collection of separate variables, then it suggests that the comparison effect outweighs any direct effects.

[10] Including the variable both directly and indirectly (through comparison wealth) would compromise the interpretability of model coefficients.

Specifically,

$$wealth = v\log(annuitised\ savings) + (1 - v)\log(income), \quad (2)$$

where $v \in [0,1]$ is the value that maximises the likelihood function when the resulting wealth variable is included in the model in place of annuitised savings and income. Combining variables is a technique often used to remedy multicollinearity in regression models (McPherson, 2001). Since annuitised savings and income are correlated ($\rho = 0.61$), this is unlikely to lead to much loss of predictive power.[11] This formulation allows comparison wealth to be defined as the median wealth of a household's reference group (without having to consider income and savings separately). Savings and income are combined into a single measure of wealth that allows for consistent comparison between households' own wealth and their comparison wealth.

4.4 Calculation of comparison wealth

A household's comparison wealth is calculated as the weighted median wealth of their reference group. In this thesis, a household's reference group is not considered as a strict subset of the total population (where other households are either in or out of the reference group). Instead, it is considered as a weighting system where every other household in society receives a weight based on the level of social comparison. If household A compares themselves to household B more than household C, then household B will carry a greater weight in household A's reference group than household C. The level of comparison between two households, and the corresponding reference weights, will depend on how similar they are in terms of their education, occupation, age and where they live.[12] Once the

[11] Indeed, Table 6.1 shows that it results in an identical model likelihood as if the variables were left separate.

[12] As discussed in Section 2.2, the idea of considering reference groups as a weighting system is suggested by van Praag and Ferrer-i-Carbonell (2008). However, they assume that the weight distribution is predominantly determined by people's income rather than other demographic characteristics.

weights have been calculated based on these characteristics, comparison wealth is equal to the weighted median wealth of the entire sample.

The process for calculating comparison wealth is as follows. First, a distance function is defined to measure how 'similar' any pair of households are.

Let $x_i = \left(I_{uni},\ I_{yr\,12},\ SEIFA,\ I_{metro},\ I_{manager/professional},\ Age\right)^T$ be the vector of comparison characteristics of household i, where

- I_{uni} is an indicator of whether the respondent has a university degree
- $I_{yr\,12}$ is an indicator of whether the respondent finished year 12
- $SEIFA$ is the standardised SEIFA score of their postcode of residence[13]
- I_{urban} is an indicator of whether the ARIA score of their postcode classifies their location as 'Highly accessible'[14]
- $I_{manager/professional}$ is an indicator of whether the respondent or their partner were in the manager or professional occupation categories
- Age is the respondent's age or the average age of the respondent and their spouse if they have one.

A description of each of these variables is provided in Section 5.2. Due to computational limitations (which will become apparent in Section 4.5), it is not practical to include all levels of the education, occupation and ARIA variables.[15]

[13] To ensure that the variables are all of a similar order of magnitude, SEIFA scores are standardised to have mean 0 and standard deviation 1.
[14] This tends only to correspond to postcodes in major cities.
[15] Regression trees were used to determine which variable levels explained the greatest variation in wealth (for an overview of regression tree analysis, see Hastie, Tibshirani and Friedman (2008) p. 307). The results of this analysis guided the choice of indicator variables used. These results are not included here due to space constraints but are available on request.

The distance between household i and household j is given by the metric

$$d_{ij} = \sqrt{(x_i - x_j)^{\mathrm{T}} \Theta (x_i - x_j)}, \tag{3}$$

where

$$\Theta = \begin{pmatrix} \theta_{uni} & & & & & \\ & \theta_{yr\ 12} & & & 0 & \\ & & \theta_{SEIFA} & & & \\ & & & \theta_{urban} & & \\ & 0 & & & \theta_{manager/professional} & \\ & & & & & \theta_{age} \end{pmatrix}.$$

The set of households and d form a metric space that represents the structure of social comparison in society. The closer two households are in this space, the more they compare themselves to each other. The matrix Θ in Equation (**3**) acts to transform distances in a Euclidean space of household characteristics into distances in social comparison space where the Euclidean distance is used as the metric. For example, if $\theta_{uni} > \theta_{urban}$ then a pair of households that differ by university education are considered further apart, or less similar, than a pair of households who differ by whether they live in an urban area or not. This would suggest that education plays a greater role in determining social comparisons than urban accessibility does. The method for selecting the θ parameters is detailed in Section 4.5.

A set of comparison weights is now computed on the basis of this distance function. A given household will assign greater weights to nearby households than far away households in the social comparison space. As such, the weight assigned by one household to another should be a monotonically decreasing function of the distance between them. Not only should the function be decreasing, it should also possess three other properties. First, $\omega_{ij} \geq 0$ for all d_{ij}, this ensures no households receive negative weights. Second, $\omega_{ij} \to 0^{+}$ as d_{ij} becomes large, this ensures that very dissimilar households do not affect each other. Third, $\omega_{ij} \nrightarrow \infty$

as $d_{ij} \to 0$, this ensures that very similar households do not carry unreasonably large weights. These criteria suggest a negative exponential function may be appropriate.[16] As such, the raw weight assigned by household i to household j (which is the same as that assigned by j to i) is given by

$$\omega_{ij} = e^{-d_{ij}}.$$

These weights are then normalised so that each household's set of weights sum to one. The normalised comparison weight assigned by household i to household j is given by

$$\omega_{ij}{}' = \frac{w_{ij}}{\sum_{k \neq i} w_{ik}}.$$

A household's comparison wealth is the level of wealth that is typical of their reference group. This is defined as the weighted median wealth of the entire population (where households most similar to them receive the highest weight). This is calculated using the `weightedMedian` function in the `R` package `aroma.light` (Bengtsson, 2011).

For each household i, let W_i denote their wealth. The comparison wealth W_i^* of household i is given by

$$W_i^* = W_m,$$

for the m that satisfies

$$\sum_{j=1}^{m} \omega_{ij}{}' \leq 0.5 \leq \sum_{j=1}^{m+1} \omega_{ij}{}',$$

where the weights $\left(\omega_{ij}{}'\right)_j$ are indexed in order of increasing W_j.

[16] Other functions exist that also meet these criteria, but the specific choice of function is unlikely to have a material impact on the nature of the results.

The wealth variable is approximately normally distributed at the aggregate level.[17] This means that the mean and median of any reference group should be roughly equivalent. For the purposes of this analysis, the median is preferred since it is less susceptible to the effect of outliers. However, for robustness, results are checked against those obtained using the weighted mean.

4.5 Parameter estimation

The θ parameters in Equation (**3**) determine the extent to which different variables affect the composition of households' reference groups. These parameters are estimated by maximum likelihood estimation simultaneously with the standard model parameters. This is inherently a computationally expensive process as the model is now highly non-linear, making optimisation a difficult task. I am not aware of any efficient algorithms for maximising the likelihood function in such a setting.

An evolutionary algorithm is developed to address this optimisation challenge and identify the set of θs that maximise the likelihood function. The `optim` function in `R` provides a general tool for optimisation but can be sensitive to the initialisation values if the likelihood space has local maxima. An algorithm that iteratively performs a sequence of local optimisations with varying initialisation values overcomes this 'lumpiness'. In each iteration, initialisation values are randomly generated from a folded normal distribution around the optimal set of θ values identified so far. The variance of the random initialisation values is specified so that it is large for early iterations but diminishes as the algorithm identifies the region in the space that consistently contains the highest likelihood values. The θ parameters, which are estimated together with the model parameters, reflect the

[17] This can be demonstrated by a Q-Q plot of the wealth distribution against the standard normal distribution. This arises because income and annuitised savings are both approximately log-normally distributed, a fact that is observed in this sample and in other studies (such as van Praag and Ferrer-i-Carbonell (2008))

composition of household's reference groups and are used to test the second part of the reference group hypothesis.

4.6 Summary

The hypotheses presented in Chapter 3 are tested by fitting cumulative link models with SFWB as the response. The acceptance criteria for the hypotheses are as follows.

- The assets and debt hypothesis is accepted if savings, house value, mortgage and personal debt are significant predictors of SFWB.
- The mental annuitisation hypothesis is accepted if age is not significantly related to SFWB once annuitised savings is included in the model.
- The wealth shock hypothesis is accepted if the indicator variables relating to investment losses and forced retirement are found to be significant predictors of SFWB.

The reference group hypothesis is tested by including comparison wealth, which is the median wealth of a household's reference group, in the model. Comparison wealth depends on a set of parameters that are estimated simultaneously with the other model parameters. These parameters determine the extent to which reference groups are formed on the basis of education, occupation, age and area of residence.

