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The Effects of Health Shocks on Labour Market Exits: Evidence from the HILDA Survey

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Abstract

This paper analyses the relationship between ill-health, health shocks and early labour market exits among older working individuals. We represent the transition to non-employment as a discrete-time hazard model using a stock-sample from the first six waves (2001-2006) of the Household, Income and Labour Dynamics in Australia (HILDA) Survey. Our results show that health shocks are key determinants of early exit choices. For men, negative shocks to health increase the hazard of becoming non-employed by 50 to 320 per cent, whereas for women, health shocks increase the hazard of an early exit from the labour market by 68 to 74 per cent. These findings are confirmed by both a measure of health limitations and a measure of latent health obtained using pooled ordered probit models as well as for two alternative definitions of health shocks.

JEL Classification: I10, C10, C41, J14

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). In Australia, despite recent rises in women's participation rates, the overall participation rate for people aged 15 or over is projected to decrease from 64.5 to 58.7 per cent between 2007 and 2047 (Australian Department

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of Treasury, 2007). This is mainly the result of the rapid increase in the proportion of individuals aged 65 years and over. The Treasury's population projections further show that within the next 40 years the proportion of older individuals (64 to 84 years old) is predicted to more than double and the number of the very old (85 and over) is expected to quadruple. As a result, while there are currently 5 individuals of working-age for every person aged 65 and over, by 2050 this number is projected to shrink to 2.7 (Australian Department of Treasury, 2010). 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 decisions to exit the labour market will help to inform policies to incentivise workers to remain in active employment and encourage younger retirees to return 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 (Kerkhofs *et al*., 1999; Blundell *et al*., 2002), individual health status plays a major role in retirement decisions. A 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; reduce the returns from work via lower wages and, by entitling individuals to non-wage income through disability benefits, act as an incentive to exit the labour market.

While there is abundant evidence on the importance of financial incentives in determining retirement behaviour (Lumsdaine and Mitchell, 1999; Blundell *et al*., 2002; French, 2005), empirical evidence on the role of health on retirement is still limited, especially for Australia. Further, problems such as measurement error (reporting bias) and the potential endogeneity of self-assessed measures of health together with the presence of unobservable heterogeneity have hampered attempts to reach definite conclusions on this relationship. Another important but unexplored issue is the relative role assumed by gradual health deterioration versus unexpected changes in health or health shocks. This theme is directly related to the econometric problem of the identification of a causal effect of health on work. Unexpected health changes and the knowledge of their timing could provide sufficient exogenous variation to isolate the effect of health on an individual's labour status.

This paper contributes to the empirical literature by assessing and quantifying the relative significance of gradual versus sudden health deterioration in early exit decisions. To the best of our knowledge, this is the first attempt to implement this kind of analysis using Australian longitudinal data. We represent the transition to non-employment 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 leaving the workforce. 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). Further, we define health shocks in two alternative ways: using information on the incidence of sudden injury or illness and looking at the differences between individual's health stocks over time.

Our results, using panel data from the first six waves (2001-2006) of the Household, Income and Labour Dynamics in Australia (HILDA) survey, show that health plays a fundamental role in individual employment transitions. For both men and women, negative shocks to health significantly increase the hazard of becoming non-employed. Apart from ageing, ill-health and health shocks are quantitatively the most important causes of early exits from the labour market among the individual socioeconomic variables considered. Furthermore, estimated effects on household type (marital status) and composition (having own dependent children) are also significant determinants of transitions to non-employment. Our findings indicate that for women, living with a partner greatly enhances the risk of an early exit; for men, having dependent children is associated with a significant decrease in the hazard of leaving the labour force.

2. Background

Several studies conclude that ill-health is one of the main causes 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.

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 a 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 objective 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 the British Household Panel Survey (BHPS), 1991 to 1998. They find that health shocks are an important determinant of retirement behaviour in the UK. These results are confirmed by Roberts *et al*. (2008), Jones *et al*. (2009) and Garcia Gomez *et al*. (2010) on the British Household Panel Survey (BHPS) and by and Hagan *et al*. (2009) on the European Community Household Panel (ECHP) data. Lindeboom *et 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.

