HEDG
Health, Econometrics and Data Group
THE UNIVERSITY *of York*

HEDG Working Paper 07/19

Health and Retirement among Older Workers

Eugenio Zucchelli
Anthony Harris
Andrew M. Jones
Nigel Rice

August 2007

ISSN 1751-1976

york.ac.uk/res/herc/hedgwp

Health and Retirement among Older Workers

Eugenio Zucchelli[α], Anthony Harris[β], Andrew M Jones[χ], Nigel Rice[δ]

August 2007

Abstract

This paper investigates the causal relationship between ill-health and retirement among older working individuals. We represent the transition to retirement as a discrete-time hazard model using a stock-sample from the first five waves (2001-2005) of the Household, Income and Labour Dynamics in Australia (HILDA) Survey. Our results show that health plays an important role in individual retirement decisions and that negative shocks to health greatly increase the hazard of retirement, especially for men. This is true for both a measure of health limitations and a measure of latent health obtained using pooled ordered probit models, as well as for three alternative health shock measures. We also consider the effects of partners' health and labour market status on an individual's retirement decision. Our estimates suggest that partners' characteristics do not significantly influence individual retirement choices.

Key words: health, health shocks, discrete-time hazard model, retirement.

JEL classification: I1 C10 C41

Acknowledgments: This paper uses unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Project was initiated and is funded by the Australian Government Department of Families, Community Services and Indigenous Affairs (FaCSIA) and is managed by the Melbourne Institute of Applied Economic and Social Research (MIAESR). The findings and views reported in this paper, however, are those of the author and should not be attributed to either FaCSIA or the MIAESR.'
We would like to thank Bruce Hollingsworth and the Centre for Health Economics at the Monash University of Melbourne for their support and contributions. We also would like to thank all the members of the Health Econometrics and Data Group at the University of York, UK, for their useful comments.

[α] Department of Economics and Related Studies & Centre for Health Economics, The University of York. Correspondence: Centre for Health Economics, Alcuin "A" Block, University of York, Heslington, York, YO10 5DD, United Kingdom. Tel: +44 1904 321 411, E-mail: ez501@york.ac.uk.

[β] Centre for Health Economics, Monash University, Melbourne.

[χ] Department of Economics and Related Studies, The University of York.

[δ] Centre for Health Economics, The University of York.

1. Introduction

Most developed countries are currently experiencing trends of declining labour force participation, especially among working-age men, combined with an ageing population (Auer and Fortuny, 2000). According to the Australian Department of Treasury and Finance (Dawkins et al., 2004), the overall male participation rate has shown a steady decline of 0.3 per cent per year from 1978-2003. Data from the Australian Bureau of Statistics (ABS) show that the proportion of the population aged 65 years and over increased from 10.5 per cent to 13.3 per cent between 1986 and 2005. The aging process is accelerating. In the 12 months between June 2005 and June 2006, the number of people aged 65 years and over in Australia increased by 2.5 per cent.[1] Population projections from ABS also illustrate that the proportion aged 65 or over is predicted to increase to between 26 per cent and 28 per cent by 2051 and by between 27 per cent and 31 per cent by 2101.[2] Early retirement and population ageing pose a threat and a challenge to the sustainability of the social security system of any industrialised economy. In this context, understanding the driving forces behind them could help to implement policies to encourage postponed exit from active employment and the return of younger retirees into the labour market.

There are several factors that could potentially influence retirement choices of older working individuals. Together with institutional factors, such as the generosity of the social security system, the introduction of early retirement options and the presence of disability benefit schemes (Blundell at al., 2002), individual health status plays a major role in retirement decisions. Decline in health status, ceteris paribus, may reduce the probability of continued work for three reasons (Disney et al., 2006): poor health may raise the disutility of work, it reduces the returns from work via lower wages and by entitling individuals to non-wage income, through disability benefits, it may act as an incentive to exit the labour market.

---

[1] Australian Bureau of Statistics, *Population by age, sex, Australian states and territories*, Catalogue no. 3201.0, December 2006.

[2] Australian Bureau of Statistics, *Population Projections, Australia, 2004-2101*, Catalogue no.3222.0, June 2006.

We model these issues, and represent the transition to retirement as a discrete-time hazard model which enables us to estimate the effect of different measures of health and health shocks and a number of socio-economic characteristics on the probability of retirement. We use the stock sampling approach of Jenkins (1995) to define our sample of interest. This method, changing the unit of analysis from the individual to the time at risk of an event (in this case, retirement), allows complex sequence likelihoods to be simplified to a standard estimation for a binary outcome (Jenkins, 1998). In order to overcome the problems related to measurement error (reporting bias) and endogeneity of self-assessed measures of health, we construct a latent health stock variable which is purged of reporting bias (Bound, 1991, 1999). As retirement decisions are often observed to be taken at the household level (Michaud, 2003), the paper also considers the effect of spouses' health and labour market status on an individual's retirement decision. Previous empirical studies, based mainly on U.S. data, reveal coordination in the retirement behaviour among spouses (Michaud, 2003; Gustman and Steinmeier, 2002). However, due to the scarcity of appropriate data and the complexity of the family decision-making process, only a few studies address this topic. We thus expand the existent empirical literature on health and labour supply of older individuals (Lindeboom, 2006a) accounting for the endogenity of health in the retirement model as well as explicitly considering partners' characteristics among the determinants of the retirement choice.

Results, using panel data from the first five waves (2001- 2005) of the Household, Income and Labour Dynamics in Australia (HILDA) survey, confirm that own health plays an important role in individual retirement decisions, and that for men negative shocks to health significantly increase the hazard of retirement. For both men and women, estimated effects on marital status, partner's health and job status are not significant. This indicates that having a partner in the labour market or having a partner in ill-health is not associated with a significant increase or decrease in the hazard of retirement.

2. Background

Several studies conclude that ill-health is the main cause of retirement among older workers (Lindeboom, 2006a). However, there is still some controversy in the measurement of health and in modelling the relationship between health and work (Lindeboom, 2006a). In particular, three problems are relevant for the analysis of this causal relationship: the endogeneity of self-reported individual health measures; the bias produced by measurement errors; and the difficulties in modelling the joint retirement decision making of couples.

Anderson and Burkhauser (1985) argue that self-reported measures are not reliable and that health should be treated as an endogenous variable. Taking arguments such as this into account, more objective measures believed to be less sensitive to justification bias or state-dependent reporting bias have been used. These include observed future mortality of sample respondents (Parsons, 1980; Anderson and Burkhauser, 1985), sickness absenteeism records (Burkhauser, 1979), and indices derived from multiple indicators (Lambrinos, 1981; Bazzoli, 1985). Bound (1991) suggests that labour supply models are sensitive to the measures of health used. Using the U.K. Retirement History Survey, Bound builds a model for labour supply, wages and health and shows that each of the solutions proposed in the literature leads to different bias. In particular he argues that when self-reported measures are used, health appears to play a larger role and economic factors a smaller one than when more objective measures are used. However, more objectives measures (i.e. functional limitations) potentially lead to different biases. Objective measures, unlikely to be perfectly correlated with the aspect of health that affects an individual's capacity for work, will suffer from an error in variables problem, leading to downwardly biased estimates of the impact of health on retirement

Empirical studies on the relationship between health and retirement produce very different conclusions. Stickles and Taubman (1986) and Stern (1989) conclude that health plays a major role both on the retirement decision and labour supply. Stern (1989) finds that subjective health measures have strong and independent effects on labour supply. Kerkhofs et al. (1999) estimate a retirement model with a range of different health constructs and find that the choice of health measure affects the estimate of health on labour supply outcomes. Dwyer and Mitchell (1999) confirm these results. They specify a retirement model where true health is instrumented with a range of more objective indicators. Their results show that health has a strong effect on retirement but that the size of the effect varies with the measure used. They also find that self-rated health measures are exogenous and there is no evidence in support of justification bias. Blau and Gilleskie (2001) suggest that health-retirement models should avoid the use of a single measure of health and that health should be treated as endogenous.

More recently, the literature recognises the importance of assessing the relative significance of permanent or temporary health shocks versus a gradual deterioration of health in retirement decisions. Bound et al. (1999) specify a model for transitions between work states and a dynamic model for health, using three waves of the U.S. Health and Retirement Study. In order to correct for the endogeneity of self-assessed health they build a latent variable model that relates self-reported measures of health to a series of physical limitation measures. They find that both changes in health and the long-term level of health are important for labour supply decisions. In Germany, Riphahn (1999) finds that health shocks, defined as a sudden drop in a self-reported measure of health satisfaction, have significant effects on employment, increasing the probability of leaving the labour force. Disney et al. (2006) apply the method of Bound et al. (1999) to the first eight waves of British Household Panel Survey (BHPS), 1991 to 1998. They find that health shocks are an important determinant of retirement behaviour in UK. These results are confirmed by Roberts et al. (2006) and Hagan et al. (2006) on the British Household Panel Survey (BHPS) and European Community Household Panel (ECHP) data respectively. Lindeboom at al. (2006b) focus on the relationship between the onset of disability and employment outcomes. The results show that health shocks increase the likelihood of an onset of disability by 138 per cent. However, health shocks are relatively rare events and therefore they conclude that the majority of observed disability rates result from gradual health deterioration.

Traditionally, among structural retirement models, the focus of analysis has been on males modelled as independent decision makers. Behavioural models were estimated from data on individuals, usually men, ignoring the retirement decision of the spouse or partner (Burtless, Moffit 1984; Gustman, Steinmeier, 1986; Stock and Wise, 1990). However, recent trends in participation rates of females coupled with an increase of frequently observed joint retirement decisions (Hurd, 1990; Michaud, 2003), suggest that spouses must be considered in retirement models.