- The first part of the reference group hypothesis is accepted if comparison wealth is a significant predictor of SFWB, and if this effect is stronger for households whose own wealth is below their comparison wealth.
- The second part of the reference group hypothesis is accepted if the θ parameters associated with education, occupation, area of residence and age signify that each of these variables influences reference group composition (all of the θs are significantly larger than zero).

The results of this analysis are presented in Chapter 6.

5 Data

Chapter 5 provides a description of the data used in this thesis. First, the data sources and collection method are described (Section 5.1). This is followed by notes and descriptions for each variable (Section 5.2). The treatment of missing values is explained in Section 5.3, followed by summary statistics of the final sample (Section 5.4). Finally some limitations of the data are discussed (Section 5.5).

5.1 Data sources

This thesis utilises data from four sources: a survey conducted by the ANU entitled *Expenditure needs, financial actions and financial wellbeing in later life*, the Socio-Economic Indexes for Areas (SEIFA), the Accessibility/Remoteness Index for Australia (ARIA), and the Australian Life Tables.

5.1.1 ANU survey

The main data source used in this thesis is a survey conducted jointly by the ANU and National Seniors Australia (NSA) entitled *Expenditure needs, financial actions and financial wellbeing in later life*.[18]

The survey was mailed to 15,000 NSA members in August 2010. The membership of NSA was stratified by age, sex and geographical location. A specific number of households were randomly selected from each of these divisions to reflect the demographic distribution of the broader Australian population. 3,485 households returned the survey, representing a response rate of 23%.

The main variable of interest, subjective financial well-being (SFWB), was measured by asking respondents 'How would you rate your current state of financial wellbeing (ranging

[18] The survey is part of an Australian Research Council Linkage Grant (LP0776784) with Rice Warner Actuaries and AMP as linkage partners.

from very good to very poor)?' on a 5-point scale. A wide range of other variables were collected including detailed demographic data, information about financial literacy and behaviour, and information about income sources and assets. The survey questions are not provided here due to space constraints but are available on request.

This thesis focuses on retired households. A household is considered retired when no member reports themselves as working full or part-time for pay, self-employed in own business, or unemployed but looking for full or part-time work. The sample of retired households used in this thesis consists of 1,590 observations, which is reduced to 1,054 once observations with missing values are omitted (see Section 5.3).

5.1.2 SEIFA

While other studies have simply used postcode or region in attempting to identify reference group effects, this thesis uses a measure of neighbourhood affluence based on respondents' postcodes. This allows comparisons to be made between postcodes and provides a robust variable for measuring geographic effects despite only having a relatively small number of observations in any given area. The Socio-Economic Indexes for Areas (SEIFA), produced by the Australian Bureau of Statistics (ABS) (2008), score each postcode in Australia by level of social and economic well-being. There are four different SEIFA indexes that use different measures of socio-economic status. The Index of Relative Socio-Economic Advantage and Disadvantage is used in this thesis because it provides the best representation of overall socio-economic status.

5.1.3 ARIA

Since living in urban areas involves a different style of living and different livings costs to rural areas, a remoteness variable based on respondents' postcodes is included in the analysis of SFWB. The measure used is the Accessibility/Remoteness Index for Australia (ARIA), which was developed by the Commonwealth Department of Health and Aged Care (2001) (now the Department of Health and Ageing). ARIA scores each postcode in Australia

by level of remoteness, defined as accessibility to certain goods, services and opportunities for social interaction.

5.1.4 Australian Life Tables

Mortality rates for males and females of different ages are used to create the annuitised savings variable (described in Section 5.2). The mortality rates used are from the 2005-2007 Australian Life Tables, which are published by the Australian Government Actuary (2009).

5.2 Variable descriptions

The variables considered in this thesis are described in Table 5.1.

Table 5.1: Variable descriptions

Variable	Notes
Subjective financial well-being (SFWB)	4 categories: 'Very good', 'Good', 'Neither good nor poor', 'Poor/Very poor'.
Income	Respondents reported their household income in one of 10 income bands. Midpoints were used to convert this to a numeric variable.[19] The modified OECD equivalence scale is applied to adjust income according to household size.[20]
Savings	Respondents reported their total savings (including investments, superannuation and property, but excluding the family home) in one of 10 bands. Midpoints were used to convert this to a numeric variable. The modified OECD equivalence scale is applied to adjust savings according to household size.

[19] The income of respondents who reported themselves in the lowest income band ($0-$20,000) was set to $15,000 rather than $10,000 since most of these households would receive the full age pension (which is at least $15,000). The income of respondents who reported themselves in the highest band ($100,000+) was set to $125,000.

[20] As discussed in Section 2.3, this controls for household economies of scale and is consistent with much of the literature (Hsieh, 2004; Stewart, 2002, 2009; Wilkins, Warren, Hahn, & Houng, 2011). The results presented in Chapter 6 are robust to using non-equivalised income and savings, as well as alternative equivalence scales. Using non-equivalised income and savings results in a slightly worse model fit and, as expected, changes the effect of marital status. Results are nearly identical when alternative equivalence scales are used.

Variable	Notes
Annuitised savings	The annuitised value of a household's equivalent savings, or the annual income level provided if their savings were converted to a life annuity.[21]
Wealth	A composite measure of income and savings – see Section 4.3.
Home ownership	4 categories: 'Own outright', 'Paying off', 'Renting', 'Other'.
House value	Value of family home if owned. Values below $80,000 are considered invalid and treated as missing.[22]
Mortgage	Mortgage value if they have a mortgage.
Rent	Weekly rent amount if renting.
Debt	Respondents reported total non-mortgage debt in one of 10 bands. Only 96 respondents reported having more debt than the lowest category ($0-25,000). Consequently, this variable is treated as an indicator of whether the respondent reports having more than $25,000 of non-mortgage debt.
Bequest	1 if the respondent intends to leave a bequest, 0 otherwise.
Age pension	3 categories: 'Full Age Pension', 'Part Age Pension', 'No'.
Marital status	4 categories: 'Single', 'Married/De facto', 'Widowed', 'Separated or divorced'.
Dependents	Number of financially dependent children (either within or outside the household).
Sex	
Age	Age of respondent or, if they have a partner, the average age of the respondent and their partner.

[21] This value assumes 5% interest, unimproved mortality from the 2005-2007 Australian Life Tables, no expenses, and level payments are made until both the respondent and their spouse (if they have one) die. Formally, each household's annuitised savings is computed as $\frac{S}{\ddot{a}}$, where S is the value of their savings and $\ddot{a} = \sum_{t=0}^{\infty} \frac{{}_tp}{(1+i)^t}$, where i is the interest rate and ${}_tp$ is the probability of at least one of the respondent and their partner surviving t years.

[22] It is likely that these respondents were reporting the purchase price rather than the current value, or they were only valuing the share they own (if they have a mortgage). The specific cut-off of $80,000 was chosen because it is consistent with the shape of the observed distribution and it roughly corresponds with the lowest plausible Australian house value.

Variable	Notes
Health	5 self-rated categories: 'Excellent', 'Very good', 'Good', 'Fair', 'Poor'.
Veteran	1 if the respondent has a veterans' affairs gold or white card, 0 otherwise.
Education	8 categories: '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'.[23]
Occupation	9 categories: 'Manager', 'Professional', 'Technician and trades worker', 'Community and personal service worker', 'Clerical and administrative worker', 'Sales worker', 'Machinery operator and drivers', 'labourer', 'Other'.[24]
SEIFA	The value of the SEIFA Index of Relative Socio-economic Advantage and Disadvantage for residential postcode.
ARIA	5 categories based on the respondent's postcode: 'Highly accessible', 'Accessible, 'Moderately accessible', 'Remote', 'Very remote'.
Involuntary loss of employment	1 if the respondent or their partner lost employment involuntarily in the last 5 years, 0 otherwise.
Investment loss	1 if household suffered major financial losses from poor performing investments in the last 5 years, 0 otherwise.

5.3 Treatment of missing values

A common problem with survey data is missing data due to respondents skipping questions or recording invalid answers. This tends to be particularly problematic for long, complex or personal surveys. Some missing values of the education and occupation variables are restored by recoding the value based on the text the respondent provided with the 'Other'

[23] Text responses were given by respondents who ticked the 'Other' category, these were recoded to one of the standard categories where appropriate.
[24] This is consistent with the Australian and New Zealand standard classification of occupations (Australian Bureau of Statistics, 2009).

category of some questions.[25] Observations with missing values for other variables are omitted from the analysis (with the exception of non-mortgage debt, which is discussed below). This provides a final sample of 1,054 valid observations from a total of 1,590 retired respondents.