Research on the effects of health on labour supply of older workers in Australia is growing but still limited if compared to the evidence available for other countries (especially UK and US). 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 (2006) analyse the relationship between health and labour market 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. Further, Laplagne *et al*. (2007) use data from HILDA and find that both better health and education are associated with greater labour force participation. Warren and Oguzoglu (2007) and Cai *et al*. (2008) also analyse different aspects of health and labour supply using the HILDA Survey. Correspondingly, they find that differences in severity levels of disability explain a significant proportion of the variance in the participation rates among disabled individuals and that lower health status and health shocks lead to reductions in working hours. Finally, Schofield *et al*. (2008) use data from 2003 ABS SDAC Survey and find that among individuals aged 45-64 years a series of chronic conditions such as back problems and arthritis are strongly associated with non-participation.

3. Econometric Framework

Duration Model for Employment Exits

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 leaving the labour force (aged between 50 years old and the year prior state retirement age: 64 for men and 61 for women) in the first wave of the HILDA Survey and we follow them through the subsequent six waves until they are observed leaving the work force or are censored. Transition to non-employment 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 a measure of health limitations) and a number of socio-economic characteristics (age, gender, education, job status, marital status, etc.) on the probability of leaving the labour market.

This method, controlling for stock-sampling and changing the unit of analysis from the individual to the time at risk of an event (labour market exit), allows a complex sequence likelihood to be simplified to the more standard estimation for a binary outcome.[1] We initially select only those individuals who are working in wave 1. Subsequently, these individuals can stay in the labour force, leave the labour force, or be lost to follow-up. Non-employment 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 non-employment (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 left the labour market (complete duration data, $\delta_i = 1$). If individuals are lost to follow-up before leaving the labour force these are also considered censored observations. $t = \tau + s_i$ is the year when non-employment occurs if $s_i = 1$ 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 leaving the work force at each t provides information on the duration distribution and the discrete-time hazard rate is:

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

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 labour market exit is observed. The conditional probability (conditional on not having left the labour force at the beginning of the time spell) of observing the event history of someone with an incomplete spell at interview is:

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

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

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

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

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

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

Jenkins (1995) suggests simplifying the log-likelihood by defining an indicator variable y_{it}. For those still working, $y_{it} = 0$ for all periods; for those who become non-employed, $y_{it} = 0$, for all periods except the exit 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:

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

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.[2] Following Jones *et al.* (2009) and Hagan *et al.* (2009), we complete the specification using a complementary log-log hazard function for the hazard h_{it}:

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

where $\theta(t)$ is the baseline hazard modelled as a step function by using dummy variables to represent each year of age at risk.[3]

Health Stock and Health Shocks

Health Stock Measure

There are three main problems related to the use of self-assessed measures of health when attempting to estimate a causal effect of health on work (Anderson and Burkhauser, 1985; Bazzoli, 1985; Stern, 1989; Bound, 1991; Bound *et al.*, 1999; Au *et al.*, 2005;

[2] See Jenkins (1995) for further details.

[3] Disney *et al.* (2006) include initial age together with a set of time dummies for time elapsed since the start of the panel in their specification of this model. However, we believe this is not an appropriate measure of duration dependence when age of labour market exit is the outcome of interest and individuals enter the stock sample at different ages. We thus follow Jones *et al.* (2009) and include in our specification a set of age dummies to represent the age at risk of exiting the labour force. We believe this is a more appropriate specification as it allows the impact of surviving to be different for individuals at different ages. Further, this appears to be more consistent with the original formulation of the discrete-time hazard model as described, for example, in Jenkins (1995, 1998).

Disney *et al*., 2006; and Brown *et al*., 2010). First, self-assessed variables might be affected by measurement error caused by reporting heterogeneity: individuals with the same underlying level of health may apply different thresholds when reporting their health status on a categorical scale (Lindeboom and van Doorslaer, 2004). Second, since health may affect productivity directly, there might be genuine simultaneity between labour market and health status. Third, individuals may systematically overstate their health status to justify being outside the labour market or as a means to obtain social security benefits (Kerkhofs and Lindeboom, 1995).

