Health and Retirement of Older New Zealanders

Emma Gorman, Grant M. Scobie
and Andy Towers

PREPARED FOR THE NEW ZEALAND ASSOCIATION OF ECONOMISTS CONFERENCE

JUNE 2012

TITLE

Health and Retirement of Older New Zealanders

MONTH/YEAR

June 2012

AUTHORS

Emma Gorman
The Treasury
Wellington
New Zealand

Email emma.gorman@treasury.govt.nz

Telephone 64-4-917 6104

Grant M. Scobie
The Treasury
Wellington
New Zealand

Email grant.scobie@treasury.govt.nz

Telephone 64-4-917 6005

Andy Towers
School of Health & Social Services
Massey University
Palmerston North
New Zealand

Email a.j.towers@massey.ac.nz

Telephone 64-6-356 9099 extn. 7358

ACKNOWLEDGEMENTS

The authors would like to thank the principal researchers from Massey University and the Family Centre Social Policy Unit involved in HWR and NZLSA projects. In particular, Associate Professor Fiona Alpass and Associate Professor Christine Stephens from Massey University who, as principal investigators of the HWR project and co-principal investigators on the NZLSA project, provided direct access to the project data.

We would also like to acknowledge the funding provided for the HWR project by the Health Research Council of New Zealand, and the funding provided for the NZLSA project from the Ministry for Science and Innovation (formerly the Foundation for Research, Science and Technology).

The authors benefited from discussion and suggestions from David Law and Lynda Sanderson from the Treasury. Special thanks are extended to Nick Carroll and John Creedy of the Treasury, Gemma Tetlow from the IFS and Julia Hall from NatCen for their helpful comments and review, and to the editor Paul Rodway from the Treasury.

DISCLAIMER

Abstract

Increasing life expectancies and uncertainty about future retirement incomes are likely to lead to various changes in behaviour. As expectations are revised, one potentially important adjustment mechanism is in labour force participation rates. There is already evidence these are rising for those beyond the age of eligibility for New Zealand Superannuation.

This paper uses a new source of longitudinal data on the health, labour force participation and retirement decisions of older New Zealanders. The central question addressed is the extent to which labour force participation of older New Zealanders is influenced by their health status (both mental and physical), in addition to a wide range of economic, social and demographic variables. Discrete choice models are employed, and particular attention is given to the potential effects of unobserved heterogeneity.

We find a range of factors to be associated with the decision to retire, notably health status, marital status and financial incentives. After accounting for the confounding influence of unobservables, we find that physical health remains a determinant of labour force exit for older males. Further, we estimate both the marginal and aggregate effects of specific chronic conditions on labour force participation.

JEL CLASSIFICATION J26 Retirement
J14 Economics of the elderly
J21 Labour force and employment
I10 Health

KEYWORDS Labour force participation; Health; Retirement; New Zealand; Longitudinal survey

Executive Summary

Increasing life expectancies and uncertainty about future retirement incomes are likely to lead to various changes in behaviour. As expectations are revised, one potentially important adjustment mechanism is in labour force participation rates. There is already evidence these are rising for those beyond the age of eligibility for New Zealand Superannuation.

This paper uses a new source of longitudinal data on the health, labour force participation and retirement of older New Zealanders. The datasets used in this paper are the Health, Work and Retirement (HWR) study and its successor, the New Zealand Longitudinal Study of Ageing (NZLSA). The HWR study was funded by the Health Research Council of New Zealand for two waves of data collection in 2006 and 2008, and was run by researchers at Massey University. The NZLSA study is funded by the Foundation for Research, Science and Technology (now the Ministry for Science and Innovation) for two waves of data collection in 2010 and 2012, and is also run by Massey University, in conjunction with the Family Centre Social Policy Research Unit.

The central question addressed is: To what extent is labour force participation of those aged 54 to 70 influenced by their health status (both mental and physical), in addition to a wide range of economic, social and demographic variables? Earlier work by Enright and Scobie (2010) used the first wave of the Health Work and Retirement survey (HWR) to investigate the effects of various factors, including health, on the decision to retire. This paper aims to add to this analysis by exploiting the extra information provided by the two more recent waves of survey data, to gain a richer understanding of the determinants of labour force participation and retirement of older New Zealanders. Longitudinal data can help better understand the direct role that health plays in the decision to participate, as the effect of changes in health over time on labour market participation may be examined.

Similarly to Enright and Scobie (2010), we find an association between both mental and physical health, and labour force participation, when not exploiting the longitudinal nature of the data explicitly. When using a relatively objective measure of health status, the predicted probability that males in good health are in the labour force at age 65 is 70%. This falls to 53% for those in ill health, a decline of 17 percentage points. For females, the corresponding drop is 15 percentage points.

Similar results were obtained using a self-rated health measure. The predicted probability of participating in the labour force is 28 percentage points lower for males in fair or poor health relative to those reporting excellent health. For females, the corresponding decline is 19 percentage points.

Based on the longitudinal aspect of the data, we find that changes in physical health are indeed significant in explaining the labour force status of males. This indicates there may be a direct effect of health on the retirement decisions of males. However, this was not the case for females.

The presence of some chronic conditions is significantly associated with a lower likelihood of participation. For both males and females, high blood pressure, kidney problems and heart problems are significantly associated with lower probabilities of remaining in the workforce. After the prevalence of the conditions is taken into account, high blood pressure and arthritis are the two most critical chronic conditions that are associated with lower labour force participation.

The measures we have for health status at best are a proxy for the true underlying health status of an individual, and observed health status is a reflection of many unobservable influences (such as genetic endowments). While this study has had access to longitudinal data, which in principle helps to isolate changes over time, the period covered by the survey (2006 to 2010) is relatively short, and encompasses just three observations. Ideally, one would want a longitudinal dataset covering many more years to begin to isolate the dynamic interrelationships between health and retirement.

Nonetheless, it is clear that health has an effect on labour force participation. However, the observed decline in health status as individuals age explains a relatively small proportion of the aggregate decline in participation of older individuals. Ill health appears to be a constraint for some proportion of older individuals, but not all. Of far greater importance are other factors such as financial incentives. For instance, New Zealand Superannuation substantially reduces the likelihood of remaining in the labour force, as do private superannuation income and receipt of government transfers. Other factors, such as changing social norms and expectations of older individuals, phased retirement and flexible work arrangements are likely to be important in encouraging increased participation. Coupled with the increasing investment in human capital by successive cohorts, this suggests an optimistic outlook for the labour market contribution of older New Zealanders.

In addition to the issue of higher rates of labour force exit of older workers, the rate of return to the labour force after a shock is of importance for increasing aggregate participation. Removing barriers to participation – age-based discrimination, limited opportunities for retraining and up-skilling, for example – may also aid in encouraging this inflow, mitigating the likelihood of a temporary withdrawal from employment becoming permanent.

In summary, the results show poor health and eligibility for benefits or pensions encourage exit from the labour force for both males and females, whilst continued employment of a spouse is associated with further participation for males. For females, financial security appears to be a relatively important factor; higher household net wealth is associated with earlier retirement, and the dissolution of marriage with a higher likelihood of participation. Additionally, we find that unobservable effects specific to the individual, explain a substantial proportion of the retirement decision.

The fact that unobservable differences between individuals play an important role in the retirement decision highlights that human behaviour is complex, and the decisions individuals and households make at any time are based on more than what can be observed in a survey. Those decisions are framed by a lifetime's experience and accumulated behaviours. Contemporaneous factors are important in explaining differences in outcomes, but policy interventions to encourage successful ageing should be enacted throughout the life course.

Contents

List of tables

List of figures

Health and Retirement of Older New Zealanders

1 Introduction

The key objective of this paper is to identify the principal factors which govern the labour force participation decisions of older New Zealanders, using longitudinal data. Particular attention is given to the role of health.

New Zealand is on the cusp of an important social and demographic change, as the so-called baby boomers began to turn 65 in 2011. Forecasts suggest that by 2051, 23% of the population will be aged over 65, a stark change from 13% in 2011 (Statistics New Zealand, 2009). The implications of this demographic shift are both significant and pervasive. Coupled with increasing life expectancies, fiscal pressures on the government to provide social security and healthcare for older individuals will heighten, and demand for workers in the healthcare and age-related sectors will likely increase. However, there will be a lower proportion of prime working-age individuals (aged 15 to 64) to provide for this growing group of older people.

The perceived reliance of the older population is often expressed in terms of the "dependency ratio". The dependency ratio relates the number individuals in the "dependent" group, those aged 65 and older, to the number of prime working-age individuals. Projections of this ratio alone paint an ominous picture of increasing numbers of "dependent" older individuals relative to "workers". However, the conditions surrounding the dependency of older individuals are not static. Social attitudes and expectations toward older individuals are changing, as are their education, skills, health and life expectancy relative to previous cohorts, particularly for women. Recognising such trends, we might ask how "dependent" our older generation really is, and what actions may be taken to alleviate barriers to continued labour force participation.

The sources of data for this project are the Health Work and Retirement (HWR) survey, and its successor project, the New Zealand Longitudinal Study of Ageing *(*NZLSA). These two surveys canvass older New Zealanders on a range of issues, including labour force status, health, wealth, well-being and transitions into retirement. The HWR participants were surveyed twice (in 2006 and 2008), and these participants were incorporated as a sub-population into the NZLSA project, and surveyed once more in 2010. It is therefore possible to follow changes in labour market participation of individuals over a number of years.

The paper is structured as follows. Section 2 explores the context and motivation for this work, while Section 3 describes the data. Section 4 outlines our definitions of participation and retirement. Section 5 addresses various issues that arise in the measurement of health status, describes the health measures used in this paper, and presents some descriptive analysis of the association between health status and participation. Section 6 describes the multivariate models used to analyse the determinants of participation. Section 7 presents the results of these models, and Section 8 concludes.

2 Background

New Zealand's population is ageing, owing to both increasing life expectancies and ageing of the baby boomers. The number of individuals aged 65 and older increased 45% between 1986 and 2006, and forecasts indicate this trend will continue (Khawaja and Boddington, 2009; Statistics New Zealand, 2009).

Labour force participation of this group has also increased dramatically in recent decades, from 6% in 1986 to 17% in 2006 (Khawaja and Boddington, 2009). Continued labour force participation has been shown to be positively related to productivity and economic growth (Disney, 1996; Dixon, 2003; Roberston and Tracy, 1998); the health and well-being of older individuals (Alpass*, et al.*, 2008; Butterworth*, et al.*, 2006; Westerlund*, et al.*, 2009) and in alleviating fiscal pressures on the government (Maestas and Zissimopoulos, 2010; OECD, 2005; Vodopivec and Dolenc, 2008).

Key drivers underlying higher participation rates for those aged over 65 are increasing life expectancies, the upward shift in the age of eligibility from 60 to 65 for New Zealand Superannuation phased in through 1992 to 2001 (Hurnard, 2005), and relatively rapid increases in the labour force participation of females.

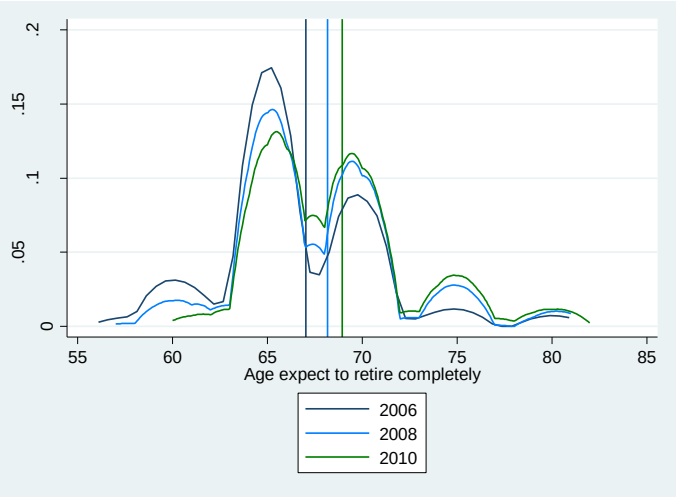
The female labour force participation rate for those aged 65 or older in the 1986 Census was 2.9%, a time when it was more common for women to spend the majority of their working-age lives in unpaid home production. Whilst participation rates for older women remain lower than their male counterparts, women now represent a larger share of the labour force; their participation rate has quadrupled since 1986 (Khawaja and Boddington, 2009). Looking forward, one might expect participation of women to increase further, as successive cohorts accumulate increasing stocks of human capital.

Population ageing and its implications are of interest internationally, for both research and policy. As such, the development of longitudinal survey datasets focussing on, or at least encompassing, older individuals is not limited to New Zealand. Comparable international datasets to the HWR and NZLSA include the Survey of Health, Ageing and Retirement in Europe (SHARE); the Health and Retirement Study in the United States (HRS) and the English Longitudinal Study of Ageing (ELSA). Comparing these three surveys, cross-country differences in retirement patterns are found to be largely due to differences in welfare institutions; specifically, pensionable retirement ages have a large influence on retirement patterns.

Health and disability are also important; typically lower self-reported health status is associated with higher probability of retirement. SHARE has the lowest participation rates relative to the North American and English surveys, and additionally has a much higher proportion of female homemakers, particularly in continental Europe. This suggests differences in participation rates are also in some part explained by heterogeneity of social norms and customs (Borsch-Supan*, et al.*, 2008).

In contrast to many other OECD countries, New Zealand has experienced high and increasing labour force participation, particularly since 1991 (Hurnard, 2005), and this trend appears set to continue. This is reflected in the average expected age of complete retirement reported in HWR and NZLSA, which has shifted out over time (see Figure 1).

Figure 1 – Distribution of expected ages of complete retirement: by survey year



Source: HWR and NZLSA longitudinal sample.

Notes: 1. Expected retirement ages above 85 have been excluded from density.
2. Includes only those who are in the labour force for all three waves, and report an expected retirement age.
3. Vertical lines indicate the mean expected retirement age for each wave.

Patterns of retirement in New Zealand have found to be associated with pensionable age (Hurnard, 2005) and with health and marital status (Enright and Scobie, 2010). The latter study was based on the first wave of the HWR survey.

This paper uses longitudinal data, allowing a richer analysis of the different factors likely to affect the decision to participate, or retire, over time. A particular focus is on the effect of health on participation.

Theoretically, the effect of health on retirement is ambiguous. Ill health may:

- decrease the return from work, through diminished productivity
- increase the likelihood of eligibility for health- or disability-based benefits, potentially creating a disincentive for continued participation
- result in a higher cost of living, and thus increase the probability of work, and
- decrease life expectancy, or years in good health. This may change preferences for leisure, inducing early retirement (Deschryvere, 2005).

Empirical evidence tends to confirm a robust negative relationship between ill health and participation, over a range of datasets. Examples include the Health and Retirement Survey (Bound*, et al.*, 1998; Maurer*, et al.*, 2011); the British Household Panel Survey (Disney*, et al.*, 2003); the Household, Income and Labour Dynamics in Australia (Lixin Cai and Kalb, 2007); the Health, Work and Retirement Survey (Enright and Scobie, 2010; Pond*, et al.*, 2010).