It is generally undesirable to omit such a large proportion of the sample.[26] One alternative to simply discarding observations with missing values would be to use imputation to generate replacement values (Batista & Monard, 2003). However, this approach risks introducing considerable noise since many of the observations are missing two or more of SFWB, income and savings, which are the response and most important explanatory variables. After omitting cases with multiple important values missing, imputation would only provide around a 10% increase in sample size. This negligible improvement does not justify the use of imputation in this thesis.

Both the omission and imputation approaches to missing data risk introducing bias if data is not missing at random. It is possible that the data are not missing at random for some variables considered in this thesis. Variables with a large number of missing values are of particular concern. The only explanatory variables missing more than 5% of values are income (14%), savings (17%), non-mortgage debt (21%), education (10%) and occupation (12%). Of these, debt has the highest rate of non-response, and poses the greatest risk of being not missing at random and introducing bias. This is because respondents with no debt may have chosen to simply skip the question, rather than ticking the $0-$25,000 box (they had the option to select 'Don't know' or 'I do not want to answer this question'). If this is the case, then the true number of low debt (and presumably high SFWB) cases is understated, weakening the observed relation between debt and SFWB. To remedy this,

[25] For example, a respondent may have ticked the 'Other' box on the education question and written 'Matriculation', which until the 1970s referred to the completion of secondary school and eligibility to enter university. This would be recoded to the 'Year 12 or equivalent' category, avoiding it being treated as a missing value.

[26] For a discussion of the issues surrounding the treatment of missing data refer to Hastie, Tibshirani and Friedman (2008) p. 332.

rather than omitting observations with missing debt values, these observations are treated as having the median debt level ($0-$25,000) and an indicator for whether debt was missing is introduced. The income, savings and education questions are less likely to have this kind of systematic non-response, and any bias introduced by omitting observations based on these missing values is likely to be negligible. Once non-response bias in the debt variable has been controlled for, the treatment of missing values is unlikely to have a material effect on the conclusions of this thesis.

5.4 Summary statistics

The overall distribution of SFWB and each other categorical variable, as well as the observed proportions in each binary variable, is shown in Table 5.2. Summary statistics for numeric variables follow in Table 5.3. 'Good' is the most common level of SFWB, representing 50% of respondents. Most respondents own their own home, receive no or only a part pension, are married or in a de facto relationship, have good or very good health, and live in an urban area. The most common level of educational attainment is a university degree (31%) and the most common occupation category is professional (in 46% of households either the respondent or their spouse was a professional).

Table 5.2: Distribution of categorical and binary variables

Variable	Proportion in each category[27]			
SFWB	Poor/ Very poor	Neither good nor poor	Good	Very good
	8%	26%	50%	16%
Home ownership	Own outright	Paying off	Renting	Other
	89%	4%	4%	4%
Age pension	Full pension	Part pension	None	
	19%	38%	43%	

[27] Values may not sum to exactly 100% due to rounding.

Variable	Proportion in each category[27]				
Marital status	Single	Married/ De facto	Widowed	Separated	
	8%	66%	17%	8%	
Health	Poor	Fair	Good	Very good	Excellent
	5%	20%	30%	36%	9%
Education	University degree or higher	Trade certificate or apprenticeship	Other certificate or diploma	Year 12 or equivalent	Year 10 or 11
	31%	10%	26%	11%	15%
	Year 9 or below	Never attended school[28]	Other[29]		
	7%	0%	0%		
Occupation[30]	Manager	Professional	Technician and trades	Community and personal service	Clerical and admin
	19%	46%	15%	7%	34%
	Sales	Machinery operator and drivers	Labourer	Other	
	8%	2%	5%	1%	
ARIA	Very remote/ Remote	Moderately accessible	Accessible	Highly accessible	
	1%	3%	12%	84%	
Non-mortgage debt	More than $25,000	Not reported			
	12%	18%			
Last 5 years	Involuntary loss of employment	Significant investment losses			
	3%	20%			
Other binary variables	Male	Intend to leave bequest	Veteran		
	58%	94%	7%		

[28] Only one respondent selected 'Never attended school'.
[29] Only two of the respondents that selected 'Other' could not be recoded to another category.
[30] The occupation categories sum to more than 100% because households are considered to be in both categories if the respondent and their spouse had different occupations.

Table 5.3: Summary statistics for numeric variables

Variable	Median	Mean	Standard deviation	Min	Max
Income (equivalent $)	30,000	34,876	21,258	8,333	125,000
Savings (equivalent $)	223,810	305,145	297,312	6,944	1,250,000
Annuitised savings (equivalent $)	17,358	28,207	32,738	395	270,464
Wealth[31]	10.1	10.0	0.8	8.0	12.0
House value ($)	450,000	520,857	475,924	0	9,000,000
Mortgage ($)	0	3,524	26,842	0	370,000
Rent ($/wk)	0	9	47	0	465
Dependents	0.0	0.1	0.3	0.0	5.0
Age	72	72	8	46	92
SEIFA	1010	1020	81	832	1214

The correlations between selected variables are shown in Table 5.4, with darker shading representing higher correlation. Multicollinearity does not appear to be a major concern since the only explanatory variables that are highly correlated ($|\rho| > 0.5$) are income, savings, wealth and the age pension. While the coefficients of these variables are to be interpreted with caution, multicollinearity is unlikely to have a significant influence on the models used in this thesis.

[31] As detailed in Section 4.3, the wealth variable corresponds to a weighted average of the logs of a household's income and annuitised savings. A 10% increase in both income and savings roughly corresponds to increasing wealth by 0.1.

Table 5.4: Correlation matrix

	SFWB	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Income	0.42											
(2) Savings	0.50	0.67										
(3) Annuitised savings	0.44	0.61	0.88									
(4) Wealth	0.55	0.79	0.84	0.77								
(5) House value	0.18	0.31	0.35	0.30	0.34							
(6) Age pension[32]	-0.38	-0.53	-0.58	-0.48	-0.60	-0.23						
(7) Dependents	-0.08	-0.10	-0.09	-0.08	-0.15	-0.02	-0.06					
(8) Age	0.07	-0.05	-0.07	0.22	0.07	0.06	0.22	-0.11				
(9) Health[33]	0.23	0.12	0.17	0.07	0.15	0.06	-0.06	-0.02	-0.08			
(10) Education[34]	0.05	0.20	0.16	0.11	0.23	0.13	-0.17	-0.02	0.04	0.11		
(11) SEIFA	0.12	0.24	0.23	0.25	0.28	0.31	-0.19	-0.01	0.18	0.03	0.18	
(12) ARIA	0.03	0.06	0.02	0.02	0.05	0.09	-0.04	0.04	0.02	0.01	0.08	0.38

[32] For the purposes of calculating the correlations presented here, the age pension categories were set to 1 for 'No', 2 for 'Part Age Pension' and 3 for 'Full Age Pension'.
[33] For the purposes of calculating the correlations presented here, the health variable was assigned values 1 ('Poor') to 5 ('Excellent').
[34] For the purposes of calculating the correlations presented here, education was assigned values 1 ('Never attended school') to 8 ('University degree of higher').

5.5 Data limitations

In addition to the issue of missing data discussed in Section 5.3, there a number of other limitations of the data used in this thesis. Despite efforts to collect a representative sample, there is likely to be some selection bias in the data. There are also a number of unfortunate consequences of the survey design that render some of the data ambiguous or impractical. While noteworthy, these limitations are unlikely to affect the nature of the results obtained.

There is likely to be some selection bias due to the selection process for survey recipients. The 15,000 NSA members that received the survey were selected to be representative of the Australian population aged 55 and over on the basis of age, sex and geography. Higgins and Roberts (2011) show that the eventual sample of returned surveys is a reasonable representation of the population. The greatest discrepancies between the survey sample and ABS population statistics were observed in the younger age groups, most of whom are not retired and, therefore, not considered in this thesis. The fact that respondents are members of NSA may also introduce some bias since there are fees associated with NSA membership. Specifically, low income households may be less likely to be NSA members. While this may bias the data collected, it is unlikely to have a significant impact on the conclusions of this thesis since the hypothesised effects are likely to be present across all divisions of society.