Three approaches have been followed in the literature on the determinants of retirement among older working couples (Bingley, Lanot, 2006). The first considers structural discrete choice modelling of the household as a decision unit (Rust and Phalan, 1997; Blau and Gilleski, 2004; Van der Klaaun and Woplin, 2005). A second approach assumes that spouses are involved in bargaining over the outcomes of their labour force participation. This bargaining can be cooperative (Michaud and Vermulen, 2004) or non-cooperative (Gustman and Steinmeier, 2000; 2002; 2004). A third approach relies on a variety of reduced-form models (Blau, 1998; Sedillot and Walreat, 2002; Mastrogiacomo et al., 2004).

Research on the effects of health on labour supply of older workers in Australia is rare and it is limited to individuals, especially men. Brazenor (2002) and Wilkins (2004) use the 1998 ABS cross-section Survey on Disability, Ageing and Carers (SDAC) to examine the impact of disability on earnings and employment status respectively. Brazenor shows that different types of disability have a negative impact on earnings. Wilkins finds that on average disability decreases the probability of labour force participation by one-quarter for males and one-fifth for females. Cai and Kalb (2005; 2006) analyse the relationship between health and labour participation using the HILDA Survey. They estimate a simultaneous equation model for working-age individuals to control for the potential endogeneity of health. Their estimates confirm that health has a significant effect on labour supply.

3. Econometric framework

3.1 Duration model for retirement

Our econometric specification is based on the duration model stock-sampling approach of Jenkins (1995). Following this method, we create our sample of interest by selecting only working individuals at risk of retirement (50 years old or above) in the first wave of the HILDA Survey and we follow them through the next four waves until they are observed to retire or are censored. Transition to retirement is represented using a discrete-time hazard model. This enables us to estimate the effect of two different measures of health status (a health stock measure and measure of health limitations) and a number of socio-economic characteristics (age, sex, education, job status, marital status, etc.) on the probability of retirement.

This method, controlling for stock-sampling and changing the unit of analysis from the individual to the time at risk of an event (retirement), allows a complex sequence likelihood to be simplified to the more standard estimation for a binary outcome.[3] We initially select only those who are working in wave 1. These individuals can stay in the labour force, retire, or be lost to follow-up. Retirement is considered an absorbing (permanent) state: transitions back in the labour market are not considered. Using Jenkins' (1995) notation, $t = \tau$ represents the first observation on the stock sample, $t = 1$ is the first period at which an individual is at risk of retirement (age 50). At the end of the time period some people will still be working (censored duration data, $\delta_i = 0$), and some will have retired (complete duration data, $\delta_i = 1$). If individuals are lost to follow-up before retiring these are also considered censored observations. $t = \tau + s_i$ is the year when retirement occurs if $\delta_i = 1$ and the final year of our data period if $\delta_i = 0$. Each respondent, i, contributes s_i years of employment spells. The probability of retiring at each t provides information on the duration distribution and the discrete-time hazard rate is:

[3] For the estimation in STATA, see Jenkins (1998).

$$h_{it} = \mathrm{P}\,[\mathrm{T}_i = t \mid \mathrm{T}_i \geq t\,;X_{it}] \tag{1}$$

where X_{it} is a vector of covariates which may vary with time and T_i is a discrete random variable representing the time at which retirement is observed. The conditional probability (conditional on not having retired at the beginning of the time spell) of observing the event history of someone with an uncompleted spell at interview is:

$$prob(T_i > t \mid T_i > \tau - 1) = \prod_{t=\tau}^{\tau+s_i} (1 - h_{it}) \tag{2}$$

The conditional probability of observing the event history of someone completing a spell between the initial observation, τ, and interview is:

$$prob(T_i = t \mid T_i > \tau - 1) = h_{i\tau+s_i} \prod_{t=\tau}^{\tau+s_i-1} (1 - h_{it}) = \left(h_{i\tau+s_i} / (1 - h_{i\tau+s_i})\right) \prod_{t=\tau}^{\tau+s_i} (1 - h_{it}) \tag{3}$$

The corresponding log-likelihood of observing the event history data for the whole sample is:

$$\log L = \sum_{i=1}^{n} \delta_i \log\left(h_{i\tau+s_i} / (1 - h_{i\tau+s_i})\right) + \sum_{i=1}^{n} \sum_{t=\tau}^{\tau+s_i} \log(1 - h_{it}) \tag{4}$$

Jenkins (1995) suggests simplifying the log-likelihood by defining and indicator variable y_{it}. For those still working, $y_{it} = 0$ for all periods; for those who retire, $y_{it} = 0$, for all periods except the retirement period when $y_{it} = 1$. Formally:

$y_{it} = 1$ if $t = \tau + s_i$ and $\delta_i = 1$,

$y_{it} = 0$ otherwise.

Using this indicator variable, the log-likelihood function can be re-expressed in a sequential binary response form:

$$\log L = \sum_{i=1}^{n} \sum_{t=\tau}^{\tau+s_i} y_{it} \log\left(h_{it} / \left(1 - h_{it}\right)\right) + \sum_{i=1}^{n} \sum_{t=\tau}^{\tau+s_i} \log\left(1 - h_{it}\right) \tag{5}$$

In this way, the log-likelihood function has the same form as the "standard" log-likelihood function for a binary variable, where the unit of analysis is now the spell period.[4] Following Roberts et al. (2006) and Hagan et al. (2006), we complete the specification using a complementary log-log hazard function for the hazard h_{it}:

$$h_{it} = 1 - \exp\left(-\exp\left(X_{it}\beta + \theta(t)\right)\right) \tag{6}$$

In (6), $\theta(t)$ is the baseline hazard modelled as a step function by using dummy variables to represent each period at risk.

3.2 Health stock and health shocks

Health stock measure

In order to overcome the problems associated with measurement error and endogeneity of self-assessed measures of individual health, we create a latent health stock variable. Following Bound (1991) and Bound et al. (1999), we estimate a model of SAH as a function of more objective measures of health (self-reported measures of physical limitations) to define a latent health stock. We then use the predicted values for the latent health stock as our health variable in the retirement model.

[4] Jenkins, S., P., "Easy Estimation Methods for Discrete-Time Duration Models." *Oxford Bulletin of Economics and Statistics.*, 1995, Vol. *57* (1), pp. 129-138.

We consider the aspect of health that affects an individual's decision to retire, h_{it}^R, to be a function of a set of more objective measures of health, z_{it}:

$$h_{it}^R = z_{it}\beta + \varepsilon_{it}, \qquad i = 1,2,\ldots,n; \quad t = 1,2,\ldots T_i \tag{7}$$

where ε_{it} is a time varying error term uncorrelated with z_{it}.

We do not directly observe h_{it}^R but instead a measure of SAH, h_{it}^S. We specify the latent counterpart to h_{it}^S as h_{it}^* in the following way:

$$h_{it}^* = h_{it}^R + \eta_{it} \qquad i = 1,2,\ldots,n; \quad t = 1,2,\ldots T_i \tag{8}$$

In (8), η_{it} represents the measurement error in the mapping of h_{it}^* to h_{it}^R. We assume η_{it} is uncorrelated with h_{it}^R. Substituting (7) into (8) gives:

$$h_{it}^* = z_{it}\beta + \varepsilon_{it} + \eta_{it} = z_{it}\beta + v_{it} \qquad i = 1,2,\ldots,n; \quad t = 1,2,\ldots T_i \tag{9}$$

In our model for retirement we use the predicted health stock, $\hat{h}_{it}^*$, purged of measurement error, to avoid the biases associated with using h_{it}^* directly. Assuming v_{it} is normally distributed, model (9) can be estimated as a pooled ordered probit model using maximum likelihood.

Health shocks

It is important to establish whether transition to retirement originates from a slow deterioration or from a shock (acute deterioration) to an individual's health. Further, identifying health shocks offers a convenient way to eliminate a potential source of endogeneity bias caused by the correlation between individual-specific unobserved characteristics and health (Disney et al., 2006).

We specify a model for both the health stock variable and a measure of health limitations to account for the gradual deterioration in individual's health. As we specify health shocks as the lag of a health stock variable conditional on initial period health, a shock is identified through deviations in health status over time and hence eliminates the individual effect. In addition, we build two alternative measures of health shocks based on self-reported information contained in the survey. One measure is derived from the health transition question "How is your health compared to one year ago? Much better, somewhat better, about the same, somewhat worse, much worse". Two dummy variables are created, one identifying "small" health shocks, where individuals classify their health as somewhat worse than last year and a second dummy variable for "large" health shocks, when individuals self-report their health as much worse than the previous year. These two variables capture the severity of the health shocks and are used in the retirement model which also conditions on the health variables, the health stock and the health limitations measures. In this way we account for both the effects of gradual and sudden health deterioration. A second health shock measure is based on the responses from a question on the occurrence of a "serious injury or illness" during the twelve months prior the interview. Accordingly, we create a dummy variable which takes value 1 if the respondent reports a serious injury or illness in the previous twelve months and value 0 otherwise.[5] We also use this variable in the retirement model together with the two general health measures.