The health of older individuals is also important for government expenditure, as health costs rise with age. Whilst non-demographic factors such as wage increases and technology advances remain key drivers of health expenditure, improvements in health are important in offsetting fiscal pressures generated by structural population ageing (Bryant*, et al.*, 2004).

3 Data

The datasets used in this paper are from the Health, Work and Retirement (HWR) study and its successor, the New Zealand Longitudinal Study of Ageing (NZLSA). The HWR study was funded by the Health Research Council of New Zealand for two waves of data collection in 2006 and 2008, and was run by researchers at Massey University. The NZLSA study is funded by the Foundation for Research, Science and Technology (now the Ministry for Science and Innovation) for two waves of data collection in 2010 and 2012, and is run by the same research team at Massey University in conjunction with a research team from the Family Centre Social Policy Research Unit.

The baseline HWR survey consists of a large cross-sectional sample of New Zealanders aged over 50, who consented to participate in the 2006 postal data collection wave. A total of 5,260 adults (including Māori) were randomly selected from the New Zealand Electoral Roll to represent a general population sample. From those still remaining on the electoral roll, 7,780 Māori adults were then randomly selected (using the Māori descent indicator on the roll) specifically to increase the Māori sub-sample. Māori over-sampling was undertaken to combat the historically poor research participation rates found in older ethnic minority populations.

As a result, 13,040 New Zealanders received an HWR study questionnaire and an invitation to participate in the study. Subsequently, 551 individuals (210 from the general population sample and 341 from the Māori sub-sample) were excluded from participation due to ineligibility (eg, deceased, institutionalised, or un-contactable), thus lowering the potential participant pool to 12,489. Of this revised total, 6,657 (53%) participants returned surveys in 2006; 3,104 (61%) from the general population sample and 3,553 (48%) from the Māori population sub-sample.

The HWR 2006 (henceforth *baseline*) survey was considered a cross-sectional study for recruitment purposes, consent to participate in the HWR 2008 data collection wave (henceforth wave 2) was not a stipulation of baseline participation. The longitudinal sample was instead gained with a specific request at the end of the baseline questionnaire for participants to participate in the wave 2. Almost half of the 2006 HWR baseline sample (N = 3,111) subsequently consented to take part in the longitudinal section of the study, and 2,471 (79%) returned completed questionnaires in the 2008 data collection wave.

The NZLSA survey began in 2010, and subsumed the longitudinal sub-sample of the HWR project. A total pool of 4,339 older New Zealanders were provided with questionnaires and invited to complete the first NZLSA postal data collection wave in 2010 (henceforth wave 3). This pool consisted of:

- the 2,471 HWR participants who participated in 2008
- 839 participants from an existing cross-sectional study of retirement planning at Massey University
- 238 from the NZLSA pilot study conducted in 2009
- 165 HWR cross-sectional participants from 2006 who consented to re-enter the study
- 683 New Zealanders randomly selected from the New Zealand Electoral Roll.

Thus a total of 3,318 individuals completed questionnaires in Wave 3, including 1,835 from HWR wave 2 and 148 of the HWR wave 1 participants. Ignoring the latter group of re-entering participants, the NZLSA project thus contains a sub-sample of approximately 1,800 New Zealanders who have been comprehensively surveyed three times since 2006 on aspects of their health, wealth and social wellbeing in the transition from later working life to retirement.

The representativeness of the baseline study and the effects of attrition were analysed, and the results are presented in full in Appendix B. Both the HWR baseline sub-samples (Māori and non-Māori) align closely with their respective New Zealand populations, as evident in the proportions of:

- participants across age groups
- men and women
- those in full-time work, and
- those with no secondary school qualifications.

However, in comparison to their respective populations, the HWR baseline sub-samples both have perceptibly higher proportions than expected of people who are:

- currently in relationships (partnered)
- in part-time work versus retired/other,
- tertiary-educated, and
- earning above $20,000.

In this regard, as opposed to the corresponding age-matched New Zealand population, the HWR sample in general reflects a disproportionately greater number of New Zealanders who are still working.

Analysis of the effects of attrition suggests that the wave 2 sample consists of baseline participants who are more likely to be working, in better health, better educated and less likely to smoke, but more likely to consume alcohol. The transition from wave 2 to wave 3 highlighted an ethnicity-specific divergence in demographic hallmarks. Whereas Māori in wave 3 were more likely than attritors to be partnered, in better health, and non-smoking, the non-Māori in wave 3 were more likely than attritors to be female, educated, non-smokers and more frequent drinkers. These differences should be borne in mind when considering the results and conclusions of the analysis.

4 Labour force participation and retirement

A key outcome of interest for this study is retirement, as opposed to labour force participation. This is because the interest for policy is in economic participation which can finance older individuals' consumption. However, this is not intended to denigrate the value of unpaid labour, for example, home production, volunteer work, or other non-market activity.

Retirement can be seen as the state when one reaches the age of eligibility for superannuation, or as a complete and sustained withdrawal from the labour force, or as transition out of the labour force over time. The key issue examined in this study is the divide between engaging in, or seeking, paid employment, in contrast to being "retired" with no paid work.

Therefore, we construct two mutually exclusive categories: labour force participation (employed or seeking work) and retirement (no paid work) which form the basis for analysis. Students, those with no identifiable labour force status, and those who report themselves to be homemakers are not included in this analysis.[1] This results in the classifications presented in Table 1. The participating group comprises those in full-time or part-time employment, or those unemployed and seeking work.

Table 1 – Labour force status by age

Labour force status	54-59	60-64	65-70	71-74	Total
2006	%	%	%	%	%
Full-time	69	51	15	n/a	49
Part-time	25	27	23	n/a	25
Unemployed	*s*	1	*s*	n/a	1
Retired	5	20	62	n/a	25
Total	**100**	**100**	**100**		**100**
2008	%	%	%	%	%
Full-time	69	58	17	5	44
Part-time	24	28	21	30	25
Unemployed	*s*	*s*	*s*	*s*	1
Retired	6	12	62	65	30
Total	**100**	**100**	**100**	**100**	**100**
2010	%	%	%	%	%
Full-time	67	53	19	6	35
Part-time	26	29	23	14	24
Unemployed	*s*	2	*s*	*s*	1
Retired	5	16	57	80	39
Total	**100**	**100**	**100**	**100**	**100**

Source: HWR and NZLSA longitudinal sample.

Notes: 1. *s* indicates an underlying sample size to small for inference.
2. The sample age range was 54–70 in 2006, and so the age group 71-74 is not applicable.

[1] This amounts to 8% of the longitudinal sample.

The survey questions on which this distinction between participation and retirement is based are as follows:

A) What is your current work situation? (in waves 1,2,3)

- Full-time employment, including self-employment
- Part-time work, including self-employment
- Retired, no paid work
- Full-time homemaker
- Full-time student
- Unemployed and seeking work
- Not in the work-force/other
- Unable to work due to health/disability (only in waves 2 and 3).

B) Do you consider yourself to be partially retired, completely retired, or not retired? (wave 1)

- Not retired at all
- Partially retired
- Completely retired

C) If you are completely retired, how long have you been completely retired for? (waves 2 and 3)

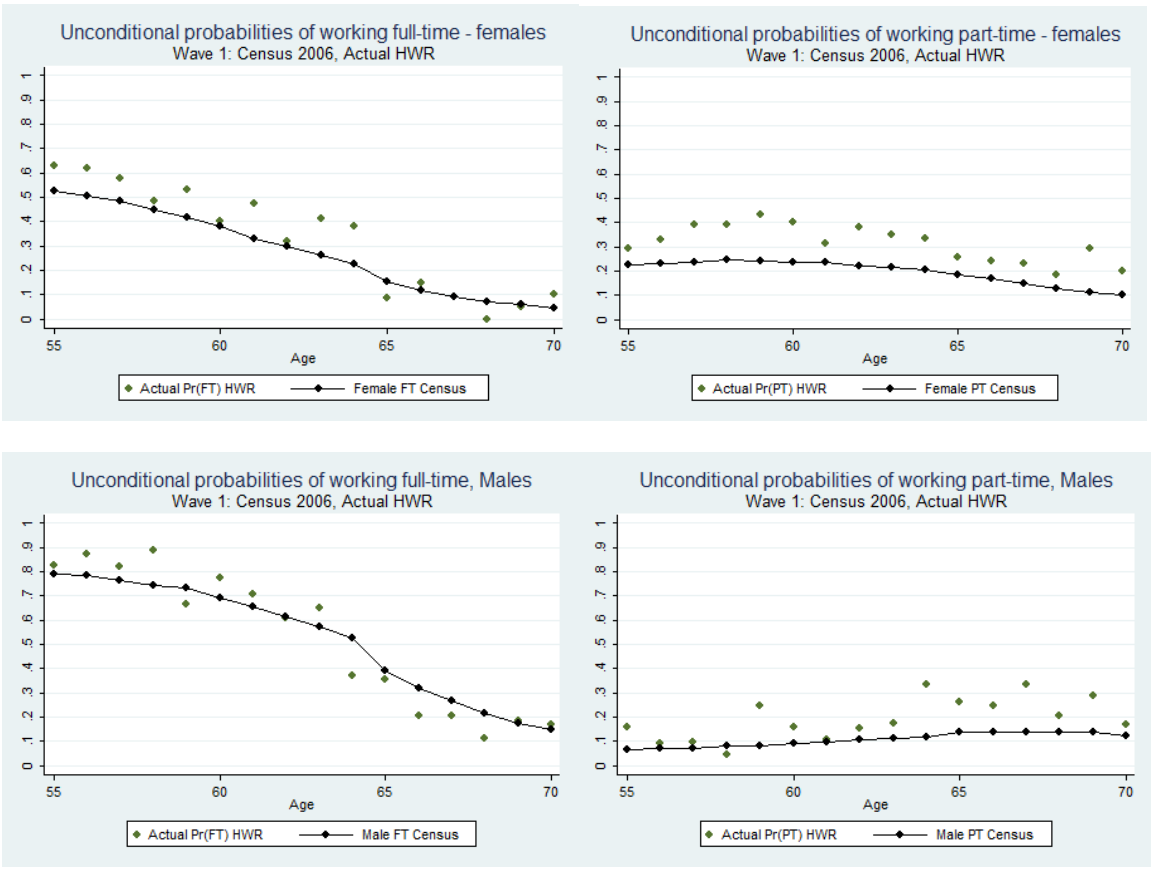
- Respondent gives answer in months/years

As the main interest is the divide between paid work and no paid work, "retirement" as used in the following analysis is defined as all those who indicate they are retired with no paid work in A; **or**: those who indicate they are completely retired in B or C (wave dependent), **and** report that they are not in the workforce or unable to work due to health problems in A. This is consistent with the definition used in previous analysis of this survey by Enright and Scobie (2010).

The patterns of labour force participation (both full- and part-time) for females and males are shown in Figure 2. These figures compare observed (from HWR) proportions of individuals at each age in full-time and part-time employment, and the observed probabilities of participation from the 2006 Census. Part-time employment and full-time employment in this study are defined slightly differently from in the Census.[2] The full-time participation rates of our longitudinal participants in the baseline wave (2006) align relatively well with the 2006 Census data, and the HWR part-time employment rates are higher than the Census.

[2] In the Census, part-time work is defined as 1-29 hours worked per week, and full-time as 30 or above. In the HWR/NZLSA surveys, respondents indicate whether they are in "part-time" or "full-time" employment, without reference to the hours they work.

Figure 2 – Full-time and part-time employment rates by gender



Source: HWR wave 1, longitudinal participants; Census 2006 (Statistics New Zealand, authors' calculations).

Sample selection effects, attrition and definition of labour market activity result in the "participation rates" calculated in this paper being *higher* than the corresponding official statistics, particularly in the lower age range.

Respondents were asked for their preferences over work status (see Table 2). Of those in full-time employment in 2006, almost two thirds reported they were satisfied; while 26% of these in full-time work would prefer to be in part-time work, and 9% would prefer to be retired (ie, no paid work). In contrast, by 2008, only 55% of those in full-time work are content, 35% would rather be working part-time, and 8% would prefer to be retired. For the majority of those in part-time work, their realised work status matches their preferred option.

Table 2 – Preferences over labour force participation

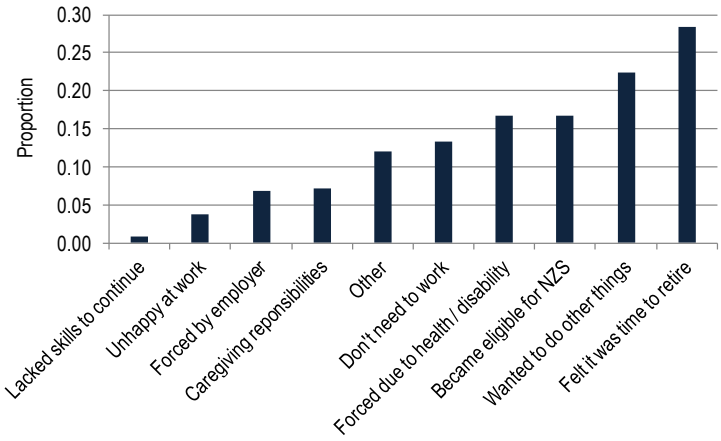
Actual		Preferred			
2006	Full-time	Part time	Retired	Other	
Full-time	62	26	9	3	100
Part time	12	76	7	5	100
Retired, no paid work	3	23	70	4	100
2008	Full-time	Part time	Retired	Other	
Full-time	55	35	8	2	100
Part-time	6	87	5	s	100
Retired, no paid work	s	19	75	6	100

Source: HWR and NZLSA longitudinal sample

Notes: 1. This question is not available for the 2010 wave.
2. *s* indicates an underlying sample size too small for inference.

Approximately 20% of those who indicate they are retired with no paid work would prefer to be in part-time employment. This suggests there may be barriers to participation for some older individuals, and again highlights a preference for the option of part-time employment. Barriers to participation may be due to labour demand factors, for example, a mismatch of skills with industry demand, a lack of suitably flexible or part-time jobs, unwillingness to up-skill or retrain older workers, or age-based discrimination. Individuals may also face barriers to supply. Figure 3 shows the proportion of respondents who indicated particular reasons for reducing or stopping work.

Figure 3 – Reasons for stopping or reducing work



Source: HWR wave 2, longitudinal participants

Notes: 1. Respondents can indicate multiple categories.
2. This graph uses data from wave 2 only, because of differences in questions over the waves.

The most commonly-cited reasons for reducing or stopping work – wanting to do other things and feeling it was time to retire – suggest that societal expectations and preference for leisure play a key role in the decision to retire. Relatively little importance is given to workplace-related factors, such as lacking the skills to continue, being unhappy at work, or being forced out by one's employer. Health and receipt of New Zealand Superannuation are cited as similarly important reasons for moving out of the labour force. Both of these areas are potentially amenable to policy intervention.

4.1 Measuring health status

Health is clearly an important factor in the retirement decision. However, identifying the effect of health on retirement is beset by various methodological challenges. This section provides a brief overview of some of these issues.

HWR and NZLSA contain multiple measures of health, including a five-point rating of general health, from poor to excellent (henceforth called self-rated health), as well as more specific questions pertaining to activity limitation and chronic condition.