The quality of the data collected from any survey question relies on all respondents reading and interpreting the question in a consistent way. A number of the variables considered in this thesis are likely to suffer from respondent inconsistencies. First, some respondents may simply have misread certain questions. For example, some respondents may have included the value of their mortgage in their amount of debt (even though the question asks for the amount excluding any mortgage), and some respondents recorded their occupation as 'Other' and wrote 'retired' (even though the question asked them what their occupation was for the majority of their paid working life). Second, and more importantly, there is likely to be inconsistency in the way respondents reported their income and savings. This is due to

the variety of financial arrangements and retirement products available to retirees. For example, a person with an account based pension might draw down a fixed amount of their total balance each year to fund consumption. Some retirees might report this as income, whereas others might only view it as the expenditure of savings. Data was collected on income sources available to each household. This data could foreseeably be used to modify reported income amounts to reflect reporting patterns associated with different income sources. However, such an exercise is beyond the scope of this thesis. While there may be discrepancies between individual respondents, it is reasonable to assume that in general wealthier households are more likely to report higher levels of income and savings. As long as this assumption holds then the results of this thesis retain their validity.

6 Results

The estimated models generally support the hypotheses considered in this thesis. Specifically, the model results are as follows.

1. Subjective financial well-being (SFWB) is positively related to savings and negatively related to the presence of debt (Section 6.1).
2. Retirees evaluate the adequacy of their savings by considering the lifetime income it can provide, rather than the absolute amount. This means that older retirees are more satisfied with a given level of savings than younger retirees (Section 6.2).
3. Wealth shocks, such as forced retirement or major investment losses, cause retirees to suffer from relative deprivation as a result of comparisons with their former lifestyle. Retirees that used to be wealthier require a higher level of wealth to be satisfied than those that have not experienced a decline in wealth (Section 6.3).
4. Retirees whose own wealth is lower than that of their reference group suffer from relative deprivation due to social comparisons (Section 6.4). Education is the main consideration in retirees' social comparisons, but former occupation, area of residence and age also play a role (Section 6.5).

The chapter concludes with a comparison of the different effects predicted by the model (Section 6.6). A discussion of a number of robustness measures is included in Appendix A.

Three specifications of the restricted model (the model resulting from the variable selection process described in Section 4.2) are used to demonstrate the first three of the results above. The outputs of these models are presented in Table 6.1 (the outputs of the full models are included in Appendix B). Model (1) includes savings and age as separate effects, model (2) combines them through the inclusion of annuitised savings and model (3) combines income and annuitised savings into a single variable – wealth. The table contains the model coefficients associated with each explanatory variable (the βs described in Section 4.1,

which are analogous to the usual regression coefficients). A positive coefficient implies that the corresponding variable is positively related to the probability of having high SFWB.

The link function found to maximise the likelihood of the model is a log-gamma link with $\lambda = -0.165$, which has a functional form very similar to that of the probit link but is slightly skewed to favour higher values of SFWB.

6.1 Assets and debt

Having more assets and less debt significantly improves financial well-being. In particular, savings is a highly significant predictor of SFWB in all specifications.

A means of understanding the results of the models is to look at the predicted probabilities of belonging to each SFWB category (Very good, Good, Neither good nor poor, and Poor/Very poor). Figure 6.1 shows how these probabilities vary with savings for three levels of income.[35] At each income level, it is clear that higher savings increases the probability of a household having high SFWB. However, the differences between the low and high income households suggest that high savings alone is not sufficient to ensure a high SFWB.

House value does not have a significant effect on SFWB and was not selected by the stepwise variable selection process. This may reflect the illiquid nature of housing wealth or that established households often do not view the family home as a financial resource. Despite house value apparently not affecting SFWB, the effect of savings indicates the importance of assets to the financial well-being of retirees.

[35] These households are otherwise identical with all other variables set to the median value. Their respective incomes are the minimum, median and maximum equivalent incomes of the sample. The predicted probabilities are generated using model specification (1).

Table 6.1: Results of cumulative link models of SFWB – restricted models

	Savings and age as separate effects	Savings and age combined to form annuitised savings variable	Income and annuitised savings combined to form wealth variable
	(1)	(2)	(3)
Income (log)	0.585***	0.574***	
	(0.082)	(0.082)	
Savings (log)	0.349***		
	(0.036)		
Age	0.014***		
	(0.005)		
Annuitised savings (log)		0.351***	
		(0.036)	
Wealth			0.925***
			(0.061)
Mortgage indicator	-0.338	-0.351*	-0.351*
	(0.207)	(0.206)	(0.205)
Debt missing value indicator[36]	0.221**	0.222**	0.222**
	(0.094)	(0.092)	(0.092)
Bequest	0.297*	0.301*	0.301*
	(0.156)	(0.156)	(0.156)
Age Pension			
None/Part Age Pension	(base category)	(base category)	(base category)
Full Age Pension	-0.282***	-0.275***	-0.275***
	(0.105)	(0.103)	(0.103)
Marital status			
Single/Married or De facto/Widowed	(base category)	(base category)	(base category)
Separated	-0.236*	-0.278**	-0.278**
	(0.131)	(0.130)	(0.130)
Health			
Excellent/Very good	(base category)	(base category)	(base category)
Good/Fair	-0.261***	-0.261***	-0.261***
	(0.074)	(0.073)	(0.073)
Poor	-0.848***	-0.855***	-0.855***
	(0.180)	(0.180)	(0.180)
Veteran	0.218	0.204	0.204
	(0.142)	(0.141)	(0.141)

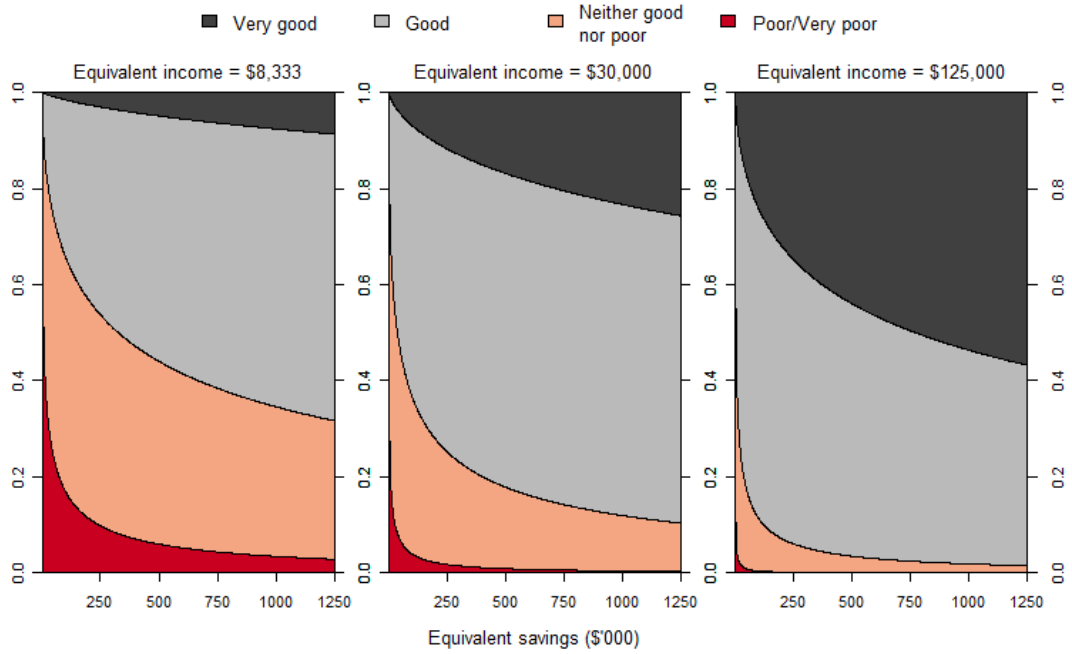
[36] This is an indicator of whether the respondent did not answer the question regarding non-mortgage debt.