4. Institutional setting and data

4.1 Institutional setting

Australia's social security retirement income system consists of two main programmes: a means-tested benefit; the old age pension, and a mandatory occupational savings scheme; the superannuation guarantee. A brief description of the two programmes helps to identify the financial incentives which might induce early exits from the labour market. The age pension is the fundamental building block and the major source of income from the retirement system. It is a means-tested benefit payment funded from general taxation revenue, which pays a flat amount to anyone

[5] The question on "serious personal injury or illness" was asked only to the respondents from wave 2 to wave 5, i.e. answers to this question are not available for wave 1.

who qualifies, regardless of the previous workforce participation. Age pension can be paid to people aged 65 or over for men, and aged 62 or over for women, who must be citizens and resident or citizens who live in a country with which Australia has a social security agreement. At March 2002, 82 per cent of people aged 65 or over received age pension, service pension or income support supplement: two-thirds of them received the maximum rate of pension and the rest received a partial rate.[6]

Since 2002 the superannuation guarantee requires employers to contribute an amount equal to at least 9 per cent of workers' earnings to individual superannuation accounts. Employees are not required to contribute but can make voluntary contributions for themselves and their spouses. The superannuation, which may be a defined benefit or defined contribution plan, is payable at the age of 55 to beneficiaries who are fully retired but the age will rise gradually to 60 between 2015 and 2025. Benefits may be taken in the form of an annuity or lump sum and are fully inheritable. More than 90% of wages and salaries were covered by superannuation in 2002.[7] The two programmes of the retirement income system interact and can potentially conflict: while the superannuation system is designed to encourage savings for retirement, the means-tested age pension discourages it. That is, higher levels of superannuation and savings can lead to a lower rate of age pension. Moreover, the lump sum provision from the superannuation scheme may act as an incentive for workers to retire early, withdraw their accumulated funds, spend them and subsequently qualify for the age-related pension.[8]

Another transfer programme which is relevant to our analysis is the government Disability Support Pension (DSP). The DSP is an income support payment for people of working age with an illness or injury for a prolonged period of time. To be eligible for DSP payments, a person must be over 16 years of age and be assessed as incapable as a result of impairment of working 30 or more hours a week at full award

[6]Australian Department of Family and Community Services, July 2005, "Submission to Senate Select Committee Inquiry", Attachment A—Age Pension. http://www.facs.gov.au/internet/facsinternet.nsf/aboutfacs/programs/seniors-age_pension.htm
[7]Australian Taxation Office, "What is the superannuation guarantee scheme?" http://www.ato.gov.au/content/downloads/2002SPR02.pdf
[8] Rix, S., E., "Old-Age Income Security in Australia", 2005, AARP Public Policy Institute, Washington DC.

wages for at least the next two years.[9] The level of payment is the same as for the age pension. Over the last thirty years, there has been a strong growth in the number of persons receiving DSP payments. In particular, from the implementation of the Disability Reform Package in 1991 to 2003, the number of recipients doubled, from 334,000 (2.9 per cent of the age-eligible population) to 673,000, (5.1 per cent of the age-eligible population) (Cai et al., 2006). More recently, an increasingly high proportion of DSP recipients have transferred to the age pension. Cai, Vu and Wilkins (2007) use payment records data of those who received DSP over the period 1995-2002 to analyse the proportion of DPS recipients exiting from the transfer programme to five alternative destinations (age pension; other payment; death; non-transfer/non-death; still on DSP). Their results show that while in 1995, only 2.2 per cent of male recipients and 1.5 per cent of female recipients transferred to the age pension, in 2001 these percentages increased to 18.7 and 14.1 per cent respectively. These figures appear to confirm the relevance of the "disability route" into retirement also identified in the English labour market (Blundell et al., 2002).

4.2 The HILDA survey data

We make use of the first five waves (2001- 2005) of The Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA is a household-based panel study which collects information about economic and subjective well-being, labour market dynamics and family dynamics. The dataset contains a broad range of variables related to individual characteristics and it is especially informative on current and previous labour market activities as well as on measures of individual health status.

The first wave consists of 7,682 households and 19,914 individuals. The households were selected using a multi-stage approach (Watson and Wooden, 2002). Individual interviews were conducted with individuals aged 15 years and over, but some limited information is also available for persons under 15 years old. Individuals are followed over time and the first wave's sample is automatically extended by adding any

[9] Department of Social Security (DSS), 1992, The Department of Social Security Annual Report 1991-1992, Canberra.

children born to or adopted by members of the selected households and new household members resulting from changes in the composition of the original households.

The attrition rates for the first five waves were 13.2 per cent, 9.6 per cent, 8.4 per cent and 5.6 per cent respectively (Goode and Watson, 2006). The first three attrition rates are slightly higher than the ones for comparable surveys such as the British Panel Household Study (BHPS).[10] According to Watson and Wooden (2004) attrition between the first and second wave is non random and the re-interview rate is lower for people living in Sydney and Melbourne; aged 15 to 24 years; single or living in a de facto marriage; born in a non-English-speaking country; Aboriginal or Torres Strait Islander; living in a flat, unit or apartment; with relatively low levels of education; unemployed or working in blue-collar or low-skilled occupations. Watson and Wooden also conclude that the bias imparted by the selectiveness of attrition is unlikely to have significant consequences. However a series of weights were introduced to correct for panel attrition.[11]

4.3 Variables

Table 1 and 2 describe the variables used in our model for retirement and the physical health measures used to build the health stock measure.

(Tables 1 and 2 about here)

[10] Although Goode and Watson (2006) believe that the rates compare favourably given the comparative waves of the BHPS were conducted 10 years earlier and it has been generally accepted that response rates to surveys have been falling.

[11] Goode, A. and N. Watson (eds) (2006) *HILDA User Manual – Release 4.0*, Melbourne Institute of Applied Economic and Social Research, University of Melbourne.

Retirement measure

We use observed transitions between economic activity and inactivity as our measure of retirement. More specifically, our definition of economic inactivity comprises individuals who classify themselves as retired, unpaid family workers, unpaid volunteers, looking after an ill person or disabled. Transitions from activity to inactivity have been used before as an outcome measure in analysing the effects of health on retirement (Bound et al., 1999; Disney et al., 2006). Its use is justified by concerns regarding the accuracy of self-reported retirement measures which is also complicated by the notion of a disability route into retirement.

Health variables

The HILDA Survey contains a series of health related variables both in the self-completion questionnaire, which contains the SF-36 Health and Well-Being Survey, and in the Person (interview) Questionnaire. To build the health-stock measure, we make use of the 5 point measure of self-assessed health (SAH) together with information derived from questions about specific physical functioning limitations, which represent our "objective" measures of health (Table 2). The 5 point measure of SAH is derived from the question: "In general, would you say your health is: excellent; very good; good; fair; poor". Information on physical limitations is derived from respondents' answers on a series of questions about the ability to perform a set of specific actions, such as climbing flights of stairs, lifting or carrying groceries, bending, kneeling or stooping, walking different distances and bathing and dressing autonomously. We create dummy variables for the presence of each of these limitations. We also use an alternative measure of health. Our self-assessed measure is derived from the question:" "Does your health now limit you in these activities?" followed by a series of daily activities. We create a dummy variable which takes a value of 1 for the presence of any one of these health limitations and 0 otherwise.

Partners' variables

In our model we also analyse the effect of partners' health and job status on individuals' retirement decisions. Therefore, together with a variable indicating whether a respondent is married or living with a partner, the model includes two dummy variables representing partner’s employment, and health status. These variables are both lagged one period to control for endogeneity.

Income and housing tenure

Our income variable is the individual specific mean of the log of household income, which consists of labour and non-labour equivalised income, across the 4 waves of observations. As income will be systematically and substantially reduced after retirement, to ease problems related to endogeneity, we use the mean of the log household income prior to retirement. We also control for housing tenure. Our retirement model distinguishes between individuals who own their homes with or without a mortgage and individuals who reside in rented accommodation.

Other socio-economic variables

We also include other demographic, social and economic variables such as age, education, job status (blue or white collar), geographical origin (if born overseas) and area of residence (if living within a major city’s area).

4.4 Stock-sample and descriptive statistics

Our stock-sample consists of 1,270 individuals - 707 men and 563 women - aged 50 years old or above. Individuals are followed through the first five waves of the HILDA survey until they retire or are censored. As we consider retirement an absorbing state, we make use of information only up to the wave where this occurs. As there are only five waves of data, this restriction is unlikely to be a concern. Tables 3 to 5 describe the transitions of individuals of the stock-sample from employment in wave 1 to other labour market states, self-reported retirement and disability. Data are presented together and separately for men and women and information on attrition and death is also provided. The number of men and women who self-report themselves as retired, as well as the number of inactive individuals, more than double from wave 3 to wave 5.[12]

(Tables 3 to 5 about here)

Table 6 describes the health status of individuals in the stock-sample before and after retirement. The table presents data for a general measure of health limitations, the 5 categories of SAH and a measure of partner's ill-health broken down by gender. A clear positive relationship between labour force participation and health status emerges. That is, the better the health of those working-age, the more likely they are to remain in the labour force. This is true for own health for both men and women but not for partners' health.

(Table 6 about here)

Kaplan-Meier survival estimates of the probability of survival (not retiring) are displayed in Figures 1 to 8. Estimates are presented for own health status, measured by SAH and health limitations, for partners' health and job status, for men and women separately. Figures 1 and 2 show that men reporting health limitations and poor health have a greater probability of retiring compared to men not reporting health limitations or reporting better self-assessed health. Similar, but smaller effects, can be found for women in Figures 5 and 6. Survival estimates for men in Figure 3 and 4 show the probability of not retiring by partners' ill-health and labour market status, should the respondents have a partner. Males with a partner without any kind of health limitations or with a partner still in the labour market have an increased probability of

[12] In the stock sample, the overall number of observations increases by 1 male unit from wave 4 to wave 5. This is due to the fact that for the specific sub-sample of individuals we follow, the number of new entrants to the existing households exceeds the number of individuals who leave the stock sample because of death or attrition. For an overview on the HILDA Survey sample design as well as on household formation see Goode, A. and N. Watson (eds) (2007) *HILDA User Manual – Release 5.0*, Melbourne Institute of Applied Economic and Social Research, University of Melbourne.

retiring, although these effects are not large. Slightly higher probabilities of retiring are also associated with women having a partner without health limitations or a partner not in the labour force (Figure 7 and 8).

(Figures 1 to 8 about here)

5. Results

Health-stock measure

Table 7 presents results for the latent health stock obtained by regressing the self-assessed health (SAH) on measures of physical limitations using pooled ordered probit models. These models were estimated on men and woman separately on data from the stock sample used for the retirement models. As expected, both for men and women, the vast majority of the estimated coefficients display negative signs. Accordingly, the reporting of health problems is associated with the lower reporting of SAH.