While there is some evidence showing self-rated health measures are good predictors of mortality (Idler and Benyamini, 1997), there is debate around the extent to which self-rated health measures correspond to actual health. One concern regarding their use is that of "justification bias". This can arise when an individual reports a lower subjective health rating, to rationalise their withdrawal from the labour force. This rationalisation can lead to an over-estimated negative effect of health on labour force participation. However, it is possible that such a desire to rationalise retirement is less prevalent now, owing to changing social norms and attitudes toward retirement.

Furthermore, there is no reason to believe that self-rated measures of health are necessarily comparable across individuals. This is because there is no commonly defined reference point. Specifically, there may be state-dependent reporting bias, whereby different groups within a population assess their health relative to different thresholds, even though they may have the same underlying level of "true" health (Deschryvere, 2005).

Another issue is that of reverse causality: withdrawal from the labour force may precede, and possibly cause, deterioration in health, and vice versa, so that explicitly determining the direction of causality becomes difficult. Instrumental variables such as expected mortality or other "objective" measures are sometimes used in an attempt to determine the direction of causality. However, finding a convincing instrument is not a simple task (Currie and Madrian, 1999). A valid instrument must have an effect on labour force participation only through the health measure suspected to be endogenous. Bound (1991) aimed to circumvent issues of endogeneity and measurement error by creating a latent health stock, estimating a model where self-rated health is theorised to be a function of more objective health measures such mortality or activity limitation. The predicted health stock measure is then used in analysis, and is analogous to instrumenting subjective measures of health with objective measures. Objective measures of health on their own (for example, indicators of chronic condition, or healthcare utilisation) may not measure aspects of health relevant for the participation decision (Bound, 1991).

The potential problem of reverse causality is not explicitly addressed in this paper, and there is a possibility that labour market status may affect health status. One hypothesis is that such change may be expected to take some time to manifest itself. That is, on average, the effects of retirement on health status would arise over a period of time, rather as an immediate result of retirement, suggesting a negligible contemporaneous effect. This has been empirically corroborated for older working-age males (Cai and Kalb, 2006). This is in contrast to a health shock, which can clearly be conceived to impair current work capacity. However, this issue is not empirically resolved here.

A final issue is that of unobservable omitted-variables bias. If there are unobservable characteristics, which may affect both health status and labour force participation (for

example, degree of risk aversion, or time preference), this can confound identification of the direct effect of health on labour force participation.

4.2 Health measures in HWR and NZLSA

Health and health-promoting behaviours are a key focus in the HWR/NZLSA dataset, and are measured via self-rated indicators across all three waves of data collection. The assessment of both positive and negative health behaviours (eg, exercise intensity/duration, smoking, and alcohol consumption) and the existence of chronic health conditions (eg, heart trouble, diabetes mellitus, visual impairment) provide a strong evidence base for tracking the development of chronic ill health and detrimental health trends.

This section will describe the measures of health status, and present some descriptive statistics of the bivariate relationship between health and participation.

4.2.1 Health scales and self-rated health

To measure specific levels of perceived health, HWR/NZLSA uses an internationally standardised, multi-faceted health measure: the Australian and New Zealand adaptation of the SF36 Health Survey Version 2 (SF36v2: Waves 1 and 2) and an abbreviated version called the SF12v2 (Wave 3). The SF36v2 (Ware*, et al.*, 2000) is a 36-item measure of health, which focuses on eight physical and mental health sub-scales, and one indicator of general health change.

In order to ensure direct compatibility of health scores across all three waves, the SF36v2 for waves 1 and 2 have been rescored into their respective SF12v2 versions.

The SF12v2 is a 12-item abbreviated version of the larger SF36v2, which still targets eight domains of physical and mental health. A summary of the health domains considered in SF12v2 is given in Table 3. As with the larger SF36v2, the SF12v2 scores for each domain are standardised with a mean of 50, a range of 0-100, and weighted such that they may be interpreted in the same direction: higher scores indicate better health.[3]

Table 3 – A description of the health domains represented by the SF12 Health Survey (version 2)

Physical health	General health (overall perception of physical health)
	Physical functioning (degree of health-related functional limitation)
	Role physical (degree physical health affects daily activities)
	Bodily pain (degree of current bodily pain)
Mental health	Mental health (overall perception of mental health)
	Role emotional (degree emotional health affects daily activities)
	Social functioning (degree of health-related social limitation)
	Vitality (general degree of perceived energy)

3 While there are New Zealand population norms for the SF36v2, there are currently no norms for the abbreviated SF12v2. In this regard, the general health status of the HWR/NZLSA sample is indicated by scores on the SF12v2 which have been transformed using US-population norms and standardised scores (see Ware, et al., 2002).

The SF12v2 sub-scales for each of the domains in Table 3 have been combined to provide two summary scores for physical and mental health status: the Physical Component Summary (PCS) and the Mental Component Summary (MCS). The PCS and MCS are computed following a three-step standardised procedure.

First, the scores from all eight domains are standardised using a linear z-score transformation. Z-scores are calculated by subtracting the domain means for the general population from each individual's domain score, and then dividing by the corresponding US population standard deviation.

Second, the z-scores are multiplied by the domain factor score coefficients for PCS and MCS and summed over all eight domains. The final score is calculated by standardising the PCS and MCS such that they have a mean of 50 and a standard deviation of 10.

Scott (2000) showed that the two-dimensional structure of the original SF36v2 did not clearly differentiate between the components of physical and mental health for older Māori. However, there have been no explorations of the degree to which this structure (as measured by the SF12v2) differentiates between mental and physical health for Māori or non-Māori.

The self-rated health measure is a very general measure of health. Specific indicators of health such as chronic condition indicators are likely to be imperfectly correlated with work capacity in many cases (Bound, 1991). The SF12v2 overcomes these issues, in that it summarises various aspects of health relevant for the participation decision, particularly health related functional limitation, the extent to which health affects daily activities and bodily pain, in addition to perception of general health (Ware*, et al.*, 2002).

There is increasing recognition of the value in using the SF12v2, rather than its more established SF36v2 parent measure, in population-based research. First, the SF12 survey versions are considerably smaller than their SF36 parent measures, which reduce participant burden and item redundancy, while increasing participant response likelihood (Han*, et al.*, 2002; Ion*, et al.*, 2011).

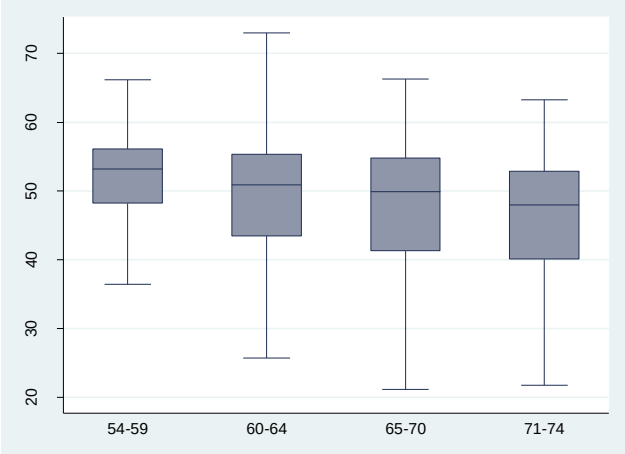
Second, there is little explanatory power lost in choosing the SF12v2 over the SF36v2. The composite and sub-scale scores from the SF12v2 show excellent compatibility with those derived from the SF36v2 across a variety of populations (see Lee*, et al.*, 2008; Ware*, et al.*, 2002) and also show very good internal reliability, and excellent convergent validity with existing self-rated measures of physical and mental health (Cheak-Zamora*, et al.*, 2009).

Third, although potentially open to self-report bias, research consistently shows that the SF12 physical and mental health scores reliably predict the likelihood of condition onset, hospitalisation and mortality across different populations (Arnold*, et al.*, 2009; Dorr*, et al.*, 2006; Haring*, et al.*, 2011).

Finally, opportunities for cross-national comparative analyses are now increasing as considerable effort is being invested in standardising it for use in non-English speaking countries, including China (Lam*, et al.*, 2010), Iran (Montazeri*, et al.*, 2011; Rohani*, et al.*, 2010), and Israel (Bentur and King, 2010). Thus, the brevity of the SF12v2, the focus on the same health domains as the SF36v2, and its increasing international applications explain why it is rapidly becoming the measure of choice for large population-based health surveys (Cheak-Zamora*, et al.*, 2009; DiBonaventura*, et al.*, 2011).

Table 4 shows the distribution of the SF12v2 physical health summary measure over age groups.

Table 4 – Distribution of SF12v2 physical health summary measure



Source: HWR and NZLSA longitudinal sample

Note: Boxes consist of the median and inter-quartile range. The whiskers terminate at the adjacent values.

Table 5 summarises the SF12 health scores for those in the work force and those retired, by age group and gender. It appears that there is little difference in the mental health scores between the working and the retired. However, those retired (both male and female) have lower physical health scores than their counterparts in participation. A five-unit change in the SF12 scores indicates a clinically-significant change in health status.

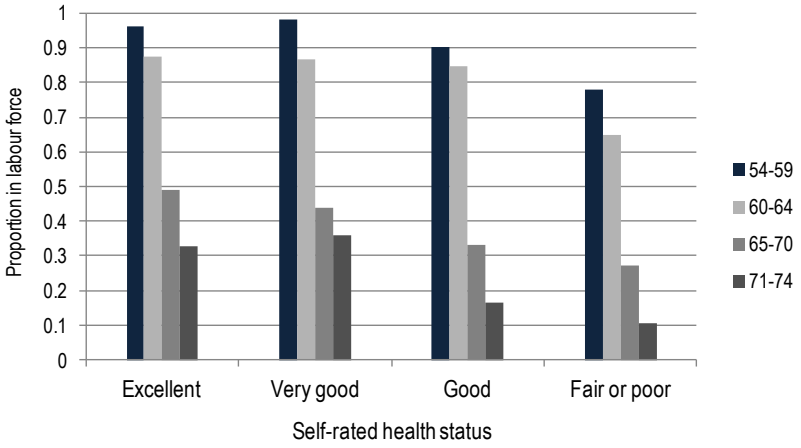
Table 5 – Mean SF12 health scores: by gender, participation and age group

		Males			Females		
Age group		Retired	Participating	Total	Retired	Participating	Total
54-64	Physical	44	50	50	45	51	50
	Mental	55	55	55	54	54	54
65-74	Physical	46	50	48	45	49	46
	Mental	53	55	54	55	56	55

Source: HWR and NZLSA longitudinal sample

On average, those who are retired have poorer health status. However, poor health is not a barrier to participation for all. In fact, a large proportion of individuals who indicate they are in fair or poor health remain in the workforce. This is reflected in Figure 4, which indicates the proportion of individuals participating by age group and self-rated health status. While the likelihood of participation decreases with age and health, there remain many individuals in fair or poor health in the labour force.

Figure 4 – Proportion participating by age group and health status

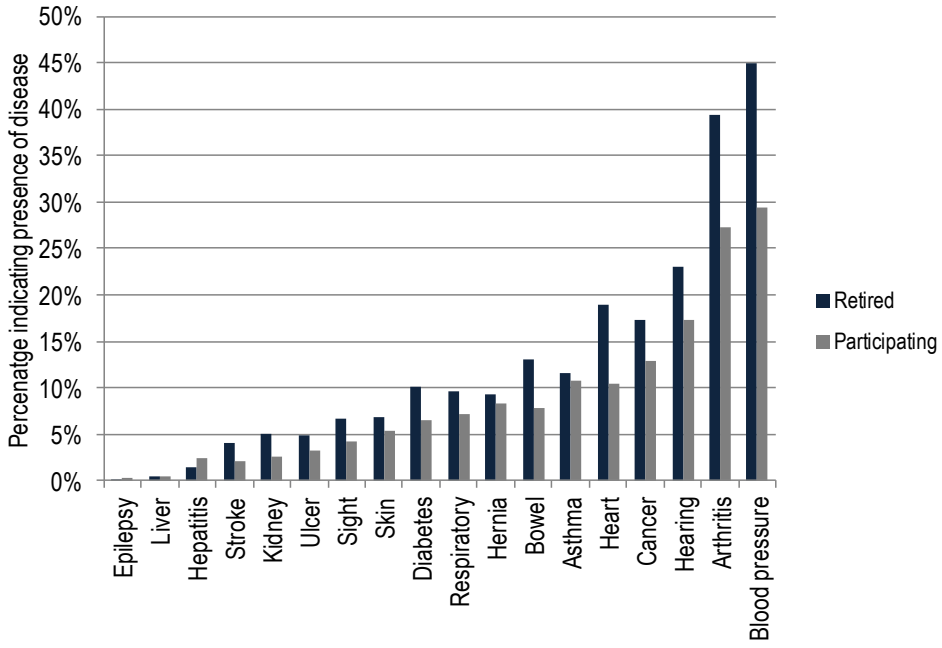


Source: HWR and NZLSA longitudinal sample

4.2.2 Chronic conditions

The HWR and NZLSA survey allow respondents to indicate the presence of numerous chronic health conditions (eg, heart trouble, diabetes mellitus, and visual impairment). Figure 5 shows the proportion of retired and participating individuals with various chronic conditions. For all conditions, a higher proportion of retired individuals have a chronic condition relative to those participating. Arthritis and high blood pressure are the most prevalent. The results are consistent with the argument that earlier retirement is associated with the incidence of a chronic condition.

Figure 5 – Prevalence of chronic conditions by labour force status.



Source: HWR and NZLSA longitudinal sample

Table 6 indicates the proportion of those with a particular chronic condition who are retired and participating, respectively. For example, 60% of individuals with high blood pressure indicate that they are working or seeking work. This contrasts with the 82% of individuals reporting no conditions, who indicate that they are in work or seeking work.

The individuals with high blood pressure have a lower proportion of workers than those reporting no condition: 82%-60% gives a difference of 22 percentage points. It would appear from this simple bivariate comparison that those with high blood pressure are less likely to be participating.

However, is important to also consider the prevalence of the condition to gain an estimate of the size of the population affected. To this end, the change in probability moving between no reported conditions to a particular condition is multiplied by the sample prevalence of that condition (then scaled by 10, with no loss of generality). This produces a prevalence-weighted change in proportion. For example, in the case of high blood pressure, the change when weighted by prevalence is (60.06-81.9)*0.34*10 = -74.

Table 6 – Prevalence-weighted proportions of chronic condition

Condition	Retired	Participating	Change in proportion participating	Prevalence	Change in participation weighted by prevalence
	%	%	%	%	%
Diabetes	40	60	-22	8	-17
Epilepsy	19	81	-1	0	0
Blood pressure	40	60	-22	**34**	**-74**
Heart	44	56	-26	**13**	**-34**
Asthma	32	68	-14	11	-15
Respiratory	37	63	-19	8	-15
Ulcer	39	61	-21	4	-8
Liver	25	75	-7	0	0
Bowel	42	58	-24	9	-22
Hernia	33	67	-14	9	-13
Kidney	35	65	-17	3	-6
Arthritis	39	61	-21	**31**	**-64**
Sight	41	59	-23	5	-11
Hearing	37	63	-18	**19**	**-35**
Stroke	45	55	-27	3	-7
Cancer	37	63	-19	**14**	**-27**
Hepatitis	30	70	-12	2	-3
Any condition	34	66			
No condition	18	82			

Source: HWR and NZLSA longitudinal sample

Notes: 1. This table indicates the proportion of cases reporting condition x in retirement and participation respectively; the change in proportion participating between those reporting condition x and those reporting no condition, the overall prevalence of a condition, and finally this change weighted by the prevalence of condition x.
2. The bolded text indicates the five most critical conditions, ranked by prevalence-weighted change in proportion.