	Savings and age as separate effects	Savings and age combined to form annuitised savings variable	Income and annuitised savings combined to form wealth variable
	(1)	(2)	(3)
Education			
Year 12 or below	(base category)	(base category)	(base category)
University degree or higher/Trade certificate or apprenticeship/Other certificate or diploma	-0.266*** (0.083)	-0.258*** (0.083)	-0.258*** (0.083)
Occupation: Professional	0.133* (0.078)	0.136* (0.078)	0.136* (0.078)
SEIFA (standardised)	-0.103** (0.042)	-0.098** (0.041)	-0.098** (0.041)
ARIA			
Highly accessible	(base category)	(base category)	(base category)
Very remote/Remote/ Moderately accessible/ Accessible	-0.207* (0.107)	-0.203* (0.107)	-0.203* (0.107)
Involuntary loss of employment	-0.487** (0.213)	-0.519** (0.210)	-0.519** (0.209)
Investment losses	-0.549*** (0.088)	-0.543*** (0.088)	-0.543*** (0.088)
Threshold 1	9.155 (0.870)	7.255 (0.779)	7.255 (0.608)
Threshold 2	10.511 (0.880)	8.608 (0.787)	8.608 (0.620)
Threshold 3	12.405 (0.900)	10.503 (0.806)	10.503 (0.642)
Number of observations	1054	1054	1054
Log-likelihood	-997.3	-997.6	-997.6
AIC	2034.5	2033.2	2031.2
Link function		Log-gamma	
λ		-0.165	

Standard errors are reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels respectively. Significance levels have not been adjusted to reflect the selection bias inherent in the stepwise variable selection process.[37]

[37] For a discussion of this problem see Foster and Stine (2004). Potential remedies include bootstrapping or using a holdout sample, or the p-values could be adjusted using a Bonferroni correction. However, given the significance levels of the main variables of interest, these adjustments are unlikely to affect the conclusions of this thesis.

Figure 6.1: Stacked predicted probabilities of each SFWB category by level of savings for a low, medium and high income household



The results provide some support for the hypothesis that debt is negatively related to SFWB, but are not conclusive. This aspect of the hypothesis was tested through the consideration of four variables – an indicator of whether households have a mortgage, the value of that mortgage, an indicator of whether they have other debt in excess of $25,000, and whether they did not answer the question regarding debt. The mortgage indicator and debt non-response indicator were identified by the stepwise variable selection process as potentially explaining some of the variability in SFWB. The coefficient estimates suggest that the presence of a mortgage is associated with lower SFWB and skipping the debt question is associated with higher SFWB. However, the small proportion of the sample with considerable debt and the data issues discussed in Section 5.3 limit the capacity of this analysis to identify a significant effect. Consequently, these results are not conclusive and the magnitude of the effect suggested by the model output should be treated with caution. The coefficient on the presence of a mortgage, while negative and relatively large, does not have a high degree of statistical significance in the models presented in Table 6.1. This low level of significance is partly due to the fact that less than 4% of the sample reported having

a mortgage. Interestingly, the indicator of whether debt was not reported is a greater predictor of SFWB than debt itself. A plausible explanation of this is that households with no debt chose to skip the question rather than ticking the $0-$25,000 box.[38] If this is assumed to be the case then the results suggest that having no debt is associated with higher levels of SFWB.

The assets and debt hypothesis is partially supported by the results presented in Table 6.1. While housing wealth is not a significant predictor of SFWB, there is a very strong relationship between SFWB and savings. The results also suggest that SFWB may be negatively related to the presence of a mortgage or other debt. However, the precise impact of debt is difficult to determine using the available data.

6.2 Mental annuitisation

The results suggest that people engage in mental annuitisation when evaluating their savings. That is, they consider the lifetime income their savings could provide, rather than the total value of their savings (thus an 85 year old will be more satisfied with a given level of savings than a 65 year old).[39] A comparison of the models presented in Table 6.1 suggests that age is not significantly related to SFWB beyond its role in the annuitisation of savings. Column (1) presents the model where age and savings are included as separate effects, column (2) presents the model where they are combined to determine the annuitised value of savings. Both models have very similar overall predictive power (as measured by log-likelihood) despite model (2) not directly including age as an explanatory variable. Age is

[38] Recall from Section 5.3 that if an observation was missing a value for debt, it was assumed to be in the $0-$25,000 band (as well as having a value of 1 for the missing indicator). The fact that the missing indicator was significant but the debt > $25,000 indicator was not suggests that people who did not respond are not simply a random sample of the population in the $0-$25,000 debt band. This is consistent with the assumption that $0 debt households may skip the question, whereas households with some debt (but less than $25,000) tick the $0-$25,000 box. Respondents could also select 'Don't know' or 'I do not want to answer this question', very few selected these options and such observations were discarded from the sample.

[39] This analysis does not directly consider the effect of any bequest motive. However, the indicator of bequest intention received a positive sign in Table 6.1, suggesting that the intention (or perceived obligation) to leave a bequest does not negatively impact SFWB. This effect is discussed further in Appendix A.

not related to SFWB once annuitised savings is included in the model. This is indicated by the rejection of age in the stepwise variable selection process. Indeed, if age is added to model (2) it receives a p-value of 0.637, confirming that it is not a significant predictor of SFWB once savings have been annuitised (none of the other coefficients are significantly affected by its introduction). These results support the mental annuitisation hypothesis that retirees evaluate the adequacy of their savings in the context of their life span, rather than simply considering the absolute amount.

The relationship between age, savings and financial well-being could be an important consideration for certain government policies. One example of this is the assets test for the Age Pension, which currently determines the level of benefits a retiree receives based on the total value of their assets (excluding the family home). If a retiree's financial well-being depends on the annuitised value of their savings, rather than the absolute amount, then the current structure of the asset test favours older retirees. The test could be modified so that younger retirees are subject to lower asset thresholds than older retirees. As with any government policy, any equity benefits that may arise from such a modification would need to be evaluated in the context of other considerations such as the associated administrative costs.

6.3 Wealth shocks

Experiencing a forced retirement or substantial investment losses significantly increase a household's probability of having low SFWB, even after controlling for current income and savings. This is demonstrated by the highly significant negative coefficients on these variables in each of the models shown in Table 6.1. The fact that such wealth shocks have a significant impact on SFWB in excess of the predicted effect of lower wealth is consistent with relative deprivation theory. These retirees feel deprived relative to their past circumstances, regardless of their ultimate level of wealth. This is demonstrated in Figure 6.2, which shows the relation between SFWB and wealth for a household that has suffered

major financial losses and one that has not (based on model (3)). A typical household with median wealth (the left panel) has a 72% probability of reporting their SFWB as 'Good' or 'Very good', whereas the corresponding probability for an otherwise identical household that has suffered major financial losses (the right panel) is only 51%.[40] When a retired household experiences a wealth shock, they not only lose spending power, but they also suffer from the psychological effect of relative deprivation, which makes them feel worse off as a result of comparing their current and former lifestyles.

Figure 6.2: Stacked predicted probabilities for each SFWB category by level of wealth for a household that has not suffered major financial losses and one that has

The effect of wealth shocks on SFWB highlights the importance of people reducing their investment risk in retirement. The relative deprivation brought about by investment losses, particularly for retirees who can no longer rely on their human capital for income, essentially magnifies the downside risk of any investment in utility terms. Like investment losses, the involuntary loss of employment can have a significant impact on the SFWB of retirees. While preventing redundancy is not as simple as adjusting asset allocation, the consequences

[40] A 'typical household' is defined as a household whose characteristics correspond to the median value of each variable.

of involuntary unemployment for older workers should be recognised by employers and policy makers. Wealth shocks can create feelings of relative deprivation compared to past or expected circumstances, and can have a significant impact on financial well-being in retirement.

6.4 The reference group effect

The wealth of a retiree's reference group has a significant effect on their SFWB. The results of the models that test the reference group effect are presented in Table 6.2. The model with comparison wealth included (model (4)) provides a significantly better fit (as measured by log-likelihood) than the model with education, occupation, SEIFA and ARIA included as separate effects (model (3), which is repeated from the Table 6.1 for comparison).[41] To interpret these results, the coefficient of the comparison wealth variable should be considered in conjunction with the coefficient of the interaction between comparison wealth and the indicator of whether own wealth is greater than comparison wealth. There is a significant negative relationship between SFWB and comparison wealth. However, this is offset by the interaction term for households whose own wealth is above their comparison wealth. This suggests that households at the top of the wealth distribution for their reference group are not discernibly affected by their peers' wealth, whereas those at the bottom suffer from relative deprivation. This conclusion is consistent with the first part of the reference group hypothesis.

[41] Model (3) includes slightly different forms of the education and occupation variables to those used to calculate comparison wealth. The model where the exact variables used to calculate comparison wealth are included in the usual way (instead of through the comparison wealth variable) has a log-likelihood of -996.8 and an AIC of 2035.7, demonstrating that the naive inclusion of these variables does not achieve as good a fit as the comparison wealth approach of model (4), which has a log-likelihood of -992.8 and an AIC of 2019.6.