(Table 7 about here)

For men, all the coefficients are statistically significant apart from the one related to difficulties in bathing and dressing (bathdress). We observe the largest effects, in terms of the size of the coefficients, for health limitations related to vigorous and moderate activities, climbing several flights of stairs, bending and kneeling and walking one kilometre. For women, not all the coefficients are significant but large effects are observed for a similar set of problems to those observed for men.

Survival Analysis

Results for the discrete time hazard models of retirement are displayed separately for men and women in Tables 8a - 8c and Tables 9a - 9c respectively. Each table contains results for health limitations and self-assessed latent health and show the estimated coefficients, standard errors and hazard ratios for all the variables. The hazard ratio measures the proportional effects on the underlying hazard of retiring of a one unit change in the value of a given variable. Hazard ratios are centred around 1, all possible decreases in the probability of retiring lie between 0 and 1 while all possible increase in the risk of retirement lie above 1. The models were estimated in STATA using the *pgmhaz8* routine (Jenkins, 1998) which incorporates unobserved heterogeneity (frailty) using a Gamma mixture distribution (Meyer, 1990).[13]

(Tables 8a to 8c about here)

In order to assess the effect of individual health status in determining retirement decisions, we consider both a general measure of health limitation and the measure of self-assessed latent health obtained from the pooled ordered probit models. These two variables are lagged one period to avoid problems of simultaneity. We also condition on first period health status. In this way the estimated coefficients of lagged health can be interpreted as a health shock (Table 8a for men, 9a for women). We also estimate models for health limitation and self-assessed latent health using two alternative definitions of health shocks. One definition is based on respondents' self–reported health transition and identifies contemporaneous "small" and "large" health shocks (Tables 8b and 9b). A second measure controls for the presence of an injury or illness in the previous 12 months (Tables 8c and 9c). In all models, the health of the spouse or partner is also considered, should a respondent have one.

For men we observe a large, positive and significant effect for health limitations variable lagged on period (Table 8a). This means that the hazard of retiring is greater for individuals experiencing a health shock that leads to a physical limitation. We also observe a large, negative and significant coefficient for our measure of (first period) latent health-stock. Since the variable is increasing with good health, this implies that the retirement hazard increases as health decreases. The effects of the health and

[13] For all the models log-likelihood ratio tests reject the null hypothesis of no heterogeneity. Tests' results are available on request.

health shocks variables become larger and highly significant using the two additional health shocks definitions (i.e. as we progress through Tables 8b and 8c). In particular, the occurrence of a small health shock is associated with a 320 per cent increase in the probability of retirement in the model for health limitations and with a 150 per cent increase in the health stock model (Table 8b). Large shocks increase the probability of retirement by approximately fifty times, and by thirty three times once conditioned on health limitations and health stock respectively (Table 8b). Finally, for men, having experienced a serious injury or illness in the last 12 months increases the likelihood of retiring between nearly four and seven times (see Table 8c).

According to the estimate for all the models, retirement decisions for men are not a function of marital status or partners' health status. More specifically, the estimated coefficients for marital status are positive. The effect is compared to the baseline category of not being married, or not living with someone. This suggests that for men, living in a couple increases the likelihood of retirement. However, the coefficients are not significant. Also, for those living with a partner, the estimated coefficients for partner's ill-health are positive but not significant.

As expected, the hazard of retiring is positive and highly significant for the age categories 60-64 and 65-69. The estimated effect is larger for ages 65-69, the age category that covers the male official state retirement age, while it is not significant for the ages 70 or older. We also observe a gradient across educational attainment compared to the baseline category of no qualifications: higher levels of education are associated with an increasing hazard of retiring. The risk is also large and positive for blue collar labourers and large and negative for managers, administrators and professionals, even if the effects are not significant. This is compared to the baseline formed by clerical, sales or service workers. Partners' labour status is not significant.

For all models, as household income increases, the hazard of retirement decreases. Also, the effect of housing tenure (renting) is negative, although not statistically significant. This suggests that renting a house decreases the chance of retiring.

(Tables 9a to 9c about here)

For women, own ill-health and health shocks have weaker effects on retirement decisions. The coefficients for the lagged latent health measure are negative and statistically significant only in the graduated health shocks model (Table 9b) and in the model which controls for the presence of an injury or illness (Table 9c). All the other health and health shocks related coefficients are positive but not significant. As with men, retirement decisions are not a function of marital status and partners' health and employment status. Age appears to be the most important factor in women's retirement decisions: the first three age bands are highly significant for all the models and their corresponding hazard ratios are particularly large. Qualitatively, the effects of the other non-health variables are the same as the corresponding models for men except for those related to education (where the signs are reversed: positive for lower degrees and negative for higher degrees).

6. Conclusions

This paper examines the role of health in determining retirement decisions among older working individuals. We use a discrete-time hazard model to represent transition to retirement on longitudinal data. We extend earlier analysis accounting for the potential reporting bias and endogeneity intrinsic in measures of self-assessed health by creating a latent health-stock variable which we use as one of our measures of health, together with a measure of health limitations. The latent health index estimates SAH as a function of more specific measures of self-reported health limitations using pooled order probit models. We also define health shocks in three different ways and consider the effects of partners' health and labour status on an individual's retirement decision.

Results are in line with the findings of the empirical literature on health and retirement based on English and U.S. data and also confirm the conclusions of Cai and Kalb (2006) for Australia. Our model show that own health is an important determinant of labour supply among older working individuals, and that this is especially true for men. Negative shocks to health greatly increase the risk of retiring, although the effect is not as marked for women. For both men and women, having a partner does not increase the likelihood of retiring. The effects on partners' job status are similar, while the effect of partners' health status implies a substantial asymmetry in retirement behaviour for men and women. Whereas having a partner with health limitations decreases the probability of retirement for women, it does increase the probability for men; however the effects are not significant. Income and age variables play a considerable role in our models. Results thus suggest that household income together with financial incentives provided by the social security system (state age pension) also matter in retirement decisions.

In summary, the policy implications are that the health of older members of the labour force is of relevance when considering the overall productivity of society. Together with fiscal and financial incentives designed to prevent working-age individuals from withdrawing early from the labour market and to encourage retirees to re-enter the labour market, polices must also be targeted at helping individuals with physical limitations, health problems or disabilities to remain in the labour force.

References

Anderson, KH, Burkhauser, RV. 1985. "The retirement–health nexus: a new measure of an old puzzle". *Journal of Human Resources*, 20, pp. 315-30.

Au, D, Crossley, TF, Schellhorn, M. 2005. "The effect of health changes and long-term health on the work activity of older Canadians". *Health Economics*, 14, pp. 999-1018.

Auer, P, Fortuny, M. 2000. "Ageing of the labour force in OECD countries: economic and social consequences". *ILO employment paper,* 2000/2.

Baker, M. 2002. "The retirement behaviour of married couples". *The Journal of Human Resources*, 37 (1), pp. 1-34.

Bazzoli, G. 1985. "The early retirement decision: New empirical evidence on the influence of health". *Journal of Human Resources*, 20, pp. 214–34.

Bingley, P, Lanot, G. 2006. "Public pension programmes and the retirement of married couples in Denmark". *Keele Economics Research Paper*, 2006/20.

Blau, DM, Gilleskie, D. 2001. "The effect of health on employment transitions of older men". In Polacheck, S (ed.), *Worker Well-Being in a Changing Labour Market*, Amsterdam: JAI Press, pp. 35–65.

Blau, DM. 1998. "Labour force dynamics of older married couples". *Journal of Labour Economics*, 16(3), pp. 595-629.

Blau, DM, Gilleskie, D. 2006. "Health insurance and retirement of married couples". *Journal of Applied Econometrics*, 21, pp. 935-953.

Blundell, R, Meghir, C, Smith, S. 2002. "Pension incentives and the pattern of early retirement". *Economic Journal*, 112*,* pp. 153-170.

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

Bound, J, Schoenbaum, M, Stinebrickner, TR, Waidmann, T. 1999 "The dynamic effects of health on the labour force transitions of older workers". *Labour Economics*, 6 (2), pp. 179-202.

Brazenor, R. 2002. "Disabilities and labour market earners in Australia". *Australian Journal of Labour Economics,* 5, pp. 319-334.

Burkhauser, RV. 1979. "The pension acceptance decision of older workers". *Journal of Human Resources*, 14, pp. 63–75.

Burtless, G, Moffitt, RA. 1984. "The effects of social security benefits on the labour supply of the aged". *In Retirement and Economics Behaviour*, edited by Aaroon, H, and Burtless, G, pp.135-174, Washington, DC: Brookings Institution.

Cai, L, Kalb, G. 2005. "Health status and labour force participation: evidence from Australia". *Health Economics*, 15(3), pp. 241–261.

Cai, L, Vu, H, Wilkins, R. 2007. "Disability support pension recipients: who gets off (and stays off) payments?". *Forthcoming in Australian Economic Review,* 40(1).

Currie, J, Madrian, B. 1999. "Health, health insurance and the labour market", in Ashenfelter, O, Card, D (eds). *Handbook of Labour Economics*, 3c, pp. 3309–416. Elsevier: Amsterdam.

Dawkins, P, Lim, G, Summers, PM. 2004. "The impact of population aging on labour force participation". *Final report to the Australian Department of Treasury and Finance.*[14]

Disney, R, Emmerson, C, Wakefield, M. 2006. "Ill-health and retirement in Britain: a panel data-based analysis". *Journal of Health Economics,* 25, pp. 621-649.

Dwyer, D, Mitchell, O. 1998. "Health problems as determinants of retirement: are self-rated measures endogenous?". *Journal of Health Economics*, 18, pp. 173–93.

Gustman, AL, Steinmeier, TL. 1986. "A structural retirement model". *Econometrica*, 54, pp. 555-84.