In order to overcome the problems associated with measurement error of self-assessed measures of individual health, we create a latent health stock variable. Following the principles outlined by Stern (1989) and Bound (1991) and subsequently applied in a number of studies, we estimate a model of SAH as a function of more detailed measures of physical health (self-reported measures of limitations in physical functioning, role-physical limitations and bodily pain in performing work and other activities) to define a latent health stock. We then use the predicted values for the latent health stock as our health variable in the duration model of employment exits.

The intuition behind this procedure is to use specific health measures to instrument the endogenous and potentially error-ridden general measure of self-assessed health. We consider the aspect of health that affects an individual's decision to retire, h^R_{it}, to be a function of a set of more specific measures of health, z_{it}:

$$h^R_{it} = z_{it}\beta + \varepsilon_{it}, \qquad i = 1,2,..., n; \quad t = 1,2,...T_i \tag{7}$$

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

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

$$h^*_{it} = h^R_{it} + \eta_{it} \qquad i = 1,2,..., n; \quad t = 1,2,...T_i \tag{8}$$

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

$$h^*_{it} = z_{it}\beta + \varepsilon_{it} + \eta_{it} = z_{it}\beta + \nu_{it} \qquad i = 1,2,..., n; \quad t = 1,2,...T_i \tag{9}$$

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 ν_{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 non-employment 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 (arguably more objective than the general self-assessed health measure) 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 an alternative measure of health shocks based on self-reported information contained in the survey. This measure is based on the responses from a question on the occurrence of a 'serious injury or illness' during the twelve months prior to the interview. Accordingly, we create a dummy variable which takes the value 1 if the respondent reports a serious injury or illness in the previous twelve months and the value 0 otherwise.[4] We also use this variable in the duration model together with the two general health measures.

4. Data

The HILDA Survey Data

We make use of the first six waves (2001-2006) of The Household, Income and Labour Dynamics in Australia (HILDA) Survey. 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 is particularly informative on current and previous labour market activities as well as on measures of individual health status.

The first wave consists of 7682 households and 19914 individuals. The households were selected using a multi-stage approach (Goode and Watson, 2006). 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 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.

Attrition rates for the first three waves (13.2 per cent, 9.6 per cent and 8.4 per cent respectively) are slightly higher than the ones for comparable surveys such as the British Panel Household Study (BHPS).[5] 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 (Goode and Watson, 2006).

Variables

Tables 1 and 2 describe the variables used in our model of employment exits and the various measures of physical limitations and bodily pain used to build the health stock measure.

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[4] The question on 'serious personal injury or illness' was asked only to the respondents from wave 2 to wave 6, i.e. answers to this question are not available for wave 1.

[5] 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.

Table 1 - Variables Used in the Model for Labour Market Exits – Description

Variables	*Description*
Dependent variable	
Labour market status	1 if respondent is economically inactive, 0 otherwise
Ill-health	
Health limitations	Self-assessed health limitations, 1 if health limits daily activities, 0 otherwise
Self-Assessed Health (SAH)	Self-assessed health: 1: excellent, 2: very good, 3: good, 4: fair, 5: poor
Health shocks	
Serious injury or illness	1 if suffered a serious injury or illness in the past 12 months, 0 otherwise
Household variables	
Marital/couple	1 if married or living together with a partner, 0 otherwise
Single	1 if single, 0 otherwise (baseline category)
Own dependent children	1 if respondent has own dependent children, 0 otherwise
No dependent children	1 if respondent does not have any dependent children, 0 otherwise (baseline category)
Income, wealth and housing tenure	
Log household income	Individual specific equivalised mean log of total household income
Household wealth	Total household net wealth
Renting home	1 if renting home, 0 otherwise
Owning home	1 if owning home with or without a mortgage, 0 otherwise (baseline category)
Age dummies	
Age dummies for each age category (50-64 for men; 50-61 for women)	1 if respondent is aged 50 or 51 or 52, etc., 0 otherwise (with Age 50-52 as baseline category)
Education	
Education/degrees	1 if respondent holds degree or post degree qualifications, 0 otherwise
Education/certificate	1 if advanced diploma or certificate, 0 otherwise
Education 12	1 if highest education completed is year 12, 0 otherwise (baseline category)
Job Status	
White collar 1	1 if last or current job as a manager, administrator or professional, 0 otherwise
White collar 2	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	
Living in major city	1 if living in a major city area, 0 otherwise
Regional or remote area	1 if living in a regional or remote area, 0 otherwise (baseline category)
Born overseas	1 if born overseas, 0 otherwise
Born Australia	1 if born in Australia, 0 otherwise (baseline category)