Table 6.2: Results of cumulative link models of SFWB – restricted model with comparison wealth included

	Comparison wealth not included	Comparison wealth included
	(3)	(4)
Wealth	0.925***	0.891***
	(0.061)	(0.088)
Comparison wealth		-0.938***
		(0.206)
$\theta_{uni} = 274.998$		
$\theta_{yr\,12} = 164.005$		
$\theta_{SEIFA} = 1.381$		
$\theta_{urban} = 0.290$		
$\theta_{age} = 0.0330$		
$\theta_{manager/professional} = 0.706$		
Indicator of whether wealth > comparison wealth		-11.705***
		(2.680)
Comparison wealth * indicator		1.171***
		(0.266)
Mortgage indicator	-0.351*	-0.408**
	(0.205)	(0.205)
Debt missing indicator	0.222**	0.249***
	(0.092)	(0.092)
Bequest	0.301*	0.309**
	(0.156)	(0.156)
Age Pension		
None/Part Age Pension	(base category)	(base category)
Full Age Pension	-0.275***	-0.326***
	(0.103)	(0.104)
Marital status		
Single/Married or De facto/Widowed	(base category)	(base category)
Separated	-0.278**	-0.254**
	(0.130)	(0.130)
Health		
Excellent/Very good	(base category)	(base category)
Good/Fair	-0.261***	-0.258***
	(0.073)	(0.073)
Poor	-0.855***	-0.836***
	(0.180)	(0.180)
Veteran	0.204	0.215
	(0.141)	(0.141)

	Comparison wealth not included	Comparison wealth included
	(3)	(4)
Education		
Year 12 or below	(base category)	
University degree or higher/ Trade certificate or apprenticeship/ Other certificate or diploma	-0.258*** (0.083)	
Occupation: Professional	0.136* (0.078)	
SEIFA (standardised)	-0.098** (0.041)	
ARIA		
Highly accessible	(base category)	
Very remote/Remote/ Moderately accessible/Accessible	-0.203* (0.107)	
Involuntary loss of employment	-0.519** (0.209)	-0.566*** (0.208)
Investment losses	-0.543*** (0.088)	-0.514*** (0.088)
Threshold 1	7.255 (0.608)	-2.323 (1.949)
Threshold 2	8.608 (0.620)	-0.973 (1.947)
Threshold 3	10.503 (0.642)	0.945 (1.949)
Number of observations	1054	1054
Log-likelihood	-997.6	-992.8
AIC	2031.2	2019.6
Link function	Log-gamma	
λ	-0.165	

Standard errors are reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels respectively. Significance levels have not been adjusted to reflect the selection bias inherent in the stepwise variable selection process.

This reference group-based relative deprivation effect means that an increase in one household's wealth creates a negative externality for those around them. The model suggests that this externality is so great that households with low wealth relative to their reference group perceive no improvement to their financial well-being when their reference group's and their own wealth increase by the same amount. Improving the financial well-being of retirees is an increasingly prominent issue given the onset of retirement for the baby-boomer generation and the inadequacy of many households' retirement savings. Many government policies, particularly those relating to superannuation and the Age Pension, are designed with this goal in mind. However, the results presented here suggest that the effectiveness of these policies at improving a given household's financial well-being depends not only on how they impact that household's wealth, but also on how they impact the wealth distribution of that household's reference group.

Models (3) and (4) can be used to estimate the effect of various adjustments to the wealth distribution when relative deprivation is and is not taken into account. Figure 6.3 shows the predicted distribution of SFWB under three scenarios for model (3) (which ignores households' comparison wealth) and model (4) (which incorporates households' comparison wealth). The left panel represents the predicted SFWB distribution at the current levels of income and savings, the middle panel represents the scenario where all households experience a 10% increase to both their income and savings, and the right panel represents the scenario where 10% of all households' income and savings are redistributed evenly across the entire sample (but the aggregate value of income and savings remains constant). Both society-wide increases in wealth and wealth redistribution are predicted to improve the distribution of SFWB (in the sense that they decrease the number of people with low SFWB), regardless of whether comparison wealth is considered. However, a society-wide increase in wealth is predicted to provide less improvement to the SFWB distribution in model (4) than model (3), and the predicted improvement to the SFWB distribution from a redistribution of wealth is greater for model (4) than model (3). This suggests that the

subjective benefits of increasing everyone's wealth are overstated and the benefits of wealth redistribution are understated when the effect of social comparisons is ignored. These discrepancies arise from the inability of model (3) to account for the externalities associated with reference group wealth.

Figure 6.3: Predicted SFWB distributions for model (3) and model (4) after different adjustments to income and savings levels

It is not the point of the preceding analysis to make precise forecasts of the impact of changes in aggregate wealth. Rather, it is intended to broadly illustrate the differences between models that only consider individual wealth and those that also account for the negative externalities created by the wealth of others.

6.5 The composition of reference groups

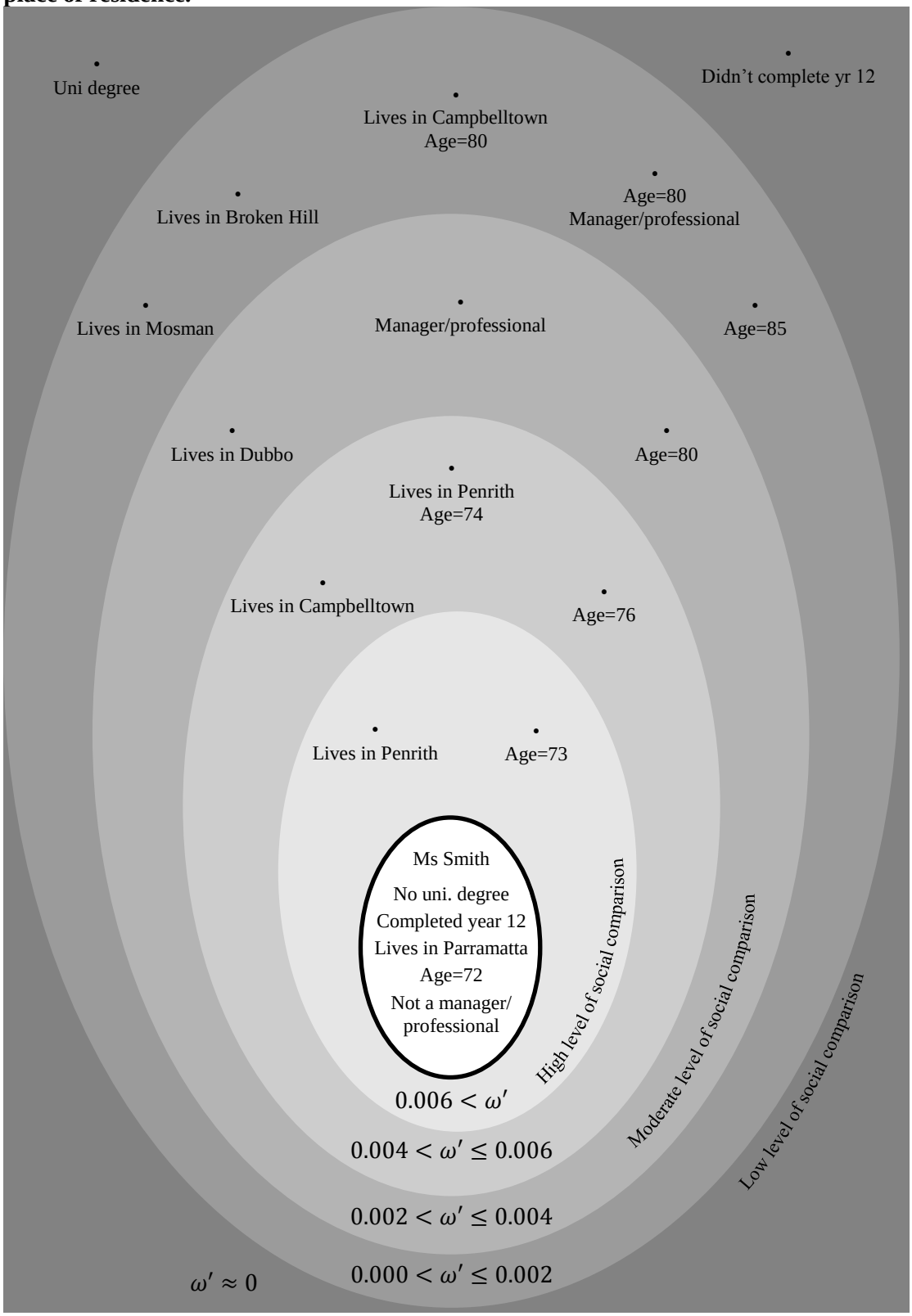
The θ parameters reported in Table 6.2 indicate the composition of the reference groups used in the model. Recall from Chapter 4, that these parameters scale the Euclidean distance to determine how influential their respective dimensions are for determining how 'similar' two households are (which indicates how likely they are to compare themselves with one another). For example, θ_{uni} and $\theta_{yr\ 12}$ are much larger than $\theta_{manager/professional}$, which

suggests that a retiree's education is much more important than their former occupation in determining their reference group.