The weighted changes suggest that high blood pressure, heart problems, arthritis, cancer and hearing impairment are conditions which have important implications for labour force participation decision and affect a relatively large proportion of the population of interest.

Table 7 – Most important conditions associated with lower labour force participation

Based on having the lowest proportion participating relative to no condition	After weighting for prevalence
Stroke	High blood pressure
Heart	Arthritis
Bowel	Hearing
Sight	Heart
Diabetes	Cancer
High blood pressure	

Source: HWR and NZLSA longitudinal sample

5 Modelling labour force participation

This section will explore the relationship between various health measures and labour force participation. In the first instance, we address a series of challenges that arise in attempting to estimate this relationship. The following two sections outline the modelling approaches adopted in this study.

5.1 Methodological challenges

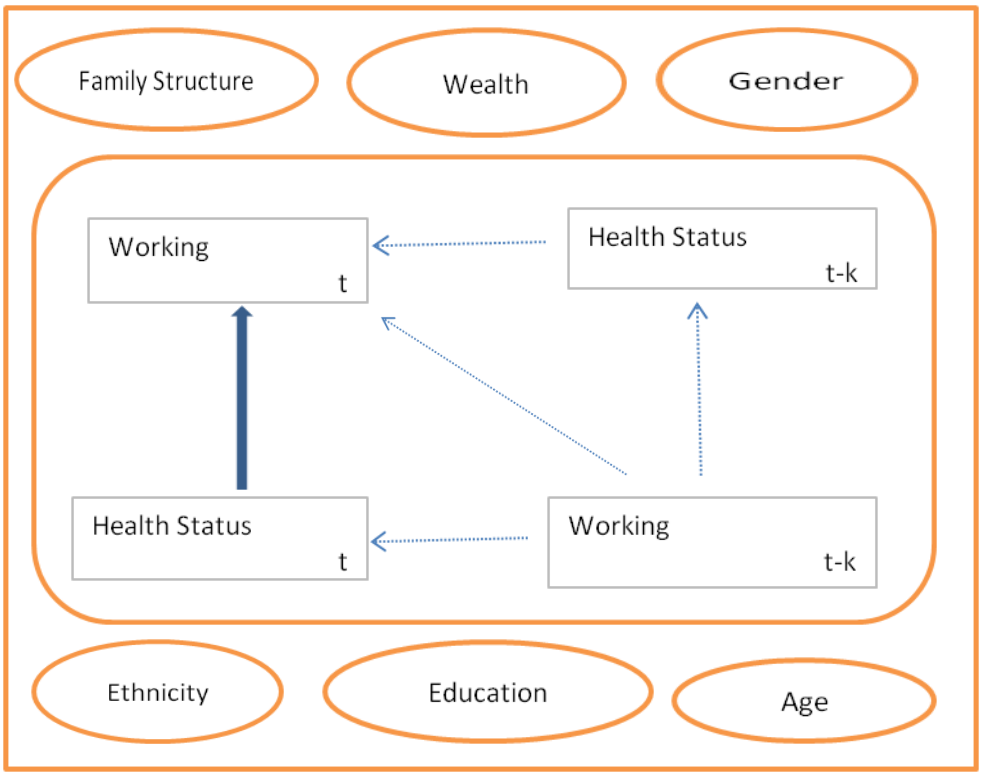
A relationship of particular interest is that between health and participation. However, it is difficult to establish robustly whether there is a direct relationship between health status and labour force participation, as health and retirement are jointly determined; and finding an appropriate measure of health can be problematic. Longitudinal data with multiple health measures are advantageous, as the change to retirement can be tracked over time for each individual, together with any associated changes in health status.

An issue faced when attempting to isolate the determinants of labour force participation is the potential influence of factors we cannot observe on an individual's health, wealth and labour market decisions.

Examples of unobservable differences between people, which may generate a spurious relationship, include heterogeneity of family background, education, culture and preferences. Early-childhood socioeconomic status and health conditions, as well one's further upbringing and life events, are important in human capital development and health investment decisions over the lifecycle (Tubeuf*, et al.*, 2012). These shape many outcomes in older ages, including labour-market engagement and health status. They also influence cognitive functioning and other measures associated with successful ageing, for example engagement in voluntary work, caregiving and social networks (Brandt*, et al.*, 2012).

Figure 6 presents a schematic depiction of some of the complex linkages between health and participation. This paper focuses primarily on the contemporaneous relationship between health and work status, denoted by the bolded arrow, controlling for the confounding factors indicated on the periphery. Given the longitudinal nature of the data, an individual's history of health status over the sample frame can be taken into account, in addition to contemporaneous health status. However, the full effects of the trajectory of health throughout the life course, and previous interactions between health and other components of human capital (for example, education) cannot be captured without a significantly longer panel, or a retrospective study.

Figure 6 – A schematic view of health and work interdependencies



Source: Enright and Scobie (2010)

Another source of heterogeneity is individual habits and preferences. Preferences and habits which influence behaviour are common factors which affect outcomes such as wealth accumulation, health and participation. A specific example is time preference, which may be theoretically related to health as follows. As formalised by Grossman (1972), health can be seen as an endogenous capital stock which is inherited at birth, depreciates with age, and can be augmented by investment in health over the life-cycle. Investments in this stock are a product of inputs such as the individual's time, as well as consumable goods and services such as medical care and diet. The efficiency of health production is influenced by "environmental" factors such as education; more educated and informed individuals are assumed to be more "efficient producers" of good health. A key difference between health and traditional human capital, such as education, is that health capital may be subject to adverse shocks. Increased investment in health leads to a lower susceptibility to shocks. Myopic individuals may under-invest in health capital, as well as in human capital. Consequently, we observe them to have a lower average level of health, have a higher susceptibility to health shocks, and a lower lifetime propensity to work, regardless of any causal effect of health on participation.

This kind of unobserved heterogeneity seems especially relevant for older individuals, as such attitudes, habits and preferences may be well cemented, or their effects have materialised, by the time the individual reaches the age of interest here. This further highlights the importance of attempting to account for these effects. Moreover, this distinction between a causal or spurious relationship is important for policy.

If there were, indeed, a causal link between health and participation, increased public provision of health care may well be effective in increasing and/or lengthening spells of participation. However, if such a link were rebutted in favour of the unobserved common factors hypothesis (ie, unobserved heterogeneity), attempting to increase labour force

participation by increasing health funding may be futile, as the genuine underlying cause would be left unaddressed. In this case, a more appropriate policy response would perhaps be policies targeted toward those who may be likely to have sub-optimal outcomes in a range of areas, including, but not limited to, health, wealth and participation, owing to unobserved preferences and habits accumulated over the life course.

To gain a more robust indicator of a relationship, one may examine how changes in health are related to labour force participation, as opposed to examining health and participation at one point in time. This is one of the strengths of longitudinal data. However, it must be noted that this method in itself does not provide definitive answers to the direction of causality.

5.2 Model framework

5.2.1 A pooled model

This section outlines the modelling framework and assumptions. Assume that the desire to be in the labour force can be captured by a latent index denoted *y**, which represents preference for work. The higher *y**, the more likely an individual is to be in the labour force, and vice versa. When *y** becomes positive, the preference for work is realised as $Y_{it} = 1$, and the *i*-th individual is observed to be in the labour force at time *t.*

This preference for work is likely to reflect such factors as age, health, household income, wealth, marital status, access to pensions and other financial benefits, and spousal work status. The first model employed is a pooled logit regression. This relates the probability of participation to a range of explanatory variables, whilst imposing uniform intercepts and slopes for all individuals, as in equation (1).

$$Y_{it} = 1(y^* > 0) = 1(\mathbf{X}_{it}`\beta + \mathbf{Z}_i`\theta + u_{it} > 0) \quad (1)$$

The latent index *y** is a function of time varying (*X)* and time invariant *(Z)* covariates, in addition to an idiosyncratic error term (u_{it}). This specification is susceptible to problems such as omitted-variable bias, stemming from unobserved heterogeneity, and reverse causality. As such, the resulting coefficients do not necessarily imply a causal relationship.

5.2.2 An extended model

A limitation of the pooled model is that it does not account for the potentially confounding effects of unobserved heterogeneity. In an attempt to address this issue, we theorise that participation in the labour force is a function of the characteristics that are observed and reported in the survey, as well as permanent unobservable characteristics which differ between individuals (eg, time preference, motivation).

$$Y_{it} = 1(\mathbf{X}_{it}`\beta + \mathbf{Z}_i`\theta + \alpha_i + u_{it} > 0) \quad (2)$$

This relationship can be estimated using a logit model with random effects, as in equation (2); where once again *X* and *Z* are time-varying and time-invariant regressors respectively, α_i is a normally-distributed individual specific effect, and u_{it} is an

idiosyncratic error term. This model accounts for the unobserved effects α_i; however, a restrictive assumption is that the unobservables (α_i) are assumed to be random, and independent of the covariates. This is unrealistic in this context. As such, a correlated random effects framework will be used, whereby the theorised relationship between time-varying covariates and permanent unobservables is explicitly parameterised, in an effort to account for these correlated unobservable differences between people (Chamberlain, 1984; Mundlak, 1978; Wooldridge, 2001). This is done by splitting the individual specific term α_i into a component, which is correlated with time-varying observables; and a random error term η_{it}, which is assumed to be independent of covariates by construction.

$$\alpha_i = \sum_{t=1}^{3} x_{it}`\lambda_t + \eta_{it} \tag{3}$$

The coefficients λ represent the extent of the correlation between the unobserved heterogeneity and the time-varying covariates; that is, λ will be equal to zero only in the case where the time-varying explanatory variables are unrelated to the unobservable effects. Following Mundlak (1978), λ is restricted to be the same over time, so $\lambda_1 = \lambda_2 = \lambda_3 = \lambda$, leading to a simpler proxy for this relationship, given by:

$$\alpha_i = \bar{X}_i`\lambda + \eta_{it} \tag{4}$$

Substituting (4) into (2) gives:

$$Y_{it} = 1(\mathbf{X}_{it}`\beta + \mathbf{Z}_i`\theta + \bar{X}_i`\lambda + \eta_{it} + u_{it}) > 0 \tag{5}$$

Here, $\bar{X}_i$ is the individual specific average of a covariate, and η_{it} and X_{it} are assumed to be conditionally independent given $\bar{X}_i$.[4]

The final specification which includes a term intended to capture differences between people ($\bar{X}_i$)[5], as well as a term which captures changes within individuals over time (X_{it}). As outlined earlier, there may be theoretical reasons to believe that the within and between effects may differ, due to omitted person-specific explanatory variables which affect the mean level of health, yet do not imply a causal effect.

5.3 Determinants of labour force participation

This section presents the results of two models for explaining labour force participation based on the contribution of a range of variables. The first model is a pooled logit model, based on equation (1). Three specifications are presented, using different measures of health to explain the binary choice between participation and retirement: the presence of a chronic condition; SF12 summary measures of functional physical and mental health; and finally the self-rated general health rating. The pooled models do not attempt to control for issues mentioned previously such as unobserved omitted variables bias and reverse causality. They act, however, as a base model with which to compare

[4] Note that any potential correlation between the errors and time-invariant regressors is not addressed, and this model relies on the assumption that the effects of unobserved heterogeneity are transmitted in a linear fashion through the individual specific time averages.

[5] Specifically, the coefficients on time means represent the *difference* between the between and within effects.

further estimates. This is followed by the results for the correlated random effects model based on equation (5), which exploits the longitudinal aspect of the data. The key findings are summarised in the tables in this section, with complete results in Appendix C.[6]

5.4 Results

5.4.1 Results from a pooled model (SF12 measures)

The initial results from the pooled model employing the SF12 indices as measures of health are summarised in Table 8. The figures presented are average marginal effects on the probability of participation.[7] For example, in the case of net wealth, the initial predicted probability of participation is 72.1%; this corresponds to the lowest net wealth quartile. In moving to quartile two, the predicted probability of participation falls to 71.2%, a decrease of 0.9 percentage points.

It appears that both better physical and mental health are associated with significantly greater probability of remaining in the labour force. A five-unit (clinically significant) increase in the physical health status measure (SF12v2 PCS) yields a 2.6 percentage point increase (or 4% increase) in the average likelihood of being in the labour force.[8]

However, while the effects of improved health are significantly associated with higher labour force participation, the absolute magnitudes of the effect are modest.

To demonstrate this point, we can consider how the predicted participation rate for individuals aged 65 to 74 would change, if they had the average reported health status of the group aged 54 to 64. The predicted participation rate for the 65 to 74 age group at their observed level of health is 38%. This would increase to approximately 41% were they to have the physical health status of the 54 to 64 age group, ie, explaining a small proportion of the drop in participation between these groups. Hence, whilst health status does play a role in participation, it is clearly not a constraint for all. Other factors appear to be of greater importance, in particular, financial incentives.

Becoming eligible for New Zealand Superannuation reduces the likelihood of being in the labour force by 20.5 percentage points. Likewise, receipt of other superannuation income or transfers reduces the likelihood of participation by 12.4 and 8.3 percentage points, respectively.

Other controls include indicators for region (urban or rural), survey year, income of other household members, migrant status, number of financial dependents and attitude toward retirement. An individual's attitude toward retirement is captured in two binary indicators derived from questions relating to perceptions of retirement. One represents a negative perception of retirement (for example, expecting to feel unproductive and bored), and the other indicating a more positive outlook (for example, looking forward to spending more time on hobbies or volunteer work). Full results are presented in Appendix C.

---

6 All regressions are unweighted.

7 See Appendix A for more details of the logit regression model.

8 An average marginal effect (AME) computes the difference between the *average* probabilities of participation in two states. This is as opposed to a marginal effect at the average, which would compute one marginal effect, for the case of the "average" person. These two methods produce very similar effects for the models in this section.