Table 2 - Specific Health Variables – Description

Variables	*Description*
Physical functioning	
Vigorous activities - limited a little	1 if limited a little in the ability of performing vigorous activities, 0 otherwise
Vigorous activities - limited a lot	1 if limited a lot in the ability of performing vigorous activities, 0 otherwise
Moderate activities - limited a little	1 if limited a little in the ability of performing moderate activities, 0 otherwise
Moderate activities - limited a lot	1 if limited a lot in the ability of performing moderate activities, 0 otherwise
Lifting or carrying groceries - limited a little	1 if limited a little in the ability of lifting or carrying groceries, 0 otherwise
Lifting or carrying groceries - limited a lot	1 if limited a little in the ability of lifting or carrying groceries, 0 otherwise
Climbing several flights of stairs -limited a little	1 if limited a little in the ability of climbing several flights of stairs, 0 otherwise
Climbing several flights of stairs - limited a lot	1 if limited a lot in the ability of climbing several flights of stairs, 0 otherwise
Climb one flight of stairs - limited a little	1 if limited a little in the ability of climbing one flights of stairs, 0 otherwise
Climb one flight of stairs - limited a lot	1 if limited a lot in the ability of climbing one flights of stairs, 0 otherwise
Bending, kneeling or stooping - limited a little	1 if limited a little in the ability of bending, kneeling, or stooping, 0 otherwise
Bending, kneeling or stooping - limited a lot	1 if limited a lot in the ability of bending, kneeling, or stooping, 0 otherwise
Walking one kilometre - limited a little	1 if limited a little in the ability of walking more than 1 kilometre, 0 otherwise
Walking one kilometre - limited a lot	1 if limited a lot in the ability of walking more than 1 kilometre, 0 otherwise
Walking half kilometre -limited a little	1 if limited a little in the ability of walking half a kilometre, 0 otherwise
Walking half kilometre - limited a lot	1 if limited a lot in the ability of walking half a kilometre, 0 otherwise
Walking 100 metres - limited a little	1 if limited a little in the ability of walking 100 meters, 0 otherwise
Walking 100 metres - limited a lot	1 if limited a lot in the ability of walking 100 meters, 0 otherwise
Bathing and dressing - limited a little	1 if limited a little in the ability of bathing or dressing, 0 otherwise
Bathing and dressing - limited a lot	1 if limited a lot in the ability of bathing or dressing, 0 otherwise
Role-physical (work and regular daily activities)	
Less work	1 if respondent spends less time working, 0 otherwise
Accomplish less	1 if respondent accomplishes less than he would like, 0 otherwise
Limited in the kind of work	1 if respondent is limited in the kind of work due, 0 otherwise
Difficulties working	1 if respondent has difficulties performing work, 0 otherwise

Table 2 - Specific Health Variables – Description (continued)

Variables	*Description*
Bodily pain	
Mild bodily pain	1 if respondent suffers from very mild or mild bodily pain, 0 otherwise
Moderate bodily pain	1 if respondent suffers from moderate bodily pain, 0 otherwise
Severe bodily pain	1 if respondent suffers from severe or very severe bodily pain, 0 otherwise
Pain interferes slightly with work	1 respondent's bodily pain interferes slightly with work, 0 otherwise
Pain interferes moderately with work	1 if respondent's bodily pain interferes moderately with work, 0 otherwise
Pain interferes a lot with work	1 if respondent's bodily pain interferes quite a bit or extremely with work, 0 otherwise