For illustration, the hypothetical reference group of Ms Smith, a 72 year old respondent who completed year 12 but does not have a university degree, lives in Parramatta, and was not a manager or professional for most of her working life, is shown in Figure 6.4 (in simplified form). The annotated points represent households in her reference group. These households have the same education, occupation, age and postcode as Ms Smith except for the differences noted. The differing shades of grey represent the weight the households carry in the reference group (light grey signifies high weights, dark grey signifies very low weights). Because the education θs are so large, respondents that do not have the same level of education as Ms Smith carry effectively zero weight in her reference group (Ms Smith only compares herself to those with similar education). Ms Smith lives in Parramatta, an urban area with a SEIFA score of 1019. Ms Smith places a high weight on people who live in similar areas, such as Penrith (which has a SEIFA score of 996), and a low weight on people who live in very different areas, such as Broken Hill (which is a rural area with a SEIFA of 898). Age is also an important consideration for Ms Smith, she places ten times more weight on people her age than people 13 years younger or older (with even less weight on people further from her age). Former occupation is not as important to Ms Smith as the other variables but it still guides her comparisons to some extent. She places half as much weight on people that were managers or professionals than she does on other occupations.

As hypothesised, education is one of the most important factors in determining a retiree's reference group. The θ estimates presented in table Table 6.1 imply that people only compare themselves to others of the same educational background. Area of residence, age and occupation are also important factors in the composition of reference groups. The θs reveal the relative importance of different demographic characteristics in shaping the reference groups of retirees.

Figure 6.4: Example reference group illustrating how weights (which represent the level of social comparison) correspond to similarity in age, education, occupation and place of residence.



Parramatta is an urban area with a SEIFA score of 1019. Penrith is an urban area with a SEIFA score of 996. Campbelltown is an urban area with a SEIFA score of 969. Mosman is an urban area with a SEIFA score of 1198. Dubbo is a rural area with a SEIFA score of 964. Broken Hill is a rural area with a SEIFA score of 898.

6.6 Relative impact of different explanatory variables

The impact of the different factors that affect SFWB can be compared by calculating the change in income and savings that has an equivalent effect.[42] The predicted impacts of selected variables are shown in Figure 6.5 (the predicted reference group effect assumes that the household has low wealth relative to their reference group). Some of these effects are equivalent to a retiree losing a large proportion of their wealth. For example, a respondent who reports having poor health is expected to have the same SFWB as a respondent who has 61% less income and savings but excellent health. The magnitude of these effects demonstrates how important factors other than income are to financial well-being.

Figure 6.5: Effects of different variables measured by the percentage change in income and savings predicted to have the same effect on SFWB (relative to a married home owner who has excellent health)

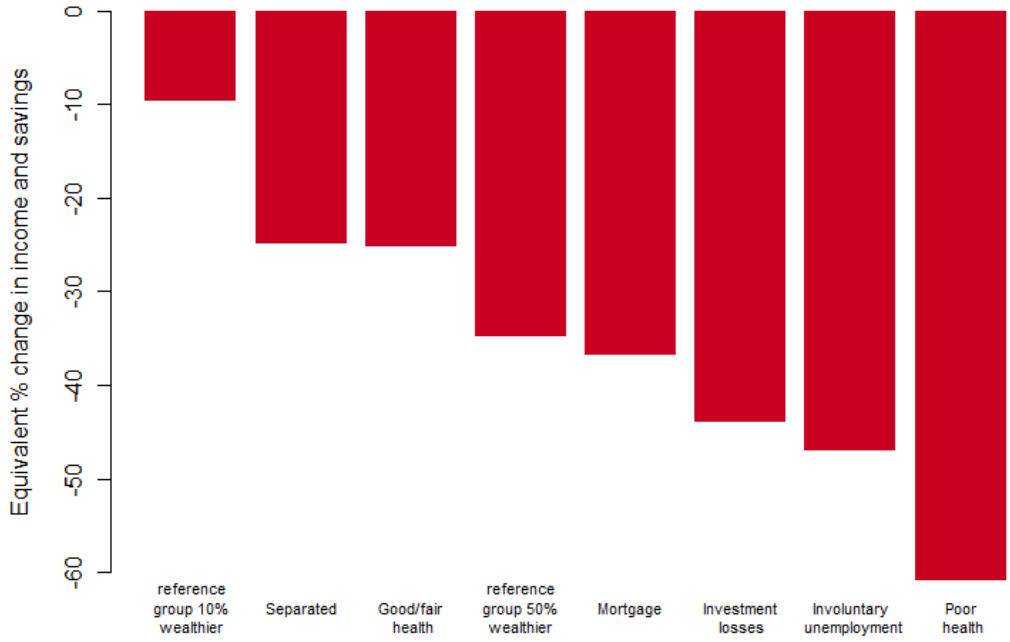


Figure 6.5 demonstrates that relative deprivation has a large impact on retirees' SFWB, both as a result of suffering a wealth shock or from having less wealth than their reference group. The predicted effect on SFWB of suffering major financial losses due to poor performing investments is about the same as the effect of losing 44% of income and savings in addition

[42] A proportional change in savings will result in the same proportional change in annuitised savings.

to the direct effect of having reduced savings. A similar effect is experienced by those who lost employment involuntarily. Having a wealthier reference group also has a large influence on SFWB. According to the model, households with less wealth than most of their reference group perceive an increase to their reference group's wealth as equivalent to an equal percentage decrease in their own wealth. Whether it is a result of comparing themselves to wealthy peers or not being able to afford the lifestyle they are accustomed to, relative deprivation can play a major role in the subjective financial well-being of retirees.

7 Conclusion

An analysis of the subjective financial well-being (SFWB) of Australian retirees is presented in this thesis. Particular emphasis is placed on how relative deprivation influences SFWB. People can suffer from relative deprivation through having a lower present standard of living than they are accustomed to, or as a result of social comparisons with a reference group. I develop an innovative method for identifying people's reference groups, and use these to determine how social comparisons impact SFWB. Unlike much of the literature, this approach does not require the composition of reference groups to be specified in advance. By estimating the set of parameters that control reference group composition simultaneously with the usual model parameters of a cumulative link model, I identify who retirees compare themselves with and how these comparisons affect their SFWB. The model also ascertains how other economic and demographic characteristics relate to the SFWB of retirees.

7.1 Discussion of results

I find that savings are an important factor in the financial well-being of Australian retirees. Further, retirees evaluate the adequacy of savings in the context of their life expectancy. For example, an 85 year old will be more satisfied with a given level of savings than a 65 year old (because they do not require their savings to support as many future years of consumption). I demonstrate that the annuitised value of savings explains the variation in SFWB otherwise attributed to age. This suggests that annuitised savings could be used as a consistent measure of savings adequacy for retirees of all ages. This measure (or a simplified version of it) could inform policy-makers and facilitate improved policy design, particularly in relation to the Age Pension and the regulation of retirement savings products.

Consistent with other studies, I find that relative deprivation can have a significant effect on the SFWB of retirees. I consider two types of relative deprivation in this thesis. First, retirees may suffer from relative deprivation if they are unable to maintain the standard of living

they are accustomed to due to an unforseen wealth shock. Retirees who had lost employment involuntarily or experienced major financial losses due to poor performing investments in the last five years have different perceptions of wealth adequacy to those who had not experienced such an event. These retirees may feel deprived relative to their past circumstances and will be less satisfied with a given amount of current wealth than a retiree whose wealth had not declined. This has implications for investment strategy in the lead-up to and during retirement. The effect of relative deprivation implies that the consequences of investment losses are greater than those predicted by standard investment models. This implication provides further support for the conventional view that people should transition towards low risk asset allocations in retirement.

Second, a retiree will suffer from relative deprivation if they perceive themselves as being worse off than other 'people like them'. I find that the wealth of a retiree's reference group can have a significant impact on their SFWB, particularly for those whose own wealth is below what is typical of their reference group. Education is the main consideration in retirees' social comparisons (which define their reference group), but former occupation, area of residence and age also play a role

A consequence of the reference group effect is that an improvement to the wealth of some households creates a negative externality for other households. These externalities have implications for the subjective benefits of society-wide increases in wealth and wealth redistributions. Specifically, a society-wide increase wealth will not provide an improvement to the SFWB of many households who are less wealthy than their reference group. In contrast, the subjective benefits for low-wealth households of wealth redistributions are two-fold – not only will they benefit from having more wealth, but their feelings of relative deprivation will be reduced due to a narrowing of the gap between rich and poor. Along with the usual economic and ethical issues, relative deprivation should be considered when evaluating any policy that relates to wealth creation or redistribution.