Table 8 – Factors associated with a change in the probability of participation based on a pooled model

Dependent variable = Participation (base= retired)	Initial probability	After the change	Marginal effect
Net wealth (base = lowest quartile)	72.1		
Quartile 2		71.2	-0.9
Quartile 3		68.6	-3.5 *
Highest quartile		66.6	-5.5 **
Ethnicity (base = Euro)	68.7		
Māori		71.9	3.2 *
Other		64.9	-3.8
Highest qualification (base = none)	66.4		
Secondary school		70.8	4.4 ***
Tertiary		72.8	6.4 **
Gender (base = male)	71.5		
Female		67.8	-3.7 **
Financial incentives			
NZS recipient	81.3	61.0	-20.3 ***
Other superannuation	70.7	62.4	-8.3 ***
Benefit recipient	70.6	58.2	-12.4 ***
Number of financial dependents	72.7	77.8	5.1 ***
Health status (five unit increase from sample mean)			
Physical (SF12)	70.0	72.6	2.6 ***
Mental (SF12)	69.5	70.6	1.1 ***
Marital status (base = married, non-working spouse)	64.9		
Separated		76.6	11.7 ***
Widow/er		70.7	5.8 **
Never married		64.3	-0.6
Married, working spouse		70.6	5.7 ***
Age	73.5	70.0	-3.5 ***
N = 3953			

Source: HWR and NZLSA longitudinal sample

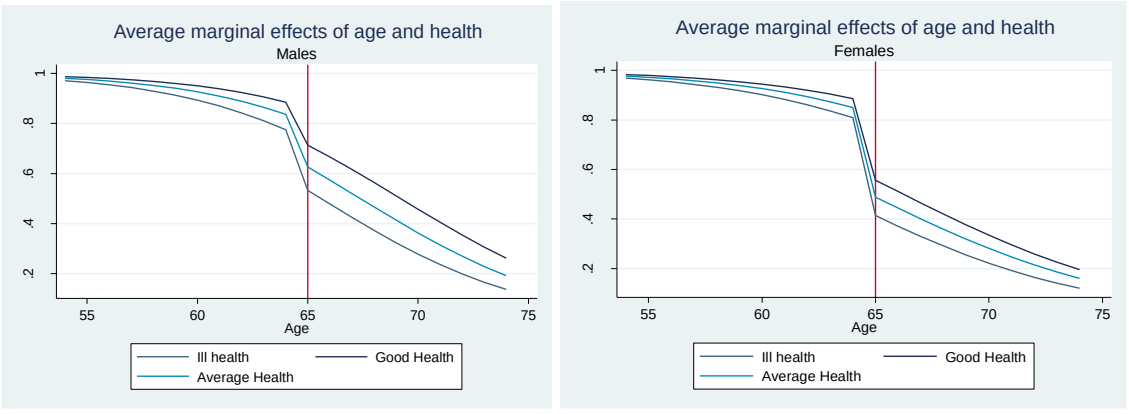
Notes:
1. Other controls are for region, survey year, log income of others in household, migrant status, number of financial dependents, attitude toward retirement.
2. Standard errors are adjusted to reflect the fact that multiple observations for each individual are used.
3. Significance levels (***) 0.01 (**) 0.05 (*) 0.10
4. Figures presented are average predicted probabilities, and marginal effects respectively.

Age is significantly associated with participation; individuals are less likely to participate as they grow older. Additionally, individuals tend to experience health declines with increasing age. One concern is that if the effects of age are inadequately captured in the model, the health variable may pick up some of effect of age, resulting in a biased estimate of the effect of health. A range of more flexible age specifications was tested, to allow non-linearities in the effect of age. After controlling for the wide range of other factors employed, the coefficient on health was found to be robust to various different functional forms for age.

This model was also estimated separately for males and females, to allow differing responses by gender. We find mostly similar effects, including the effects of health status. Key exceptions include marital status: for married males, having a working spouse as opposed to a non-working spouse is associated with a higher likelihood of being in work; specifically a 7.5 percentage point (or a 9.9%) increase in the likelihood of participation. For females, the dissolution of marriage has a significant positive association with labour force participation.

Figure 7 shows how the average predicted probability of participation (as opposed to retirement) changes with age and health status. “Ill health” and “good health” here are defined by a one-standard-deviation change in the SF12v2 physical health summary measure around the mean. When age is fixed at 65 and physical health is set at one standard deviation above the sample mean, the average predicted probability of participation for males is 70%. Setting health at one standard deviation below the mean to represent ill health, the average predicted probability of participation falls to 53%. This implies a marginal change in the probability at age 65 of 17 percentage points, ie, on average, males aged 65 in good health are 17 percentage points more likely to be participating than those in ill health. For females, this difference is 15 percentage points. It is apparent that, holding all else constant, lower physical health is associated with a reduced probability of participation.

Figure 7 – Marginal effects of age and health on labour force participation



Source: HWR and NZLSA longitudinal sample

5.4.2 Results for pooled model (chronic condition)

To isolate the association between chronic conditions and labour force participation, holding other observable factors constant, a logit regression was estimated relating probability of participation to economic and demographic characteristics as well as chronic conditions, separately for males and females.

For males, high blood pressure, heart and kidney conditions and cancer all have significant negative associations with labour force partipation. For females, high blood pressure and heart problems are also significant, as well as arthritis and kidney problems. These results are consistent with the simpler descriptive calculations of Table 6.

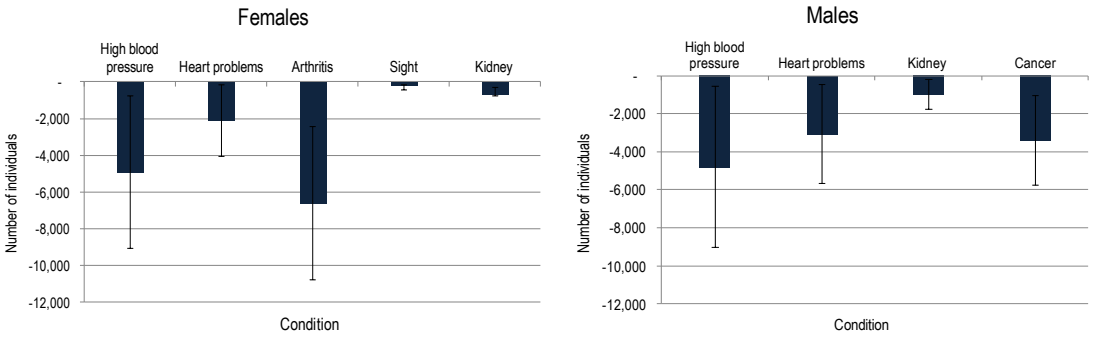
Note that these results must interpreted carefully; they are do not necessarily imply causal effects. It is likely that for many individuals, living with a chronic condition means that they cannot work. However, this may not be the case for all. For example, high blood pressure may be seen by the individual as an indicator of an overly stressful and unhealthy lifestyle, which may be a catalyst in prompting retirement regardless of treatment options available. This is in contrast to high blood pressure in itself impairing work capacity. Indeed, qualitative research examining the HWR dataset identified multiple health-related pathways to retirement, including health preservation and a desire to maximise the remainder of one's healthy years, particularly after being confronted by a health scare (Pond*, et al.*, 2010).

Moreover, individuals with an unhealthy lifestyle may be more likely to develop certain conditions, such that if this condition were to be "cured", or the symptoms managed, there may still be underlying issues (health or otherwise) which make employment less likely.

However, we may think of these "marginal effects" as lower and upper bounds of the effects of a chronic condition on aggregate participation, by multiplying the change in probability of participation by the size of the population affected.

Figure 8 indicates the implied decrease in aggregate participation. The vertical whiskers indicate 95% bounds of confidence. These clearly indicate that overall arthritis and high blood pressure are the most critical conditions in relation to labour force participation.

Figure 8 – Prevalence-weighted marginal effects (females and males)



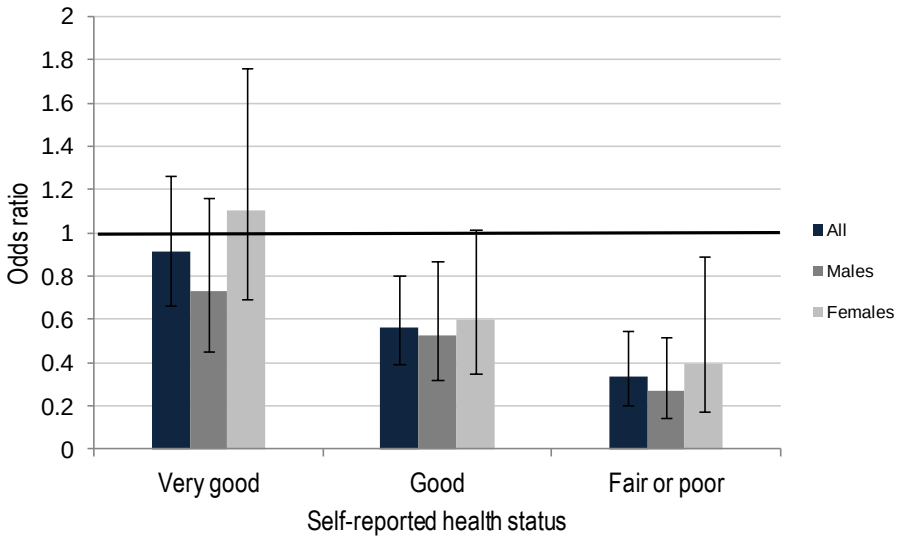
Source: HWR and NZLSA longitudinal sample.

5.4.3 Results from a pooled model (self-rated health)

The corresponding regression of participation status on demographic and health variables was also estimated using self-rated health status in place of SF12v2. Figure 9 displays the results of this alternative specification. It shows how the odds of participation relative to retirement change when a respondent indicates he or she is in very good, good or fair/poor health, relative to the base category of excellent health. The *odds* of an event occurring is the probability of that event occurring divided by the probability that it will not occur. In this context, the *odds ratio* compares the odds of participation in two different states, specifically, the odds of participation in very good, good or fair/poor health relative to the odds of participation in excellent health. If an odds ratio is not significantly different from 1, then we cannot say that the odds of participation are different in health state *x* compared with health state *y*.

It is apparent that being in any health state aside from excellent is associated with decreased odds of participation; however, only good and fair/poor show statistically significant effects at the 95% level.

Figure 9 – Odds of participation, by health status relative to excellent health



Source: HWR and NZLSA longitudinal sample

Note: Effects are significant if the confidence interval does not cross the horizontal line at 1.

Based on these results, we can compare the predicted probabilities of participation. For males, the marginal change in the average likelihood of participation at age 65 from being in good health relative to excellent is a 13 percentage point reduction; and a 28 percentage point reduction for fair/poor health. For females, the change is an 11 percentage point reduction in moving to good health, and 19 percentage points less for fair/poor.

5.4.4 Transitions

Information concerning the relationship between health and participation can be gleaned from examining transitions over time. Table 9 summarises the transitions in self-rated health over successive waves. Only 54% of those reporting excellent health remained in excellent health in the following wave. The results also highlight that changes in health status are not always to a lower status. Of those reporting their health status was good, 27% report an improvement to very good in the following wave of the survey.

Table 9 – Self-rated health transitions

Self-rated health		Excellent	Very good good	Good	Fair/poor	Total
		Health status in wave *t+1*				
	Excellent	54	41	4	s	100
Health status	Very good	11	64	24	2	100
in wave *t*	Good	1	27	60	12	100
	Fair/poor	*s*	5	39	55	100
	Total	14	44	33	9	100

Source: HWR and NZLSA longitudinal sample

Note: *s* indicates an underlying sample size to small for inference.

We now address the following question: To what extent do changes in labour force participation correspond to changes in self-rated health status? To answer this, three specific labour force transitions are examined. These are:

A. Moving from participation in the current period to retirement in the following period.

B. Remaining in the labour force for two consecutive periods.

C. Remaining retired in two consecutive periods.

The results for these three cases are summarised in Table 10. Consider the case of those who move from work to retirement in consecutive periods: Was this associated with declining self-rated health status? The evidence in panel A of Table 10 is that 21% reported a decline in self-rated health status, 61% reported no change in health status, while the remaining 18% reported their health status improved.

Panel B of Table 10 reports on the transitions of those who remained in work in successive periods. 60% of these reported no change in health status, while 17% reported an improvement in self-rated health status.

Finally, panel C summarises the transitions of those remaining in retirement: 61% of these individuals reported no change in health status, 17% an improvement and 22% a decline.

To summarise, those moving to retirement from participation do not appear to report a more significant decline in self-rated health than those remaining in work; 17% of those who continue to work reported an improvement in health, only marginally below 18% for those who moved into retirement. There is no evidence from these descriptive statistics that self-rated health declines more significantly among those who remain in retirement.[9] The relationship between changes in health and labour force participation will be examined in more detail in the next sections, using multiple measures of health, and more advanced methods.

[9] Retirement to labour force participation was considered. Sample sizes within health transitions, however, were too small for meaningful inference.

Table 10 – Self-rated health transitions by labour force transitions

			Retired(t+1)		
A.		Excellent	Very good	Good	Fair or poor
Participating(t)	Excellent	6%	3%	0%	0%
	Very good	5%	26%	11%	3%
	Good	0%	10%	20%	4%
	Fair or poor	0%	0%	3%	9%
			Participating (t+1)		
B.		Excellent	Very good	Good	Fair or poor
Participating(t)	Excellent	10%	8%	1%	0%
	Very good	5%	30%	10%	1%
	Good	0%	8%	17%	3%
	Fair or poor	0%	1%	3%	3%
			Retired(t+1)		
C.		Excellent	Very good	Good	Fair or poor
Retired(t)	Excellent	6%	4%	1%	0%
	Very good	3%	20%	11%	1%
	Good	1%	7%	22%	5%
	Fair or poor	0%	1%	5%	13%

Source: HWR and NZLSA longitudinal sample

5.4.5 Results of extended model

This section exploits the longitudinal dimension of the data,[10] using a panel logit regression with random effects.[11] By including individual specific means for particular variables, we endeavour to account for the potentially confounding effects of correlated unobserved individual level effects.[12] The health measures used in this section are the two SF12v2 measures (PCS and MCS).

The SF12v2 measure of health is our preferred measure of health, as it overcomes many of the potential shortfalls in the self-rated measure; it comprises more concrete and specific survey questions about functional limitations and bodily pain, in addition to perceptions of general health. Using the SF12v2 physical and mental health summary scores, we find a significant effect of health on participation. Once again, the models were run separately for males and females. The results are summarised in Table 11, and compared with the pooled estimation.

For males, the change associated with a 5-unit negative shock to physical health status is a 2 percentage point (or a 3%) decrease in the average likelihood of participation, holding all else constant. About one quarter of males in the sample experienced such a health shock during the sample period. One interpretation of this result is that there is

[10] A likelihood-ratio test rejected the hypothesis that the share of variance due to individual specific unobserved heterogeneity is equal to zero, indicating that a panel model is more appropriate than a pooled model; and a Wald test of the joint null hypothesis that all cluster means coefficients are equal to zero was rejected, rejecting the null hypothesis of equal within-and-between effects for the final model specification.

[11] A conditional fixed-effect logit (Chamberlain, 1980) was also estimated for comparison with the correlated random effects estimates. Similar effects of health are found, and these are presented in Appendix B.

[12] The time means of all time-varying variables were not included, to maximise information used where it was not useful to examine within and between effects separately. Specifically, where the between and within effects did not differ significantly at the 5% level, a time mean was not included, as suggested in *Multilevel and Longitudinal Modelling in Stata* (Rabe-Hesketh and Skrondal, 2008) .

indeed a direct effect running from physical health shocks to the retirement decision for males.