Labour Market Status

We use observed transitions between economic activity and inactivity as our measure of labour market exit. 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. In order to build the health-stock measure, we make use of the 5 point measure of self-assessed health (SAH) and a series of self-reported health indicators related to physical functioning, role-physical limitations and bodily pain which represent our specific 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 functioning is derived from respondents' answers on a series of questions about the degrees of limitations in performing 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 different degrees of each of these limitations. Role-physical functioning questions relate to problems with work or daily activities as a result of physical health. Accordingly, we create four dummy variables to reflect whether an individual in the last four weeks had to cut down the amount of time spent on work or other activities; if he has accomplished less than he would like; if he was limited in the kind of work he was doing and had difficulties in performing work or other activities. We also build a specific set of dummy variables to define different levels of bodily pain suffered by an individual in the last four weeks (very mild or mild; moderate; and severe or very severe bodily pain) and the degree to which pain interferes with normal work (slightly; moderately; quite a bit or extremely). In addition, we use an alternative measure of general health based on health limitations. This 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.

Income, Wealth and Housing Tenure

Our income variable is the individual-specific mean of the log of total household income, which consists of all the sources of labour and non-labour equivalised income, across the 6 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. Total household wealth is constructed using information on household net worth. In HILDA, household net worth is defined as the difference between total household assets and total household debts and is provided in a special wealth module collected in waves 2 and 6. To capture total household wealth prior retirement, we choose to make use of information on household net worth in wave 2 only.[6] We also separately 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.[7]

Household Variables

In our model we also analyse the effect of household type (marital status) and composition (having dependent children) on individuals' decisions to leave the labour market. Therefore, together with a variable indicating whether a respondent is married or living with a partner, the model includes a dummy variable indentifying the presence of dependent children. These variables are both lagged one period to control for endogeneity.

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).

Stock-sample and Descriptive Statistics

Our stock-sample consists of 1564 individuals – 903 men and 661 women – aged between 50 years old and the year prior state retirement age (64 and 61 years old for men and women respectively).[8] Individuals are followed through the first six waves of the

[6] That is, our measure of total household wealth is time-invariant and uses only wave 2 information. For a detailed description of the different components used to build household net worth in HILDA, see the on-line HILDA user manual: http://www.melbourneinstitute.com/hilda/manual/userman_dvwealth.html.

[7] The 2008 Tax Review (p.27) and a recent NATSEM (National Centre for Social and Economic Modelling) research report (Kelly, 2009) underline that home ownership is a significant factor in retirement planning among Australian individuals.

[8] At the time when the data were collected the Australian Age pension could be paid to people aged 65 or over for men, and aged 62 or over for women. For detailed and comprehensive descriptions of the Australian retirement system see Warren and Oguzoglu (2007) and Kelly (2009).

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. 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 employed (either as an employee or self-employed) rapidly decreases from 1564 to 672 between wave 1 and wave 6. Also, the total number of inactive individuals increases from 111 in wave 2 to 158 in wave 6. This represents the 10 per cent of the original sample of 1564 individuals.

Table 3 - Labour Market Status by Wave

	1	*2*	*3*	*4*	*5*	*6*
Employee	1090	836	732	621	545	474
Own/Self-employed	474	364	304	259	222	198
Unemployed		16	14	13	11	16
Retired		60	74	83	91	101
Unpaid family worker		7	6	5	3	3
Unpaid volunteer		6	7	6	10	9
Looking after ill person		1	2	7	4	4
Disabled		21	24	26	33	25
Attrition and death		253	148	143	101	89
Total		1311	1163	1020	919	830
Total inactive		111	127	140	152	158
Total employed	1564	1200	1036	877	767	672

Table 4 - Labour Market Status by Wave – Men

	1	*2*	*3*	*4*	*5*	*6*
Employee	566	440	387	325	287	246
Own/Self-employed	337	256	218	186	161	145
Unemployed		10	12	9	7	10
Retired		33	48	45	54	57
Unpaid family worker		4	3	4	1	1
Unpaid volunteer		2	2	3	5	5
looking after ill person		0	2	3	3	3
Disabled		14	17	17	22	19
Attrition and death		144	70	97	52	54
Total		759	689	592	540	486
Total inactive		63	84	81	92	95
Total employed	903	696	605	511	448	391