7.2 Limitations and suggestions for future research

There are a number of data quality issues and sample characteristics that affected the ability of this research to reliably analyse the relationship between certain variables and SFWB. The most noteworthy of these is the effect of having a mortgage or other debt. Very few respondents reported having a mortgage and a large number did not answer the question regarding other debt. These issues made it difficult to reliably determine the effect of debt on the SFWB of retirees. A larger sample and modifications to the survey design could potentially shed further light on the nature of this relationship.

A consequence of the timing of the survey is that the magnitude of the relative deprivation effects identified due to involuntary unemployment and investment losses may not be generalisable to periods of greater economic stability. This is because the survey was conducted in 2010, shortly after the global financial crisis (GFC) of 2008-2009, when the frequency and severity of investment losses and redundancies was much higher than usual. While the effect of the GFC may have influenced the results of this study, it also provides opportunities for future research. 40% of respondents specified that they would be willing to participate in future surveys. This creates the potential for longitudinal analysis that could provide further insight into the determinants of SFWB of retirees. In particular, it would allow a more detailed analysis of the ongoing effects of having experienced a wealth shock. For example, future research could examine whether feelings of relative deprivation caused by wealth shocks persist, or whether people become accustomed to a lower standard of living.

The model used in this thesis makes a rather simplistic assumption about how comparison wealth affects SFWB. This arises through the inclusion of the indicator that splits the sample into two groups according to whether a household's wealth is above or below their comparison wealth. Comparison wealth is then assumed to have a different effect depending on which group a household is in (the magnitude of which is determined by the coefficients

on comparison wealth and the interaction term). This leads to an unrealistic discontinuity at the point where wealth is equal to comparison wealth – a household $1 wealthier than their reference group will be affected in a different way to a household $1 poorer. While this method is sufficient for testing the hypotheses under consideration, respecifying the way comparison wealth is related to SFWB by allowing varying degrees of relative deprivation may provide further insight.

The method for forming reference groups, while less restrictive than the procedure used in much of the literature, imposes a number of assumptions about the structure of reference groups. In the model, each person forms their reference group in an identical way on the basis of education, occupation, age and area of residence (although the relative influences of these variables are endogenously determined). There will, in reality, be other factors that determine the social comparisons that these reference groups are intended to reflect. In future research, the model could be generalised to investigate whether other social or psychological characteristics (such as religion or ethnic origin) affect the way people form reference groups.

As a final point, the method of endogenously determining the optimal distance measure that is applied here to reference groups could be applied to any phenomenon that depends on the distance between objects, but where the appropriate distance measure is not known in advance. With further theoretical development (to overcome the problems of computational tractability), this could have applications for genetics, pattern recognition, recommender systems and many other areas.

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Appendix A

The results reported in Chapter 6 were replicated under a number of modifications to ensure the results are not biased by particular aspects of the methodology or variable choice. None of these alternative formulations led to notably different results. Table A1 outlines the potential issues and the action taken to confirm they were not influencing the results. In addition to these measures, the fitting of both full and restricted models, as well as the careful consideration of missing values detailed in Section 5.3, provide further certainty of the results.

Table A1: Robustness measures

Potential issue	Action and result
Inappropriate choice of link function.	Alternative link functions were used for each model specification. The results are robust to the choice of link function.
Inappropriate use of equivalence scales.	The analysis was repeated using non-equivalised income and savings, as well as alternative equivalence scales. The results were mostly unchanged, with the exception of expected differences in the effect of marital status and dependents (since these were no longer accounted for by the use of equivalent income).
Inappropriate choice of comparison wealth measure.	The weighted mean also produces a highly significant comparison wealth variable. The implied reference group composition is very similar to that obtained using the weighted median.
The effect of bequest on SFWB may be endogenously determined – SFWB may influence people's decision to leave a bequest, as well as a bequest motive affecting their SFWB.	All other model coefficients are approximately the same when bequest is omitted from the model, suggesting that its presence does not affect any of the major results discussed above.

Appendix B

Table B1: Results of cumulative link models of SFWB – full models

	Savings and age as separate effects	Savings and age combined to form annuitised savings variable
	(1f)	(2f)
Income (log)	0.540***	0.542***
	(0.090)	(0.090)
Savings (log)	0.344***	
	(0.039)	
Age	0.018***	0.007
	(0.005)	(0.005)
Annuitised savings (log)		0.341***
		(0.039)
Home ownership		
Own outright	(base category)	(base category)
Paying off (mortgage)	0.142	0.137
	(0.326)	(0.326)
Renting	0.154	0.180
	(0.553)	(0.553)
Other	0.065	0.090
	(0.563)	(0.563)
House value (log)	0.010	0.012
	(0.042)	(0.042)
Mortgage value (log)	-0.041	-0.041
	(0.031)	(0.031)
Debt > $25,000 indicator	0.107	0.108
	(0.115)	(0.115)
Debt missing value indicator	0.210**	0.210**
	(0.097)	(0.097)
Bequest	0.251	0.245
	(0.16)	(0.160)
Age Pension		
None	(base category)	(base category)
Part Age Pension	-0.165*	-0.151
	(0.094)	(0.095)
Full Age Pension	-0.425***	-0.412***
	(0.132)	(0.132)
Marital status		
Single	(base category)	(base category)
Married or De facto	-0.116	-0.044
	(0.144)	(0.144)

	Savings and age as separate effects	Savings and age combined to form annuitised savings variable
	(1f)	(2f)
Widowed	-0.076 (0.155)	-0.083 (0.155)
Separated	-0.282 (0.177)	-0.275 (0.177)
Dependents	-0.033 (0.119)	-0.038 (0.119)
Sex (female)	0.051 (0.086)	0.064 (0.086)
Health		
Excellent	(base category)	(base category)
Very good	-0.174 (0.132)	-0.171 (0.132)
Good	-0.351*** (0.135)	-0.350*** (0.135)
Fair	-0.480*** (0.144)	-0.487*** (0.144)
Poor	-1.017*** (0.212)	-1.016*** (0.212)
Veteran	0.198 (0.147)	0.181 (0.147)
Education		
University degree or higher	(base category)	(base category)
Trade certificate or apprenticeship	-0.018 (0.149)	-0.018 (0.149)
Other certificate or diploma	0.131 (0.099)	0.131 (0.099)
Year 12 or equivalent	0.296** (0.132)	0.292** (0.132)
Year 10 or 11	0.440*** (0.129)	0.438*** (0.129)
Year 9 or below	0.186 (0.170)	0.190 (0.170)
Never attended school	0.600 (1.226)	0.619 (1.226)
Other	1.062 (0.84)	1.071 (0.840)
Occupation		
Manager	0.133 (0.108)	0.133 (0.108)

	Savings and age as separate effects	Savings and age combined to form annuitised savings variable
	(1f)	(2f)
Professional	0.216**	0.219**
	(0.104)	(0.104)
Technician and trades worker	0.082	0.077
	(0.122)	(0.122)
Community and personal service worker	0.230	0.231
	(0.152)	(0.152)
Clerical and administrative worker	0.000	0.003
	(0.092)	(0.092)
Sales worker	0.139	0.140
	(0.143)	(0.143)
Machinery operator and drivers	0.102	0.101
	(0.272)	(0.272)
Labourer	0.001	0.001
	(0.181)	(0.181)
SEIFA (standardised)	-0.105**	-0.104**
	(0.043)	(0.043)
ARIA		
Remote/ Very remote/Moderately accessible	(base category)	(base category)
Accessible	-0.054	-0.049
	(0.212)	(0.212)
Highly accessible	0.16	0.161
	(0.197)	(0.197)
Involuntary loss of employment	-0.546**	-0.559***
	(0.215)	(0.214)
Investment losses	-0.542***	-0.542***
	(0.09)	(0.090)
Threshold 1	9.287	7.798
	(1.118)	(1.109)
Threshold 2	10.668	9.178
	(1.127)	(1.116)
Threshold 3	12.579	11.089
	(1.142)	(1.129)
Number of observations	1054	1054
Log-likelihood	-998.2	-998.4
AIC	2068.4	2068.7
Link function	Log-gamma	
λ	-0.087	

Standard errors are reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% levels respectively.