For females, after accounting for unobserved heterogeneity, the effect of physical health visible in the pooled model disappears. This suggests that health is important for explaining differences in female participation at a point in time, but health shocks are not influential in shaping females' decisions, on average. Possible explanations for this may be lagged responses to health shocks not picked up in the sample period; a propensity to be employed in jobs with more flexible hours or part-time work; or in jobs which are less physically demanding. Women we observe to be in the work at this point may be selected to be more strongly attached to the labour force than males.

Family structure – being married with a working spouse, relative to being married with a non-working spouse – is an important factor for males. Moving from a non-working spouse to a working spouse is associated with an average effect of a 4-percentage-point (or 5%) increase in the likelihood of participation. That is, males who partner with females who continue working are more likely to do so themselves.

For females, this is not a significant effect. This may reflect a preponderance of traditional household structures in that it is more common for females to be a secondary earners and to exit the labour force earlier than their partners, whereas this is less common for males.

The effects of marital status appear to affect participation in a different way for females than males. The dissolution of marriage – separation, divorce, becoming a widow – is significant and has a positive association with participation. This may reflect the gender asymmetry of financial dependence in many households. Women are traditionally more likely to be relatively financially dependent on their partners, having spent more time removed from the labour force in home production and child-bearing over their life-cycle. The removal of this financial support may force, or encourage, some women back in the labour force, leading to the positive association between divorces and being a widow on the likelihood of participation.

We find the effects of education to be gender-specific; having a secondary or tertiary education is strongly associated with participation for females. However, there are no significant effects for males.

Financial incentives appear to be important for both genders, as we see those in receipt of government transfers less likely to be participating; and receipt of New Zealand Superannuation to discourage participation significantly. Net wealth appears to be more important for females; having the financial security of higher household net wealth is associated with a lower probability of participation.

Table 11 – Comparison of correlated random effects (CRE) and pooled models

	Males				Females			
	CRE		POOLED		CRE		POOLED	
	Average marginal effects							
Dependent variable: **Participation** (base = retired)								
Net wealth (base = lowest quartile)								
Quartile 2	2.3		1.8		-2.3		-2.9	
Quartile 3	4.2		1.1		-5.6	**	-7.5	***
Highest quartile	-1.8		-3.2		-4.1		-6.6	**
Highest qualification (base = none)								
Secondary school	2.9		2.6		7.1	***	6.5	***
Tertiary	3.7		4.2		1.9	**	8.8	**
Financial incentives								
NZS recipient	-10.9	***	-11.8	***	-17.8	***	-21.7	***
Other superannuation	-2.9		-8.9	***	-6.4		-6.2	*
Benefit recipient	-5.6		-11.2	***	2.5		-15.1	***
Number of financial dependents	1.6		2.7	**	2.5		8.1	***
Health status (five-unit change)								
Physical (SF12)	2.4	***	4.1	***	0.0		3.1	***
Mental (SF12)	0.1		0.9	*	0.1		1.3	**
Marital status (base = married with working spouse)								
Separated	4.9		7.6		15.0	***	14.4	***
Widow/er	3.2		5.1		4.8		6.4	*
Never married	-6.5		-5.7		8.8		5.5	
Married, working spouse	4.0	**	6.4	***	2.4		3.5	
Age	-3.5	***	-3.4	***	-4.7	***	-3.2	***
N	2004		2004		1949		1949	

Source: HWR and NZLSA longitudinal sample.

Notes: 1. Other controls are for survey year, log income of others in household, migrant status, region, attitude toward retirement, ethnicity; time averages are included for physical health, receipt of benefits or other superannuation.
2. Significance levels (***) 0.01 (**) 0.05 (*) 0.10.
3. Figures presented are average marginal effects, and predictions assume the random effect (ai) to be zero.

6 Discussion and conclusions

This study has examined the factors associated with labour force participation among older New Zealanders. Increased labour force participation is one potentially important source of adjustment in the face of an ageing population, particularly given continued increases in life expectancy.

We used a rich data set based on a longitudinal survey of older New Zealanders, first surveyed in 2006. Follow-up waves of data collection took place in 2008 and 2010. Earlier work by Enright and Scobie (2010), using cross-sectional data from the first wave, established a significant association between health status, marital status, spousal work status and labour force participation. However, analyses based on observations at a single point in time may lead to biased estimates.

Indeed, it is quite possible that a cross-sectional survey could reveal that while those in better health on average are more likely to be in the workforce, changes in the health status of an individual may or may not alter that individual's probability of participating in the labour force. The real value of longitudinal data is that these latter changes over time can be used to analyse the underlying relation between health status and labour force participation.

Our results highlight that changes in health status are not always to a lower status. Of those reporting their health status was good, 27% report an improvement to very good in the following wave of the survey. Additionally, only 54% of those reporting excellent self-rated health remained in excellent health in the subsequent wave.

We find an association between both mental and physical health, and labour force participation. At age 65, the predicted probability that males in good health are in the labour force is 70% (using a relatively objective measure of health). This falls to 53% for those in ill health, a decline of 17 percentage points. For females, the corresponding drop is 15 percentage points.

Similar results were obtained using a self-rated health measure. The predicted probability of participating in the labour force is 28 percentage points lower for those males in fair or poor health, relative to those reporting excellent health. For females, the corresponding decline is 19 percentage points.

Based on the longitudinal aspect of the data, we find that changes in physical health as measured by the SF12 index are significant in explaining the labour force status of males; this suggests there may be a direct effect of health on retirement for males. However, this was not the case for females. The relationship between physical health and participation for females disappears after accounting for unobserved influences.

The presence of some chronic conditions is significantly associated with a lower likelihood of participation (although, again, not necessarily implying causal effects). For both males and females, high blood pressure, kidney and heart problems are significantly associated with lower probabilities of remaining in the workforce. After the prevalence of each of the chronic conditions is taken into account, high blood pressure and arthritis are the two most critical chronic conditions associated with lower labour force participation.

The measures we have for health status at best are a proxy for the true underlying health status of an individual, and in addition, observed health status is a reflection of

many unobservable influences (such as genetic endowments). While this study has had access to longitudinal data which in principle helps to isolate changes over time, the period covered by the survey (2006 to 2010) is relatively short, and encompasses just three observations. Ideally one would want a longitudinal dataset covering many more years to begin to isolate the dynamic interrelationships between health and retirement.

Nonetheless, it is clear that health has an effect on labour force participation, particularly for unusually large health shocks. However, the observed decline in health status as individuals age explains a relatively small proportion of the aggregate decline in participation of older individuals. Ill health appears to be a constraint for some proportion older individuals, but not all. Of far greater importance universally are other factors, such as financial incentives. For instance, we found New Zealand Superannuation substantially reduces the likelihood of remaining in the labour force. This was true also for those individuals in receipt of other superannuation income or government transfers.

Other factors, such as changing social norms and expectations of older individuals, phased retirement, and flexible work arrangements are likely to be important in encouraging increased participation. This, coupled with the increasing investment in human capital by successive cohorts, suggests an optimistic outlook for the labour market contribution of older New Zealanders.

In addition to the issue of higher rates of labour force exit of older workers, the rate of return to the labour force after a shock is of importance for increasing aggregate participation. Removing barriers to participation – age-based discrimination, limited opportunities for retraining and up-skilling, for example – may also aid in encouraging this inflow, mitigating the likelihood of a temporary withdrawal from employment becoming permanent.

In summary, we find poor health and eligibility for benefits or pensions to encourage exit from the labour force for both males and females; whilst continued employment of a spouse is associated with further participation for males. For females, financial security appears to be a relatively important factor: higher household net wealth is associated with earlier retirement, and the dissolution of marriage with a higher likelihood of participation. Additionally, we find that unobservable effects, specific to the individual, explain a substantial proportion of the retirement decision.

The fact that unobservable differences between individuals play an important role in the retirement decision merely highlights the fact that human behaviour is complex, and the decisions individuals and households make at any time are based on many more factors than what can be captured in a survey. Those decisions are framed by a lifetime's experience and accumulated behaviours. Contemporaneous factors are important in explaining differences in outcomes, but policy interventions to encourage successful ageing should be enacted throughout the life course.

7 References

Alpass, Fiona, Christine Stephens, Jack Noone and Andy Towers (2008). *Health differences among retirees and workers: Findings from the New Zealand Health, Work and Retirement Study.* Paper presented at the Gerontological Society Of America 61st Scientific Meeting, Resilience in an Ageing Society: Risks and Opportunities. The Gerontologist.

Arnold, Suzanne, Karen Alexander, Frederick Masoudi, MIchael Ho, Lan Xiao and John Spertus (2009). The effect of age on functional and mortality outcomes after acute myocardial infarction. *Journal of the American Geriatrics Society, 57*(2), 209-217.

Bentur, Netta and Yaron King (2010). The challenge of validating SF-12 for its use with community-dwelling elderly in Israel. *Quality of Life Research, 19*(1), 91-95.

Borsch-Supan, Axel, Agar Brugiavini, Hendrik Jurges, Arie Kapteyn, John Mackenbach, Johannes Siegrist*, et al* (2008). *First Results from the Survey of Health, Ageing and Retirement in Europe (2004-2007)*. Mannheim: Mannheim Research Institute for the Economics of Aging (MEA).

Bound, John (1991). Self-reported versus objective measures of health in retirement models. *The Journal of Human Resources, 26*(1), 106-138.

Bound, John, Michael Schoenbaum, Todd Stinebrickner and Timothy Waidmann (1998). *The dynamic effects of health on the labor force transitions of older workers* (No. 6777): NBER.

Brandt, Martina, Christian Deindl and Karsten Hank (2012). Tracing the origins of successful ageing: The role of childhood conditions and social inequality in explaining later life health. *Social Science and Medicine, 74*, 1418-1425.

Bryant, John, Audrey Teasdale, Martin Tobias, Jit Cheung and Mhairi McHugh (2004). *Population Ageing and Government Health Expenditures in New Zealand, 1951-2051*. Wellington: NZ Treasury.

Butterworth, Peter, Sarah Gill, Bryan Rodgers, Kaarin Anstey, Elena Villamil and David Melzer (2006). Retirement and mental health: Analysis of the Australian National Survey of mental health and well-being *Soc Sci Med, 62*(5), 1171-1191.

Cai, Lixin and Guyonne Kalb (2007). Health status and labour force participation of older working-age Australian men. *Australian Journal of Labour Economics, 10*(4), 227-252.

Cai, Lixin and Guyonne Kalb (2006). Health status and labour force participation: evidence from Australia. *Health Economics, 15*(3), 241-261.

Chamberlain, Gary (1980). Analysis of covariance with qualitative data. *The Review of Economic Studies, 47*, 225-238.

Chamberlain, Gary (1984). Panel Data. In Z. Griliches & M. Intrilligator (Eds.), *Handbook of Econometrics* (pp. 1247-1318). Amsterdam: North-Holland.

Cheak-Zamora, Nancy, Kathleen Wyrwich and Timothy McBride (2009). Reliability and validity of the SF-12v2 in the medical expenditure panel survey. *Quality of Life Research, 18*, 727-735.

Currie, Janet and Brigitte Madrian (1999). Health, health insurance and the labour market. In O. Ashenfelter & D. Card (Eds.), *Handbook of Labour Economics Volume 3*. Amsterdam: Elsevier.

Deschryvere, Mathias (2005). *Health and retirement decisions: an update of the literature* (No. 6): The Research Institute of the Finnish Economy.

DiBonaventura, Marco, Shaloo Gupta, Margaret McDonald and Alesia Sadosky (2011). Evaluating the health and economic impact of osteoarthritis pain in the workforce: results from the National Health and Wellness Survey. *BMC Musculoskeletal Disorders, 12*(83), (Open Access Journal: http://www.biomedcentral.com/1471-2474/1412/1483).

Disney, Richard (1996). *Can we afford to grow older? A perspective on the economics of ageing.* Cambridge, MA: MIT Press.

Disney, Richard, Carl Emmerson and Matthew Wakefield (2003). *Ill-health and retirement in Britain: A panel-data based analysis*. London: Institute for Fiscal Studies.

Dixon, Sylvia (2003). Implications of population ageing for the labour market *Labour Market Trends*, 67-76.

Dorr, David, Spencer Jones, Laurie Burns, Steven Donnelly, Cherie Brunker, Adam Wilcox*, et al* (2006). Use of health-related, quality-of-life metrics to predict mortality and hospitalizations in community-dwelling seniors. *Journal of the American Geriatric Society, 54*, 667-673.

Enright, Jamas and Grant Scobie (2010). *Healthy, wealthy and working: retirement decisions of older New Zealanders* (No. 10/02). Wellington: The Treasury.

Grossman, Michael (1972). On the concept of health capital and the demand for good health. *Journal of Political Economy, 80*(2), 223-255.

Han, Cong, Christopher Pulling, Susan Telke and Katherine Huppler Hullsiek (2002). Assessing the utility of five domains in SF-12 Health Status Questionnaire in an AIDS clinical trial. *AIDS, 16*, 431-439.

Haring, Robin, You-Shang Feng, Jorn Moock, Henry Völzke, Marcus Dorr, Matthias Nauck*, et al* (2011). Self-perceived quality of life predicts mortality risk better than a multi-biomarker panel, but the combination of both does best. *BMC Medical Research Methodology, 11*, 103.

Hurnard, Roger (2005). *The effect of New Zealand Superannuation eligibility age on the labour force participation of older people* (No. Working Paper No.05/09). Wellington: The Treasury.

Idler, Ellen and Yael Benyamini (1997). Self-rated health and mortality: a review of 27 community studies. *Journal of Health and Social Behaviour, 38*(1).

Ion, Allyson, Wenjie Cai, Dawn Elston, Eleanor Pullenayegum, Fiona Smaill and Marek Smieja (2011). A comparison of the MOS-HIV and SF-12v2 for measuring health-related quality of life of men and women living with HIV/AIDS. *Research & Therapy, 8*(5), 2-9.

Khawaja, Mansoor and Bill Boddington (2009). Too early to retire? Growing participation of older New Zealanders in the labour force. *New Zealand Population Review, 35*, 75-93.

Lam, Cindy, C. Wong, E. Lam, Yvonne Lo and W. W Huang (2010). Population norm of Chinese (HK) SF-12 health survey_version 2 of Chinese adults in Hong Kong. *The Hong Kong Practitioner, 32*, 77-86.

Lee, Ellen, Lisa Browell and Dina Jones (2008). Measuring health in patients with cervical and lumbosacral spinal disorders: Is the 12-item Short-Form Health Survey a valid alternative for the 36-item Short-Form Health Survey?. *Archives of Physical Medicine and Rehabilitation, 89*, 829-833.

Maestas, N and J. M. Zissimopoulos (2010). How longer work lives ease the crunch of population aging. *Journal of Economic Perspectives, 24*, 139-160.

Maurer, Jurgen, Roger Klein and Francis Vella (2011). Subjective health assessments and active labor market participation of older men: Evidence from a semi-parametric binary choice model with non-additive correlated individual-specific Effects. *The Review of Economics and Statistics, 93*(3), 764-774.