Gustman, AL, Steinmeier, TL. 1986. "A disaggregated structural analysis of retirement by race, difficulty of work and health". *Review of Economics and Statistics*, 67, pp. 509-13.

Gustman, AL, Steinmeier, TL. 2000. "Retirement in dual-career families: a structural model". *Journal of Labour Economics*, 18(3), pp. 503-545.

Gustman, AL, Steinmeier, TL. 2002. "The social security early entitlement age in a structural model of retirement and wealth". *NBER Working Paper No. 9183*.

Gustman, AL, Steinmeier, TL. 2004. "Social security, pensions and retirement behavior within the Family". *Journal of Applied Econometrics*, 19 (6), pp. 723-737.

Heyma, A. 2004. "A structural dynamic analysis of retirement behavior in the Netherlands". *Journal of Applied Econometrics*, 19(6), pp. 739–59.

Hurd, MD. 1990. "Research on the elderly: economic status, retirement and consumption and savings". *Journal of Economic Literature*, 28, pp. 565-637.

[14]Web:http://www.dtf.vic.gov.au/DTF/rwp323.nsf/0/c31777f9b5a03dbeca2570110004de66/$FILE/THE%20IMPACTS%20OF%20POPULATION%20AGEING%20ON%20LABOUR%20FORCE%20PARTICIPATION.pdf

Jenkins, SP. 1995. "Easy estimation methods for discrete-time duration models" *Oxford Bulletin of Economics and Statistics*, 57 (1), pp. 129-138.

Jenkins, S.P. 1998. "Discrete time proportional hazards regression". *STATA Technical Bulletin*, STB-39, pp. 22-32.

Kalwij, A, Vermeulen, F. 2005 . "Labour force participation of the elderly in Europe: the importance of being healthy", *IZA Discussion Paper No.1887*.

Kerkhofs, MJM, Lindeboom, M, Theeuwes, J. 1999. "Retirement financial incentives and health". *Labour Economics*, 6, pp. 203–27.

Van der Klaauw, W, Wolpin, W. 2005. "Social security, pensions and the savings and retirement behaviour of households". mimeo, *University of North Carolina.*

Lambrinos, J. 1981. "Health: a source of bias in labour supply models". *Review of Economics and Statistics*, 63 (2), pp. 206–12.

Lazear EP. 1986. "Retirement from the labour force". In *Handbook of Labour Economics Vol. 1*. Ashenfelter, OC, Layard, R, (eds). Elsevier: Amsterdam.

Lindeboom, M. 2006a. "Health and work of older workers". In *Elgar Companion to Health Economics*, Jones, AM, (ed). Edward Elgar: Aldershot.

Lindeboom, M, Llena-Nozal, A, van der Klaauw, B. 2006b. "Disability and work: the role of health shocks and childhood circumstances". *IZA Discussion Paper No. 2096.*

Mastrogiacomo, M, Alessie, R, Lindeboom, M. 2004. "Retirement behaviour of dutch elderly households". *Journal of Applied Econometrics*, 19(6), pp. 777-794.

Meyer, BD. 1990. "Unemployment insurance and unemployment spells". *Econometrica*, 58, pp. 757-782.

Michaud, PC. 2003. "Joint labour supply dynamics of older couples", *Tilburg University, Centre for Economic Research*, *Discussion Paper No. 69*.

Michaud, PC, Vermuelen, F. 2004. "A collective retirement model: identification and estimation in the presence of externalities". *IZA Discussion Paper No. 1294*.

Parsons, D. 1980. "The decline in male labour force participation". *Journal of Political Economy*, 88, pp. 117–34.

Roberts, J, Rice, N, Jones, AM. 2006. "Sick of work or too sick to work? Evidence on health shocks and early retirement from the BHPS". *HEDG Working Paper*, *06/13*.

Riphahn, RT. 1999. "Income and employment effects of health shocks. A test case for the German welfare state". *Journal of Population Economics*, 12, pp. 363-389.

Rust, J, Phelan, C. 1997. "How social security and Medicare affect retirement in a world of incomplete markets". *Econometrica,* 65(4), pp. 781-832.

Sedillot, B, Walraet, E. 2002 "La Cessation D'activité Au Sein Des Couples: y a-t-il Interdependence Des Choix". *Economie et Statistique*, n 357-358.

Sickles, RC, Taubman, P. 1986. "An analysis of the health and retirement status of the elderly". *Econometrica*, 54, pp. 1339–56.

Sickles, RC, Yazbeck, A. 1998. "On the dynamics of demand for leisure and the production of health". *Journal of Business and Economic Statistics*, 16(2), pp. 187–97.

Spataro, L. 2002. "New tools in micro modelling retirement decisions: overview and applications to the Italian Case". *Working Paper 28/02*, *Center for Research on Pensions and Welfare Policies. Turin (Italy)*.

Stern, S. 1989. "Measuring the effect of disability on labour force participation". *Journal of Human Resources*, 24, pp. 361–95.

Stock, JH, Wise, DA. 1990. "The pension inducement to retire: an option value analysis". In *Issues of Economics of Aging*, edited by David Wise, pp. 204-24. Chicago: University of Chicago Press.

Wilkins, R. 2004. "The effects of disability on labour force status in Australia". *The Australian Economic Review,* 37 (4), pp. 359–382.

Table 1: Variables used in the model for retirement - description

Variables	Description
Retirement	
Retired	Dependent variable: 1 if respondent is economically inactive, 0 otherwise
Own Health	
Hllt	Self-assessed health limitations, 1 if health limits daily activities, 0 otherwise
SAH	Self-assessed health: 1:poor, 2: fair, 3: good, 4: very good, 5: excellent
Health shocks	
Small_shock	1 if health somewhat worse than last year, 0 otherwise
Large_shock	1 if health much worse than the last year, 0 otherwise
Injury_illness	1 if suffered an injury or illness in the past 12 months, 0 otherwise
Partner/Spouse	
Marital	1 if married or living together with a partner, 0 otherwise
Partner's Health and Job	
Health_p	1 if partner/spouse has physical health limitations, 0 otherwise
Job_p	1 if partner/spouse is still in the labour market, 0 otherwise
Income and housing tenure	
Income	Individual specific equivalised mean log of household income
Rent	1 if renting house, 0 otherwise
Own_morg	1 if owning house with or without a mortgage, 0 otherwise (baseline category)
Age dummies	
Age5559	1 if respondent is aged 55 to 59, 0 otherwise
Age6064	1 if respondent is aged 60 to 64, 0 otherwise
Age6569	1 if respondent is aged 64 to 69, 0 otherwise
Age70plus	1 if respondent is aged 70 or above, 0 otherwise
Education	
Edudegrees	1 if respondent holds degree or post degree qualifications, 0 otherwise
Educert	1 if advanced diploma or certificate, 0 otherwise
Edu12	1 if highest education completed is year 12, 0 otherwise (baseline category)
Job Status	
White_col1	1 if last or current job as a manager, administrator or professional, 0 otherwise
White_col2	1 if clerical, sales or service worker, 0 otherwise (baseline category)
Blue_collar	1 if tradesperson, labourer, production or transport worker, 0 otherwise
Geographical variables	
Major_city	1 if living in a major city area, 0 otherwise
Regional_remote	1 if living in a regional or remote area, 0 otherwise (baseline category)
Born_overeas	1 if born overseas, 0 otherwise
Born_au	1 if born in Australia, 0 otherwise (baseline category)

Table 2: Physical limitations variables – description

Variables	Description
Vigact	1 if limited (a little or a lot) in the ability of performing vigorous activities, 0 otherwise
Modact	1 if limited (a little or a lot) in the ability of performing moderate activities, 0 otherwise
Liftgr	1 if limited (a little or a lot) in the ability of lifting or carrying groceries, 0 otherwise
Climbsev	1 if limited (a little or a lot) in the ability of climbing several flight of stairs, 0 otherwise
Climbone	1 if limited (a little or a lot) in the ability of climbing one flight of stairs, 0 otherwise
Bendkneel	1 if limited (a little or a lot) in the ability of bending, kneeling, or stooping, 0 otherwise
Walkonek	1 if limited (a little or a lot) in the ability of walking more than 1 kilometer, 0 otherwise
Walkhalfk	1 if limited (a little or a lot) in the ability of walking half a kilometer, 0 otherwise
Walkmet	1 if limited (a little or a lot) in the ability of walking 100 meters, 0 otherwise
Bathdress	1 if limited (a little or a lot) in the ability of bathing or dressing, 0 otherwise

Table 3: Labour market status by wave

	1	2	3	4	5
Employee	863	764	732	665	633
Own/Self-employed	407	349	335	313	307
Unemployed		12	12	15	12
Retired		86	113	170	204
Unpaid family worker		12	13	12	8
Unpaid volunteer		7	10	12	20
Looking after ill person		2	2	8	4
Disabled		15	21	26	34
Attrition and death		23	9	17	
Total		1247	1238	1221	1222
Total inactive		122	171	243	282
Total employed	1,270	1,113	1,067	978	940

Table 4: Labour market status by wave - Men

	1	2	3	4	5
Employee	432	398	368	341	321
Own/Self-employed	275	239	238	221	212
Unemployed		6	10	10	7
Retired		45	66	91	116
Unpaid family worker		6	4	6	3
Unpaid volunteer		1	3	4	9
looking after ill person		1	2	4	3
Disabled		9	13	16	23
Attrition and death		2	1	11	
Total		705	704	693	694
Total inactive		68	98	131	161
Total employed	707	637	606	562	533

Table 5: Labour market status by wave – Women

	1	2	3	4	5
Employee	431	366	364	324	312
Own/Self-employed	132	110	97	92	95
Unemployed		6	2	5	5
Retired		41	47	79	88
Unpaid family worker		6	9	6	5
Unpaid volunteer		6	7	8	11
Looking after ill person		1		4	1
Disabled		6	8	10	11
Attrition and death		21	8	6	
Total		542	534	528	528
Total inactive		66	73	112	121
Total employed	563	476	461	416	407