Montazeri, Ali, Mariam Vahdaninia, Sayed Mousavi, Mohsen Asadi-Lari, Sepideh Omidvari and Mahmoud Tavousi (2011). The 12-item medical outcomes study short form health survey version 2.0 (SF-12v2): a population based validation study from Tehran, Iran. *Health and Quality of Life Outcomes, 9*, 1-12.

Mundlak, Yair (1978). On the pooling of time series and cross section data. *Econometrica, 46*(1), 69-85.

OECD (2005). *Live longer, work longer*. Paris, France.

Pond, Rachael, Christine Stephens and Fiona Alpass (2010). How health affects retirement decisions: Three pathways taken by middle-older New Zealanders. *Ageing & Society, 30*, 527-545.

Rabe-Hesketh, Sophia and Anders Skrondal (2008). *Multilevel and longitudinal modelling using Stata* (Second Edition ed.). Texas: Stata Press, StataCorp LP.

Roberston, A and C. S. Tracy (1998). Health and productivity of older workers. *Scandinavian Journal of Work, Environment & Health, 24*, 85-97.

Rohani, C, H. A Abedi and A Langius-Eklöf (2010). The Iranian SF-12 Health Survey Version 2 (SF-12v2): Factorial and convergent validity, internal consistency and test-retest in a healthy sample. *Iranian Rehabilitation Journal, 8*, 48-55.

Scott, Kate M., Diana Sarfati, Martin I. Tobias and Stephen J. Haslett (2000). A challenge to the cross-cultural validity of the SF-36 health survey: factor structure in Māori, Pacific and New Zealand European ethnic groups. *Social Science and Medicine, 51*, 1655-1664.

Statistics New Zealand (2009). National Population Projections: 2009 (base) - 2061. Wellington: Statistics New Zealand.

Tubeuf, Sandy, Florence Jusot and Damien Bricard (2012). Mediating the role of education and lifestyles in the relationship between early-life conditions and health: evidence from the 1958 British cohort. *Health Economics, 21*(1), 120-150.

Vodopivec, Milan and Primoz Dolenc (2008). *Live longer, work Longer: Making it happen in the labor market*: The World Bank.

Ware, John E., Mark Kosinski and James E. Dewey (2000). *How to score version 2 of the SF-36 Health Survey*. Lincoln, RI: QualityMetric Incorporated.

Ware, John E., Mark Kosinski, Diane Turner-Bowker and Barbara Gandek (2002). *How to Score Version 2 of the SF-12 Health Survey*. Lincoln, RI.

Westerlund, Hugo, Mika Kivimaki, Archana Singh-Manoux, Maria Melchior, Jane Ferrie, Jaana Pentti*, et al* (2009). Self-rated health before and after retirement in France (GAZEL): a cohort study. *Lancet, 374*, 1889-1896.

Wooldridge, Jeffrey M. (2001). *Econometric Analysis of Cross Section and Panel Data*. MIT Press Books, The MIT Press.

8 Appendix A

8.1 Statistical methods

This study makes extensive use of discrete choice models, specifically logit models. These are used to model discrete outcomes: for example, participation in the labour force (*Y=1*) as opposed to being retired (*Y=0*). The outcomes of interest (*Y)* are theorised to be a function of a set of explanatory variables, *X.* This section will provide a brief explanation of the binary outcome logit case.

The probability of "success" (*Y=1)* is denoted *p* and is assumed to follow a logistic distribution.

$$\Pr(\mathrm{Y}=1) = p = \frac{1}{(1+e^{-Z})} \tag{1}$$

where $Z = \alpha + \sum_{i=1}^{k} \beta_i X_i$.

Suppose the probability of some event denoted *p* is 0.8 (eg, the probability that a respondent is in the labour force). The probability that the individual is not in the labour force is then *1-p = 1-0.8 = 0.2.* The *odds* of the event are defined as the ratio of the probability of "success" to the probability of "failure":

$$\mathrm{Odds} = \frac{p}{1-p} \tag{2}$$

In the above example, this would be *0.8/(1-0.8) = 4*. In other words, the odds of a person participating (relative to being retired) are four to one.

The estimated coefficients from this model describe the amount by which the *log odds* change in response to a one-unit change in the corresponding X_i.

By working with the logarithm of the odds, the problem of the restricted range for of probability is circumvented. The transformation to logarithmic odds maps the underlying probability whose range is from zero to one, into a variable with range from negative infinity to positive infinity. This is referred to as a logit transformation.

We now sketch the use of this transformation in the estimation of the coefficients associated with the explanatory variables in the underlying model. Let *p* be the probability of success. Then:

We can now show that *Z* is equal to the log of the odds. Rearranging equation (1) to solve for *Z* yields:

$$e^{Z} = \frac{p}{1-p},$$

and taking natural logarithms of both sides gives:

$$\ln\left[\frac{p}{1-p}\right] = \ln(e^{Z}) = \alpha + \sum_{i=1}^{k} \beta_i X_i \tag{3}$$

Hence we can see a linear relationship between covariates and the log odds, contrasting with the non-linear relation between covariates and the probability of success.

We can now proceed to estimate equation (3), in this case using maximum likelihood estimation, an iterative procedure which searches for that set of values for α and the set of β such that the probability of observing the dependent variables in the sample of data is maximised. The logit specification is advantageous in that it generates predicted probabilities which lie between zero and one, and it can be extended to incorporate panel-data methods; one potential limitation, however, is the somewhat arbitrary imposition of the logistic distribution for the error term.

8.2 Interpreting the logit regression

We turn now to the interpretation of the coefficients in the logit equation. The estimated values of each of the coefficients describe the amount by which Z, the log odds, changes in response to a one-unit change in the corresponding X_i.

However, this interpretation is not especially intuitive. A preferable approach is to consider the impact of a unit change in a particular X_j on the odds rather than the log odds. The *odds ratio* is defined as

$$\text{Odds ratio} = \frac{\text{odds evaluated at a particular set of values}}{\text{odds evaluated at a different set of values}} \tag{6}$$

ie, it is the ratio of two odds. Consider the following which involves finding the odds ratio for a one unit change in say X_1:

$$\text{Odds ratio} = \frac{e^{[\alpha+\beta_1(X_1+1)+\sum_{j=2}^{k}\beta_j X_j]}}{e^{[\alpha+\beta_1 X_1+\sum_{j=2}^{k}\beta_j X_j]}} \tag{7}$$

This expression reduces to e^{β_1} as all other terms cancel out. This result simply states that, for a one-unit increase in X_1, the ratio of the odds between the base level and the increased level is given by e^{β_1}. It is constant; specifically, it does not depend on the values of the other variables (X_j). Note that while the odds ratio is constant, this does not imply that the odds themselves are constant at various values of the X_j. In fact, owing to the multiplicative effect, the actual change in the odds depends on the starting point. An odds ratio of two would increase odds of one to two, and odds of two to four.

Another way to interpret the output of logit models is to consider the probability of success with some explanators fixed at certain values of interest. This can be used to evaluate the marginal effect of a specific change; for example, the marginal effect on the probability of participation in moving from ill to good health. The baseline probability of success is denoted by p_0 (eg, ill health), and p_1 represents the probability of success after a change (eg, to excellent health).

$$\textit{Average marginal effect} = p_1 - p_0$$

Here, p_0 is found by predicting the probability of participation for each individual, whilst fixing the variable of interest at a certain level, for example, setting health as "ill health". Then the average predicted probability of participation over all individuals can be calculated.

The same procedure is then enacted to find p_1, now setting health to represent "good health" for all individuals (for example). The difference between these average probabilities is the marginal effect of health, as health status is the only thing that has changed; all other explanators are left as they are originally observed.

9 Appendix B

9.1 Representativeness at baseline and sample attrition

A primary goal for the sample selection process of any national study is to ensure that the final sample accurately represents the national population which it is intended to reflect. Table 1 illustrates the degree to which the HWR Māori and non-Māori sub-samples from the baseline survey in 2006 reflect the demographic characteristics of the New Zealand 55 to 70 year old Māori and non-Māori populations, as per demographic data from the 2006 New Zealand National Census (Statistics New Zealand, 2011).[13]

Table 12 shows that both the HWR baseline sub-samples (Māori and non-Māori) align closely with their respective New Zealand populations, as evident in the proportions of (1) participants across age groups, (2) men and women, (3) those in full time work, and (4) those with no secondary-school qualifications. However, in comparison to their respective populations, the HWR baseline sub-samples both have perceptibly higher proportions than expected of people who are (1) currently in relationships (partnered), (2) in part-time work versus retired/other, (3) tertiary educated, and (4) earning above $20,000. In this regard, as opposed to the New Zealand population aged 55-70, the HWR sample in general reflects a disproportionately greater number of New Zealanders who are still working.

Table 12 – Demographic characteristics of HWR sample at baseline (2006) in comparison with their age-matched New Zealand populations

	Māori		Non-Māori	
	HWR sample	NZ 55-70	HWR sample	NZ 55-70
Sex				
Male	44.12% (1369)	47.61% (20544)	47.01% (1603)	49.12% (255735)
Female	55.88% (1734)	52.39% (22608)	52.99% (1807)	50.88% (264870)
Age (year groups)				
55-59	41.36% (1187)	43.18% (18633)	38.82% (1235)	39.53% (205779)
60-64	30.56% (877)	29.69% (12810)	32.25% (1026)	30.73% (159975)
65-70	28.08% (806)	27.13% (11709)	28.92% (920)	29.74% (154854)
Marital status				
Partnered	63.97% (1985)	53.86% (21726)	76.56% (2616)	70.76% (359592)
Separated	16.82% (522)	22.49% (9072)	12.47% (426)	16.58% (84267)
Widowed	12.60% (391)	15.15% (6111)	6.91% (236)	7.49% (38088)
Never married	6.61% (205)	8.49% (3426)	4.07% (139)	5.17% (26265)
Work status				
Working full-time	41.49% (1217)	41.37% (17850)	42.17% (1460)	44.01% (229107)
Working Part-time	19.62% (562)	13.85% (5976)	22.62% (765)	15.50% (80715)
Unemployed	2.44% (70)	2.63% (1134)	1.03% (35)	1.28 (6663)
Other (including retired)	35.44% (1015)	42.15% (18189)	33.18% (1122)	39.21% (204126)

[13] The distinction between Māori and non-Māori in this table (and henceforth) reflects prioritised responses (see Statistics New Zealand, 2001) to HWR ethnicity questions rather than the Electoral Roll-based categorisation used for sample selection purposes.

Educational qualifications				
No secondary	57.01% (1508)	57.35% (20514)	38.50% (1160)	35.15% (169314)
Secondary	9.72% (257)	21.08% (7539)	15.07% (454)	29.95% (144240)
Post-secondary	12.25% (324)	8.60% (3075)	15.50% (467)	11.16% (53775)
Tertiary	21.02% (556)	12.97% (4641)	30.93% (932)	23.74% (114321)
Annual income ($)				
0-20,000	38.27% (843)	52.10% (19572)	33.18% (927)	43.25% (212922)
20,001-35,000	22.47% (495)	23.55% (8847)	20.33% (568)	22.02% (108411)
35,001-70,000	32.09% (707)	20.53% (7710)	32.93% (920)	25.49% (125505)
70,001+	7.17% (158)	3.82% (1434)	13.56% (379)	9.24% (45507)

Source: HWR wave 1 and 2006 Census.

Notes: 1. Sub-sample given in parentheses. These may vary from sample total due to missing data.
2. For the purposes of comparing with the Census, approximately 375 participants are excluded from the age-group analysis as they were 54 years old at the time of the wave 1 survey. This reflects the imprecision of the Electoral Roll's age-indicator which is based on participants' "birth year" rather than their specific birth-date. Four further participants were excluded from the age-group analysis, as they reported ages beyond the 70-year upper limit.
3. Secondary = high school; post secondary = trade or polytechnic; tertiary = university

The demographic characteristics of the cross-sectional baseline sample were compared with the HWR longitudinal sample characteristics at wave 2 and wave 3 (see Table 13).

These results suggest that the wave 2 sample is comprised of baseline participants who are more likely to be working, in better health, better educated and less likely to smoke, but more likely to consume alcohol. The transition from wave 2 to wave 3 highlighted an ethnicity-specific divergence in demographic hallmarks. Whereas Māori in wave 3 were more likely than attritors to be partnered, in better health, and non-smoking, the non-Māori in wave 3 were more likely than attritors to be female, educated, non-smokers and more frequent drinkers. These differences should be borne in mind when considering the results and conclusions of the analysis.

Table 13 – Changes in the characteristics of the HWR sample across waves using baseline data from 2006.

		Baseline (2006)	Wave 2 (2008)	Wave 3 (2010)
Total number		***6,657***	***2,472***	***1,835***
	Māori	3,117	1065	707
	Non-Māori	3,540	1407	1128
Mean age (SD)				
	Māori	60.79 (4.69)	61.00 (4.59)	61.16 (4.63)
	Non-Māori	61.07 (4.69)	61.15 (4.48)	61.29 (4.50)
Females				
	Māori	55.88% (1734)	56.17% (596)	54.69% (385)
	Non-Māori	52.99% (1807)	51.31% (707)	52.67% (581)
Partnered (married/de facto)				
	Māori	63.97% (1985)	65.60% (696)	68.14% (479)
	Non-Māori	76.56% (2616)	76.56% (1055)	77.54% (856)
Working (full & part-time)				
	Māori	62.12% (1779)	64.84% (649)	65.57% (438)
	Non-Māori	65.79% (2225)	69.40% (948)	68.97% (758)
Lives in urban centre (30,000+)				
	Māori	42.46% (1289)	43.40% (454)	43.62% (304)
	Non-Māori	52.38% (1808)	51.26% (714)	51.84% (579)
% Current smoker				
	Māori	22.39% (683)	18.80% (198)	16.50% (115)
	Non-Māori	12.95% (450)	11.33% (158)	10.28% (115)
Educational qualifications				
Māori	No secondary	56.27% (1508)	45.85% (431)	45.24% (285)
	Secondary	9.59% (257)	10.11% (95)	8.89% (56)
	Post-secondary	12.09% (324)	14.57% (137)	14.92% (94)
	Tertiary	22.05% (591)	29.47% (277)	30.95% (195)
Non-Māori	No secondary	38.12% (1160)	31.14% (383)	30.29% (299)
	Secondary	14.92% (454)	15.20% (187)	14.49% (143)
	Post-secondary	15.35% (467)	15.77% (194)	15.40% (152)
	Tertiary	31.61% (962)	37.89% (466)	39.82% (393)
Economic living standard				
Māori	Hardship	37.74% (685)	33.28% (207)	30.60% (123)
	Comfortable	49.09% (891)	50.16% (312)	51.24% (206)
	Good	13.17% (239)	16.56% (103)	18.16% (73)
Non-Māori	Hardship	20.53% (403)	18.50% (151)	17.78% (117)
	Comfortable	51.55% (1012)	53.92% (440)	53.50% (352)
	Good	27.92% (548)	27.57% (225)	28.72% (189)
Current health				
Māori	Fair/poor	20.77% (640)	17.77% (188)	15.63% (110)
	Good	34.21% (1054)	31.47% (333)	31.25% (220)
	Very good/excellent	45.02% (1387)	50.76% (537)	53.13% (374)
Non-Māori	Fair/poor	12.28% (431)	10.16% (142)	9.45% (106)
	Good	31.30% (1099)	29.28% (409)	29.14% (327)
	Very good/excellent	56.42% (1981)	60.56% (846)	61.41% (689)
Alcohol consumption				
Māori	Never	26.78% (824)	22.37% (236)	20.86% (146)
	Monthly or less	27.95% (860)	27.68% (292)	27.57% (193)
	2-4 times per month	16.28% (501)	17.06% (180)	16.86% (118)
	2-3 times per week	14.53% (447)	16.02% (169)	16.14% (113)
	4 or more times per week	14.46% (445)	16.87% (178)	18.57% (130)
Non-Māori	Never	15.37% (539)	12.65% (177)	11.41% (128)
	Monthly or less	17.88% (627)	16.44% (230)	16.49% (185)
	2-4 times per month	16.14% (566)	16.80% (235)	17.83% (200)
	2-3 times per week	20.87% (732)	21.16% (296)	21.39% (240)
	4 or more times per week	29.74% (1043)	32.95% (461)	32.89% (369)

9.2 Attrition from baseline to wave 2

Comparing the baseline data for Māori participants completing wave 2 with those Māori only completing the baseline (henceforth "wave 2 dropouts") shows that there was no significant change in participant mean age or the proportion of Māori participants who were female, partnered, living in urban vs. rural centres. However, compared to wave 2 completers, the Māori wave 2 dropouts were significantly *less* likely to be working (X^2(1, 2864) = 4.84, p<0.028, Φ = .04), *less* educated (χ^2(3, 2680) = 71.83, p<0.001, Φ = .16), had significantly *lower* living standards (χ^2(2, 1815) = 13.48, p<0.001, Φ = .09), were in *poorer* health (χ^2(2, 3031) = 22.31, p<0.001, Φ = .09), were *more* likely to smoke (χ^2(1, 3051) = 11.88, p<0.001, Φ = .06) though consumed alcohol *less* frequently (χ^2(4, 3077) = 21.21, p<0.001, Φ = .08).

Comparing non-Māori wave 2 completers with wave 2 dropouts shows that there was no change in the proportion of non-Māori who were female, partnered, living in urban vs. rural centres, or in participants' living standards. However, compared to wave 2 completers, non-Māori wave 2 dropouts were slightly older (*t*(3378) = -.83, p<.035), were significantly *less* likely to be working (χ^2 (1, 3382) = 13.27, p<0.001, Φ = .06), *less* educated (χ^2(3, 3043) = 52.45, p<0.001, Φ = .13), were in *poorer* health (χ^2 (2, 3511) = 18.50, p<0.001, Φ = .07), were *more* likely to smoke (χ^2(1, 3476) = 5.36, p<0.021, Φ = .04), though consumed alcohol *less* frequently (χ^2(4, 3507) = 22.66, p<0.001, Φ = .08).

9.3 Attrition from wave 2 to wave 3

Comparing Māori participants who completed wave 3 with the Māori wave 3 dropouts revealed that there were no significant changes in mean age or the proportion of participants who were female, working, and living in urban vs. rural centres. Nor was there any difference in the distribution of participants across levels of education and living standards, or in the frequency of drinking. However, in comparison to wave 3 completers, wave 3 dropouts were significantly *less* likely to be partnered (χ^2(1, 1061) = 5.95, p<0.015, Φ = .08), were in *poorer* health (χ^2(2, 1058) = 7.81, p<0.05, Φ = .09), and *more* likely to smoke (χ^2(1, 1053) = 7.17, p<0.01, Φ = .08).

Comparing non-Māori participants who completed wave 3 with the non-Māori wave 3 dropouts revealed that there were no significant changes in the proportion of participants who were partnered, working, living in urban vs. rural centres. Nor was there any difference in the distribution of participants across levels of living standards and health. However, in comparison to wave 3 completers, wave 3 dropouts were significantly *more* likely to be men (χ^2(1, 1378) = 4.14, p<0.05, Φ = .06) and smokers (χ^2(1, 1394) = 6.31, p<0.05, Φ = .07), *less* likely to be educated (χ^2(3, 1230) = 8.18, p<0.05, Φ = .08), and had slightly lower frequency of alcohol consumption (χ^2(4, 1399) = 10.66, p<0.05, Φ = .09).

10 Appendix C

Table 14 – Pooled logit (SF12)

	Pooled logit					
	All		Males		Females	
	or/se		or/se		or/se	
Dependent variable = participation (base=retired)						
Log other HH income	0.990		0.969		1.008	
	(0.019)		(0.028)		(0.025)	
Net wealth quartiles (base=lowest quartile)						
Quartile 2	0.929		1.163		0.787	
	(0.144)		(0.277)		(0.165)	
Quartile 3	0.751	*	1.096		0.536	***
	(0.124)		(0.259)		(0.126)	
Highest quartile	0.640	**	0.768		0.576	**
	(0.118)		(0.194)		(0.153)	
Ethnicity (base=Euro)						
Māori	1.295	*	1.375		1.189	
	(0.178)		(0.269)		(0.233)	
Other	0.740		0.514		0.942	
	(0.235)		(0.287)		(0.348)	
Highest qualification (base=none)						
Secondary	1.430	***	1.243		1.722	***
	(0.195)		(0.239)		(0.341)	
Tertiary	1.682	**	1.412		2.084	**
	(0.363)		(0.426)		(0.667)	
Gender (base=male)	0.743	**				
	(0.099)					
Negative attitude toward retirement	1.850	***	1.997	***	1.751	***
	(0.234)		(0.334)		(0.343)	
Positive attitude toward retirement	0.864		0.771		1.027	
	(0.117)		(0.139)		(0.210)	
NZS	0.249	***	0.378	***	0.164	***
	(0.037)		(0.079)		(0.035)	
Other superannuation	0.517	***	0.479	***	0.594	*
	(0.099)		(0.117)		(0.172)	
On a benefit	0.375	***	0.397	***	0.285	***
	(0.075)		(0.114)		(0.079)	
Number of Financial Dependents	1.542	***	1.259	**	2.086	***
	(0.139)		(0.131)		(0.313)	
Physical SF12	1.042	***	1.049	***	1.037	***
	(0.007)		(0.010)		(0.010)	
Mental SF12	1.018	***	1.016	*	1.021	**

	(0.006)		(0.009)		(0.010)	
Marital status (base=married, non-working spouse)						
Separated	2.602	***	1.877		3.321	***
	(0.653)		(0.763)		(1.118)	
Widow/er	1.581	**	1.517		1.699	*
	(0.367)		(0.806)		(0.461)	
Never married	0.958		0.627		1.585	
	(0.325)		(0.287)		(0.718)	
Married, working spouse	1.567	***	1.695	***	1.343	
	(0.194)		(0.275)		(0.258)	
Region (base = main urban)						
Other urban	0.810		0.758		0.852	
	(0.118)		(0.154)		(0.177)	
Rural	0.904		0.990		0.828	
	(0.140)		(0.231)		(0.174)	
Migrant	1.149		1.211		1.074	
	(0.233)		(0.345)		(0.310)	
Age	0.804	***	0.788	***	0.811	***
	(0.017)		(0.023)		(0.026)	
N	3953		2004		1949	
Number of clusters	1432		717		716	
Avg. obs per cluster	2.8		2.8		2.7	
Pseudo R^2	0.37		0.35		0.40	
Log likelihood	-1525.7		-765.0		-738.8	

Notes: 1. Significance levels (***) 0.01 (**) 0.05 (*) 0.10.
2. Odds ratios and standard errors (in parenthesis) are presented.
3. The sample used for all regression models consists of those individuals for whom we have at least two consecutive periods of non- missing information.

Table 15 – Pooled logit (self-rated)

	Pooled logit		
	All	Males	Females
	or/se	or/se	or/se
Dependent variable = participation (base=retired)			
Log other HH income	0.989	0.971	1.005
	(0.019)	(0.029)	(0.025)
Net wealth quartiles (base=lowest quartile)			
Quartile 2	0.965	1.175	0.833
	(0.148)	(0.276)	(0.176)
Quartile 3	0.799	1.140	0.589
	(0.130)	(0.267)	(0.138)
Highest Quartile	0.695 **	0.835	0.627
	(0.126)	(0.207)	(0.165)
Ethnicity (base=Euro)			
Māori	1.280 *	1.384 *	1.161

	(0.175)		(0.268)		(0.227)
Other	0.781		0.530		1.000
	(0.250)		(0.297)		(0.385)
Highest qualification (base=none)					
Secondary	1.429	***	1.287		1.649
	(0.193)		(0.245)		(0.325)
Tertiary	1.667	**	1.428		1.977
	(0.362)		(0.426)		(0.639)
Gender (base=male)	0.703	***			
	(0.094)				
Negative attitude toward retirement	1.790	***	1.926	***	1.673
	(0.226)		(0.321)		(0.328)
Positive attitude toward retirement	0.849		0.756		1.008
	(0.115)		(0.134)		(0.208)
NZS	0.241	***	0.370	***	0.156
	(0.036)		(0.077)		(0.033)
Other superannuation	0.537	***	0.508	***	0.616
	(0.104)		(0.125)		(0.181)
On a benefit	0.350	***	0.372	***	0.271
	(0.070)		(0.108)		(0.075)
Number of financial dependents	1.530	***	1.257	**	2.069
	(0.137)		(0.130)		(0.303)
Physical SF12					
Mental SF12					
Marital status (base=married, non-working spouse)					
Separated	2.769	***	1.973	*	3.566
	(0.699)		(0.803)		(1.222)
Widow/er	1.568	**	1.590		1.671
	(0.359)		(0.860)		(0.449)
Never married	1.000		0.656		1.571
	(0.345)		(0.315)		(0.717)
Married, working spouse	1.587	***	1.658	***	1.414
	(0.198)		(0.269)		(0.270)
Region (base = main urban)					
Other urban	0.811		0.767		0.839
	(0.118)		(0.154)		(0.176)
Rural	0.904		0.942		0.862
	(0.138)		(0.215)		(0.180)
Migrant	1.173		1.257		1.115
	(0.237)		(0.356)		(0.324)
Age	0.802	***	0.786	***	0.811
	(0.017)		(0.023)		(0.026)
Self-rated health (base = excellent)					
Very good	0.913		0.727		1.103
	(0.150)		(0.175)		(0.264)
Good	0.564	***	0.526	**	0.595

	(0.101)		(0.134)		(0.162)	
Fair or poor	0.333	***	0.271	***	0.396	
	(0.084)		(0.089)		(0.163)	
N	3923		1992		1931	
Number of clusters	1432		717		716	
Avg. obs per cluster	2.7		2.8		2.7	
Pseudo R^2	0.37		0.35		0.4	
Log likelihood	-1527.0		-770.1		-735.7	

Notes: 1. Significance levels (***) 0.01 (**) 0.05 (*) 0.10.
2. Odds ratios and standard errors (in parenthesis) are presented.
3. The sample used for all regression models consists of those individuals for whom we have at least two consecutive periods of non- missing information.

Table 16 – CRE and conditional fixed-effects logit

	Females				Males			
	Fixed effects		CRE		Fixed effects		CRE	
	or/se		or/se		or/se		or/se	
Dependent variable = participation (base=retired)								
Net wealth quartiles (base=lowest quartile)								
Quartile 2	1.161		0.719		1.977		1.426	
	(0.688)		(0.269)		(1.396)		(0.662)	
Quartile 3	1.482		0.442	**	4.643	**	1.880	
	(0.921)		(0.180)		(3.507)		(0.909)	
Highest quartile	2.935		0.546		3.577		0.760	
	(2.145)		(0.256)		(2.925)		(0.370)	
Log other HH income	0.992		0.994		0.961		0.979	
	(0.100)		(0.051)		(0.056)		(0.046)	
Negative attitude toward retirement	0.479		0.739		1.235		0.960	
	(0.297)		(0.384)		(0.827)		(0.527)	
Positive attitude toward retirement	1.156		1.260		0.702		0.558	*
	(0.599)		(0.430)		(0.424)		(0.182)	
Other superannuation	0.408		0.393		0.707		0.649	
	(0.414)		(0.279)		(0.419)		(0.360)	
NZS	0.088	***	0.073	***	0.606		0.191	***
	(0.070)		(0.031)		(0.288)		(0.074)	
On a benefit	3.763		1.439		0.659		0.427	
	(3.111)		(0.942)		(0.395)		(0.240)	
Physical SF12	0.998		1.002		1.072	**	1.072	***
	(0.030)		(0.024)		(0.033)		(0.025)	
Mental SF12	1.016		1.023		1.013		1.022	
	(0.027)		(0.017)		(0.026)		(0.017)	
Marital status (base=married, non-working spouse)								

Separated	9.987	*	8.933	***	0.853	2.104	
	(13.562)		(5.940)		(0.721)	(1.470)	
Widow/er	0.627		2.017		1.197	1.632	
	(0.657)		(1.155)		(1.025)	(1.366)	
Never married	0.000		3.642		0.235	0.372	
	(0.155)		(3.953)		(0.464)	(0.337)	
Married, working spouse	0.900		1.424		1.446	1.844	**
	(0.461)		(0.494)		(0.553)	(0.554)	
Age	0.750		0.619	***	1.224	0.598	***
	(0.188)		(0.041)		(0.308)	(0.041)	
Number of financial dependents	1.384		1.481		1.008	1.121	
	(0.452)		(0.395)		(0.228)	(0.236)	
Ethnicity (base=Euro)			1.000			1.000	
			(.)			(.)	
Māori			1.211			2.113	*
			(0.447)			(0.845)	
Other			1.330			0.286	
			(1.128)			(0.241)	
Highest qualification (base=none)							
Secondary			2.827	***		1.555	
			(1.108)			(0.655)	
Tertiary			4.104	**		1.744	
			(2.596)			(1.006)	
Region (base = main urban)							
Other urban			0.699			0.564	
			(0.275)			(0.227)	
Rural			0.627			0.606	
			(0.254)			(0.263)	
Migrant			0.885			1.612	
			(0.497)			(0.893)	
Individual specific means							
Negative attitude toward retirement			6.868	***		7.030	***
			(4.943)			(5.263)	
Physical SF12			1.088	***		1.049	
			(0.035)			(0.036)	
Other superannuation			1.079			0.240	*
			(1.127)			(0.193)	
On a benefit			0.033	***		0.187	
			(0.034)			(0.200)	
Number of financial dependents			5.426	***		1.703	
N	387		1949		415	2004	
Number of clusters	141		716		146	717	
Average obs. per cluster	2.7		2.7		2.8	2.8	
Log likelihood	-86.72		-624.5		-91.56	-637.6	

ρ	0.733	0.741

Notes: 1. Significance levels (***) 0.01 (**) 0.05 (*) 0.10.
2. Odds ratios and standard errors (in parenthesis) are presented.
3. ρ is the variance share of unobserved heterogeneity.
4. The sample used for all regression models consists of those individuals for whom we have at least two consecutive periods of non- missing information. Recent work by Jeffery Wooldridge extends the correlated random effects methodology for unbalanced panels; however, these are not incorporated here.