Table 6: Own health and partner's health when in labour force and when retired

	Men		**Women**	
	Employed	Retired	Employed	Retired
Own health				
Health limitations	23.53%	54.4%	30.95%	37.5%
SAH poor	0.96%	9.24%	0.93%	7.56%
SAH fair	9.96%	19.57%	9.67%	16.86%
SAH good	38.54%	39.67%	37.77%	36.05%
SAH very good	39.86%	28.8%	40%	35.47%
SAH excellent	10.68%	2.72%	11.47%	4.07%
Partners' health				
Health limitations	27.36%	27.59%	33.4%	37.5%

Figure 1: Kaplan-Meier survival estimates of the proportion of men not retired by health limitations

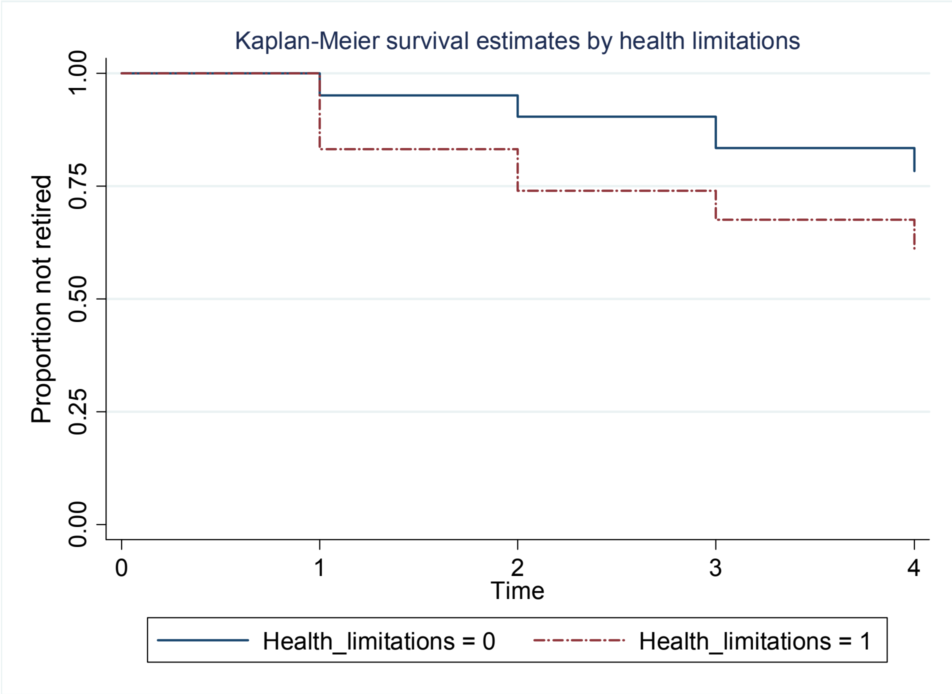

Figure 2: Kaplan-Meier survival estimates of the proportion of men not retired by self-assessed health

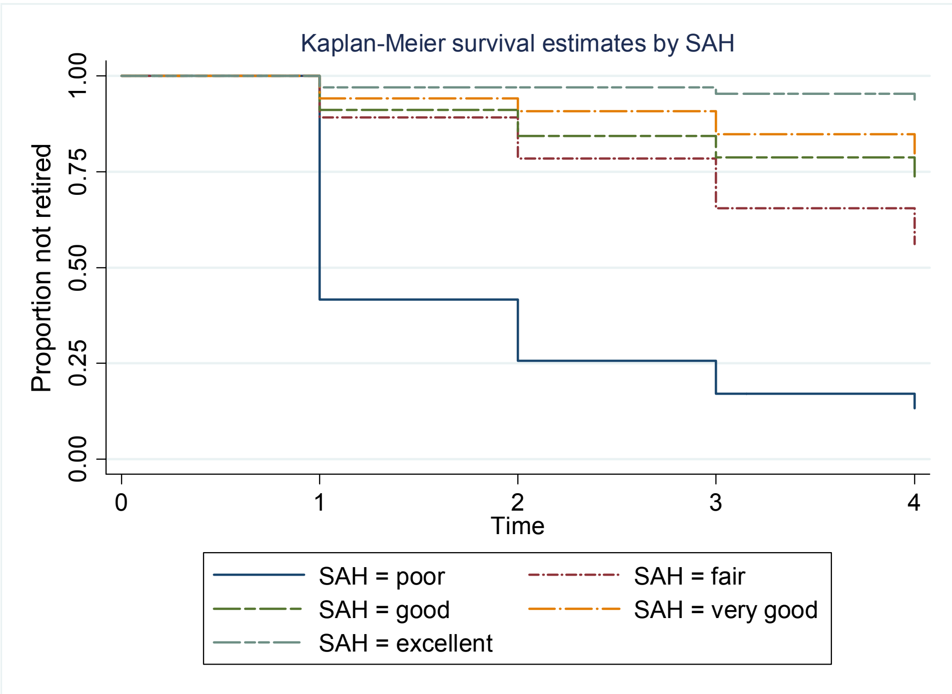

Figure 3: Kaplan-Meier survival estimates of the proportion of men not retired by partner's health limitations

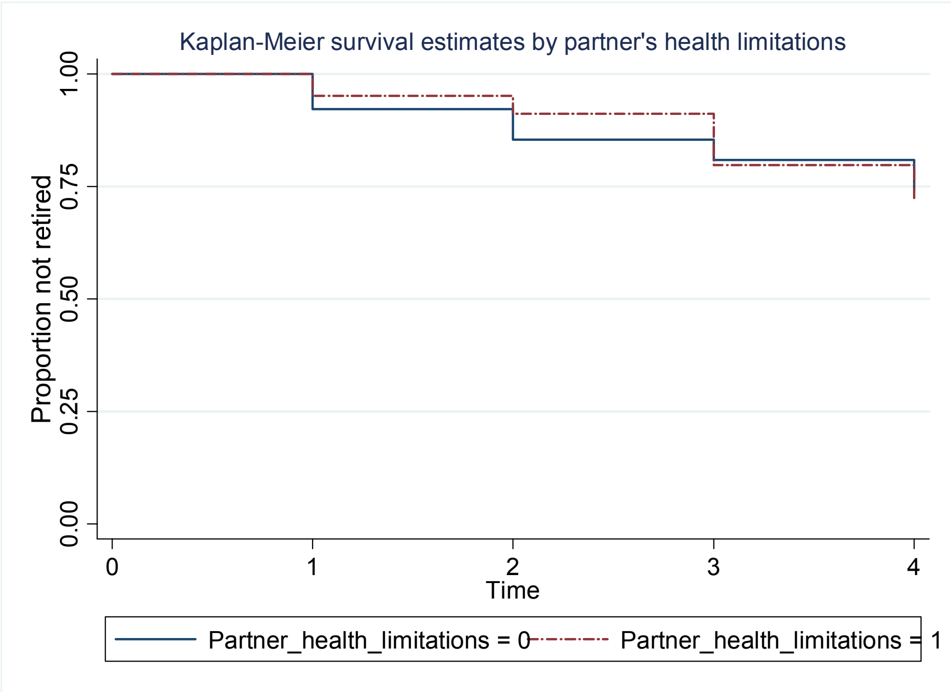

Figure 4: Kaplan-Meier survival estimates of the proportion of men not retired by partner's job status

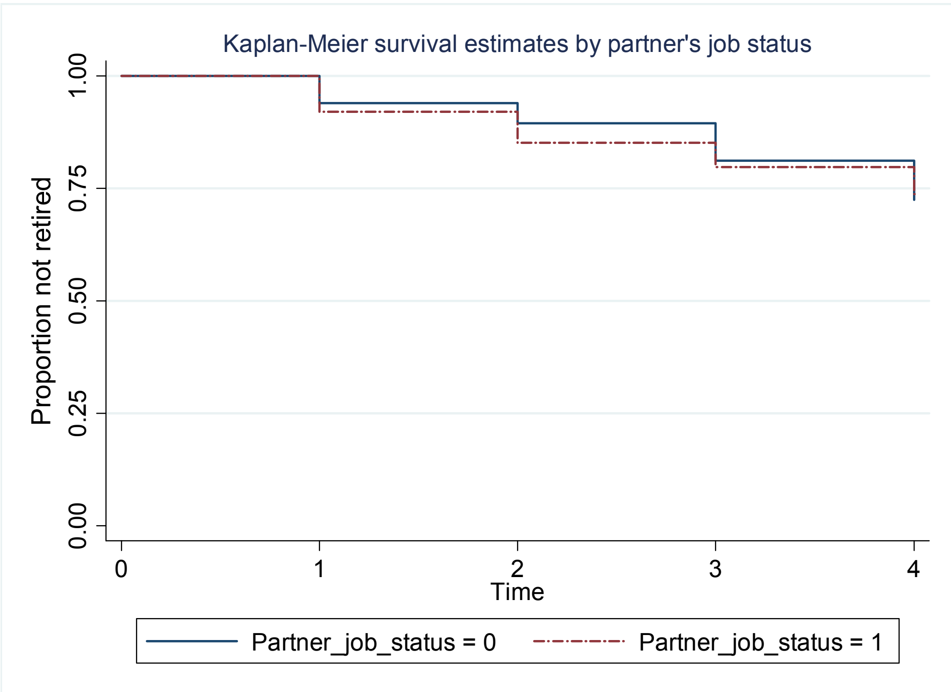

Figure 5: Kaplan-Meier survival estimates of the proportion of women not retired by health limitations

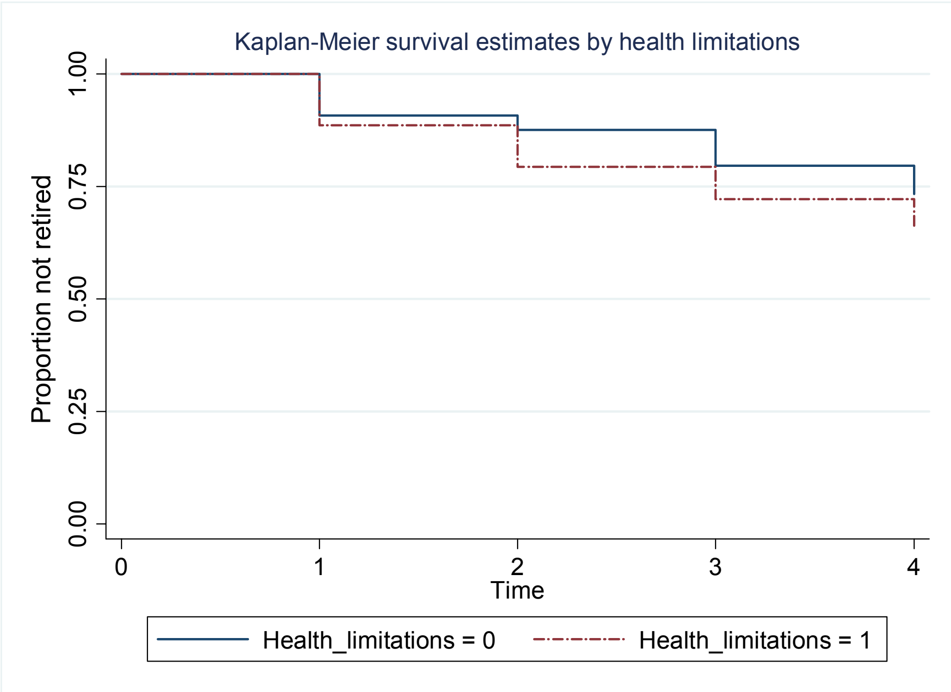

Figure 6: Kaplan-Meier survival estimates of the proportion of women not retired by self-assessed health

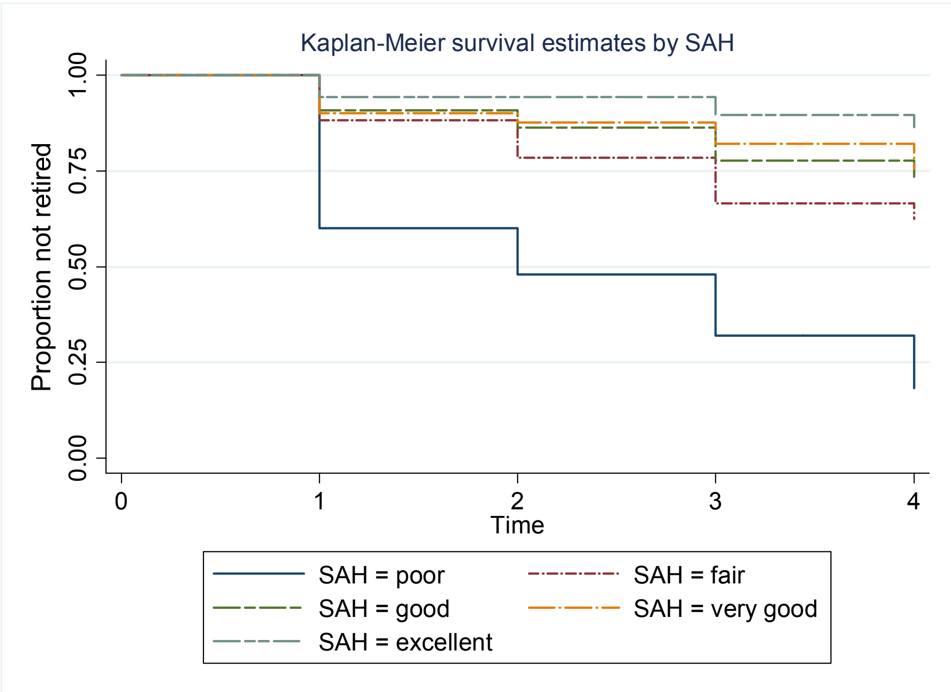

Figure 7: Kaplan-Meier survival estimates of the proportion of women not retired by partner's health limitations

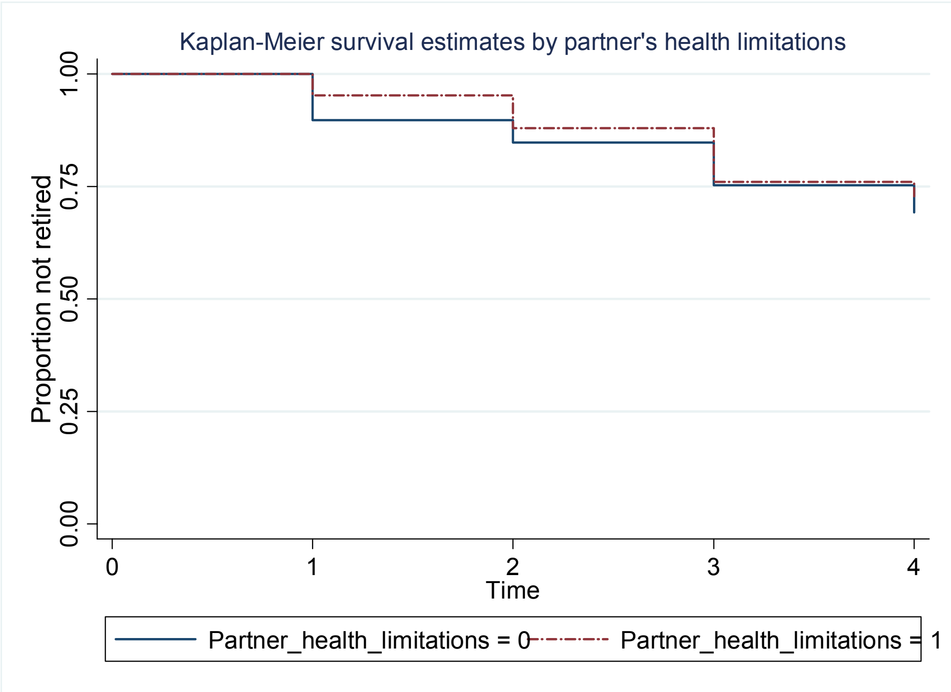

Figure 8: Kaplan-Meier survival estimates of the proportion of men not retired by partner's job status

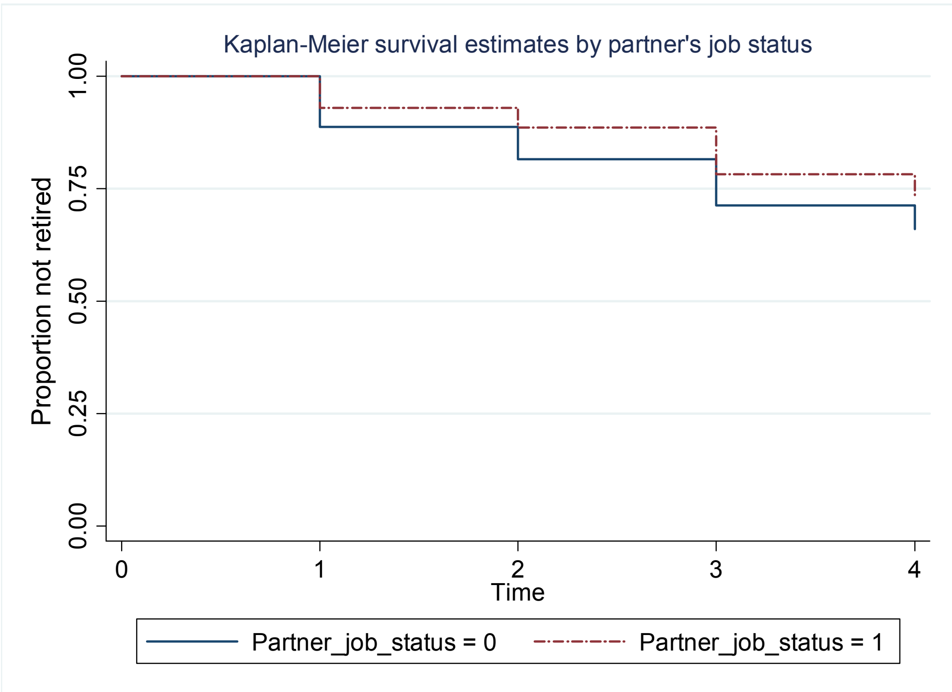

Table 7: Pooled Ordered Probit models for SAH

Men			**Women**		
Latent Health Index	Coef.	S. E.	Latent Health Index	Coef.	S. E.
Vigact	-.595***	(.050)	Vigact	-.468***	(.061)
Modact	-.437***	(.066)	Modact	-.304***	(.068)
Liftgr	-.242***	(.077)	Liftgr	-.359***	(.072)
Climbsev	-.365***	(.054)	Climbsev	-.318***	(.055)
Climbone	-.313***	(.084)	Climbone	-.299***	(.082)
Bend/kneel	-.199***	(.047)	Bend/kneel	-.058	(.053)
Walkonek	-.273***	(.068)	Walkonek	-.438***	(.068)
Walkhalfk	-.210**	(.097)	Walkhalfk	-.025	(.103)
Walkmet	.301**	(.107)	Walkmet	.135	(.123)
Bathdress	-.103	(.093)	Bathdress	-.260**	(.123)
Observations	3,229			2,546	
Log-likelihood	-3617.2819			-2766.2511	

Significance levels: *: 10% **: 5% ***: 1%

Table 8a: Hazard model for retirement – Men

	Health limitations			Self-assessed latent health		
	Coef.	S.E.	Hazard ratio	Coef.	S.E.	Hazard ratio
Covariates:						
Own health						
Hllt(0)	.458	.583	1.582			
Hllt(t-1)	.807*	.462	2.242			
SAHlat(0)				-.921*	.475	.398
SAHlat(t-1)				-.185	.333	.83
Other covariates						
Age5559	.202	.547	1.224	.468	.613	1.597
Age6064	1.076*	.591	2.935	1.262*	.670	3.532
Age6569	2.394**	.903	10.96	2.788**	.961	16.257
Age70plus	-.272	1.104	.761	.572	1.169	1.773
Edudegrees	1.464***	.717	4.327	1.556***	.740	4.743
Educert	.644	.512	1.905	.690	.533	1.995
White_col1(t-1)	-.381	.553	.682	-.419	.612	0.657
Blue_collar(t-1)	.326	.618	1.385	-.124	.725	0.882
Income(t-1)	-1.22*	.668	.295	-.921	.584	0.397
Rent(t-1)	-.461	.836	.630	-.616	.995	0.539
Born_overseas	-.426	.462	.652	.110	.543	1.117
Major_city	.15	.439	1.162	-.015	.482	.984
Marital(t-1)	.326	.791	1.386	.600	.905	1.823
Spousal health and job						
Health_p(t-1)	.223	.396	1.25	.334	.431	1.397
Job_p(t-1)	.087	.427	1.091	-.321	.439	.724
Observations	1099			961		
Log-likelihood	-265.00			-228.26		

Significance levels: *: 10% **: 5% ***: 1%

Table 8b: Hazard model for retirement - men

	Health limitations			Self-assessed latent health		
	Coef.	S.E.	Hazard ratio	Coef.	S.E.	Hazard ratio
Covariates:						
Own health						
Hllt(t-1)	.976**	.471	2.656			
SAHlat(t-1)				-.523**	.238	.592
Health shocks						
Small_shock	1.434***	0.500	4.195	.930***	.398	2.535
Large_shock	3.906***	1.114	49.72	3.52***	.940	33.79
Other covariates						
Age5559	.417	.584	1.517	.523	.555	1.687
Age6064	1.399**	.620	4.051	1.384**	.599	3.993
Age6569	2.594***	.887	13.39	2.361***	.799	10.60
Age70plus	.199	1.047	1.221	.679	.948	1.972
Edudegrees	1.604**	.767	4.974	1.154*	.592	3.171
Educert	.846	.575	2.331	.712	.438	2.039
White_col1(t-1)	-.326	.562	.721	-.032	.493	.968
Blue_collar(t-1)	.405	.621	1.499	.511	.545	1.667
Income(t-1)	-1.005**	.497	.365	-.487	.377	.614
Rent(t-1)	-1.031	.957	.356	-1.46	1.026	.231
Born_overseas	-.599	.492	.548	-.331	.411	.717
Major_city	.224	.437	1.252	.025	.387	1.025
Marital(t-1)	.026	.779	1.027	.373	.755	1.453
Spousal health and job						
Health_p(t-1)	.167	.406	1.182	.255	.386	1.29
Job_p(t-1)	-.143	.400	.866	-.309	.366	.734
Observations	1058			985		
Log-Likelihood	-244.06			-224.29		

Significance levels: *: 10% **: 5% ***: 1%

Table 8c: Hazard model for retirement - Men

	Health limitations			Self-assessed latent health		
	Coef.	S.E.	Hazard Ratio	Coef.	S.E.	Hazard Ratio
Covariates:						
Own health						
Hllt(t-1)	1.136**	.527	3.115			
SAHlat(t-1)				-.628**	.260	.533
Health shocks						
Injury_illness	2.162***	.687	8.690	1.589***	.524	4.903
Other covariates						
Age5559	.426	.621	1.531	.534	.577	1.707
Age6064	1.526**	.689	4.603	1.492**	.634	4.446
Age6569	2.926***	.950	18.66	2.679***	.904	14.57
Age70plus	.0327	1.266	1.033	.636	1.071	1.890
Edudegrees	1.664*	.853	5.282	1.153*	.637	3.169
Educert	.817	.604	2.265	.678	.473	1.971
White_col1(t-1)	-.364	.649	.694	-.121	.551	.885
Blue_collar(t-1)	.347	.721	1.416	.357	.600	1.429
Income(t-1)	-1.241	.622	.289	-.607	.445	.544
Rent(t-1)	-.852	1.050	.426	-1.629	1.139	.195
Born_overseas	-.707	.572	.492	-.376	.462	.686
Major_city	-.036	.498	.964	-.168	.433	.844
Marital(t-1)	.131	.850	1.141	.426	.822	1.532
Sposual health and job						
Health_p(t-1)	.185	.438	1.204	.32812	.397	1.388
Job_p(t-1)	.027	.471	1.027	-.3344	.392	.715
Observations	1023			981		
Log-likelihood	-248.29			-227.49		

Significance levels: *: 10% **: 5% ***: 1%

Table 9a: Hazard Model for retirement - Women

	Health limitations			Self-assessed latent health		
	Coef.	S.E.	Hazard ratio	Coef.	S.E.	Hazard Ratio
Covariates:						
Own health						
Hllt(0)	.168	.621	.735			
Hllt(t-1)	.467	.377	1.596			
SAHlat(0)				-.095	.375	.908
SAHlat(t-1)				-.479	.315	.619
Other covariates						
Age5559	1.521***	.490	4.577	1.719***	.573	5.580
Age6064	2.469***	.610	11.82	2.891***	.785	18.02
Age6569	2.708***	.783	15.00	3.381***	1.084	29.40
Age70plus	1.966*	1.278	7.146	3.523*	2.104	33.89
Edudegrees	-.337	.511	.7134	-.577	.618	0.561
Educert	.073	.401	1.076	.188	.486	1.207
White_col1(t-1)	.492	.409	1.635	.333	.484	1.396
Blue_collar(t-1)	.183	.542	1.201	-.031	.689	.969
Income(t-1)	-.505	.324	.6033	-.344	.376	.708
Rent(t-1)	.243	.660	1.276	.426	.772	1.532
Born_overseas	-.603	.446	.5466	-.710	.559	.490
Major_city	.272	.361	1.313	.170	.429	1.185
Marital(t-1)	-.258	.650	.772	-.1376	.821	0.871
Spousal health and job						
Health_p(t-1)	-.177	.386	.837081	-.456	.470	.633
Job_p(t-1)	-.387	.358	.679091	-.499	.416	.606
Observations	980			821		
Log-likelihood	-254.61			-223.91		

Significance levels: *: 10% **: 5% ***: 1%

Table 9b: Hazard model for retirement - Women

	Health limitations			Self-assessed latent health		
	Coef.	S.E.	Hazard ratio	Coef.	S.E.	Hazard ratio
Covariates:						
Own health						
Hllt(t-1)	.544	.360	.621			
SAHlat(t-1)				-.425**	.217	.653
Health shocks						
Small_shock	.517	.391	1.677	.361	.388	1.434
Large_shock	1.728	1.346	5.629	1.655	1.255	5.236
Other covariates						
Age5559	1.510***	.497	4.528	1.480***	.496	4.396
Age6064	2.459***	.615	11.70	2.360***	.603	10.59
Age6569	2.684***	.790	14.64	2.435***	.752	11.42
Age70plus	2.066	1.300	7.900	2.510*	1.288	12.31
Edudegrees	-.322	.528	.724	-.273	.491	.760
Educert	.096	.411	1.101	.032	.379	1.033
White_col1(t-1)	.451	.415	1.570	.424	.384	1.529
Blue_collar(t-1)	.062	.572	1.064	-.213	.553	.807
Income(t-1)	-.488	.326	.613	-.305	.288	.736
Rent(t-1)	.312	.668	1.366	.484	.633	1.623
Born_overseas	-.725	.469	.483	-.563	.435	.569
Major_city	.239	.373	1.270	.182	.350	1.199
Marital(t-1)	-.206	.664	.813	.117	.675	1.125
Spousal health and job						
Health_p(t-1)	-.228	.402	.795	-.245	.390	.782
Job_p(t-1)	-.366	.372	.692	-.440	.353	.643
Observations	935			852		
Log-Likelihood	-248.11			-233.74		

Significance levels: *: 10% **: 5% ***: 1%

Table 9c: Hazard model for retirement - Women

	Health limitations			Self-assessed latent health		
	Coef.	S.E.	Hazard Ratio	Coef.	S.E.	Hazard Ratio
Covariates:						
Own health						
Hllt(t-1)	.525	.346	1.691			
SAHlat(t-1)				-.380*	.211	.683
Health shocks						
Injury_illness	.471	.472	1.601	.358	.447	1.431
Other covariates						
Age5559	1.493***	.490	4.453	1.428***	.488	4.17
Age6064	2.355***	.599	10.54	2.229***	.579	9.299
Age6569	2.542***	.779	12.71	2.283***	.727	9.807
Age70plus	.887	1.436	2.427	1.371	1.372	3.942
Edudegrees	-.289	.507	.748	-.241	.469	.785
Educert	.104	.400	1.110	.039	.362	1.039
White_col1(t-1)	.408	.400	1.504	.370	.367	1.448
Blue_collar(t-1)	.119	.551	1.126	-.139	.529	.869
Income(t-1)	-.502	.321	.605	-.330	.276	.718
Rent(t-1)	.183	.654	1.201	.384	.611	1.468
Born_overseas	-.612	.450	.542	-.462	.410	.629
Major_city	.223	.359	1.250	.166	.333	1.181
Marital(t-1)	.070	.684	1.072	.390	.709	1.477
Spousal health and job						
Health_p(t-1)	-.217	.393	.804	-.23188	.379877	.793045
Job_p(t-1)	-.372	.357	.689	-.42329	.338149	.654886
Observations	929			846		
Log-likelihood	-246.81			-232.75		

Significance levels: *: 10% **: 5% ***: 1%