Table 5 - Labour Market Status by Wave – Women

	1	*2*	*3*	*4*	*5*	*6*
Employee	524	396	345	296	258	228
Own/Self-employed	137	108	86	73	61	53
Unemployed		6	2	4	4	6
Retired		27	26	38	37	44
Unpaid family worker		3	3	1	2	2
Unpaid volunteer		4	5	3	5	4
Looking after ill person		1	0	4	1	1
Disabled		7	7	9	11	6
Attrition and death		109	78	46	49	35
Total		552	474	428	379	344
Total inactive		48	43	59	60	63
Total employed	661	504	431	369	319	281

Table 6 reports descriptive statistics for all data and broken down by employment status. These are presented for men and women separately and include a series of health variables (health limitations; the five categories of SAH and a measure of health shocks, that is whether an individual has suffered from a serious injury or illness in the previous 12 months) and a set of socioeconomic characteristics (age, marital status, the presence of dependent children, household income and wealth, housing tenure, education, geographical variables and job characteristics for those employed). A clear positive relationship between labour force participation and health status emerges. That is, the better the health of those of working-age, the more likely they are to remain in the labour force. This is true for both men and women. Concerning health shocks, it is notable that the proportion of men reporting a health shock nearly doubles for the group of non-employed individuals compared to individuals in work. As for the other socioeconomic characteristics, for both genders being outside the labour market appears to be associated with a higher average age, the absence of dependent children, a slightly lower household income and a lower household wealth. The data also appears to reveal the presence of an educational gradient, with a higher proportion of educated individuals among the employed. Further, most individuals in the stock sample report having a partner (85.7 per cent of men and 70.5 per cent of women). However, the percentage of individuals in couples is greater for the sub-sample of non-employed male individuals.

Table 6 - Descriptive Statistics

	Men			*Women*		
	All	*In work*	*Inactive*	*All*	*In work*	*Inactive*
Health variables						
Health limitations	0.269	0.227	0.589	0.208	0.213	0.342
SAH excellent	0.102	0.111	0.024	0.097	0.110	0.047
SAH good	0.366	0.386	0.238	0.402	0.400	0.288
SAH Very good	0.378	0.380	0.338	0.373	0.375	0.426
SAH fair	0.125	0.107	0.270	0.113	0.104	0.181
SAH poor	0.030	0.016	0.129	0.015	0.011	0.058
Health shocks	0.101	0.085	0.194	0.081	0.082	0.118
Socioeconomic characteristics						
Age	57.014	56.657	59.257	55.818	56.103	57.412
Married/couple	0.857	0.856	0.818	0.705	0.752	0.756
Own dependent children	0.334	0.334	0.149	0.274	0.293	0.194
Log household income	11.153	11.201	10.739	11.062	11.118	10.871
Household wealth*	82.475	89.014	68.517	73.619	86.189	68.525
Rent	0.090	0.092	0.057	0.103	0.090	0.104
Education/degrees	0.236	0.233	0.182	0.238	0.239	0.184
Education/certificate	0.377	0.363	0.418	0.255	0.291	0.282
Education 12	0.388	0.404	0.400	0.507	0.470	0.534
White collar 1	0.474	0.536	0.000	0.419	0.530	0.000
White Collar 2	0.202	0.236	0.000	0.287	0.291	0.000
Blue collar	0.198	0.208	0.000	0.117	0.139	0.000
Living in a major city	0.314	0.302	0.292	0.255	0.272	0.244
Born overseas	0.594	0.597	0.462	0.608	0.583	0.598

Note: *household wealth is divided by 10000.

Kaplan-Meier survival estimates of the probability of survival (not leaving the labour force) are displayed in figures 1 to 6. Estimates are presented for health limitations, SAH and health shocks defined as injury or illness, for men and women separately. Figures 1 and 2 show that men reporting health limitations and poor health have a greater probability of leaving the labour force if compared to men not reporting health limitations or reporting better self-assessed health. Similar, but smaller effects, can be found for women in figures 4 and 5. Survival estimates for men in figure 3 show the probability of not retiring by health shocks. Males who suffered from a health shock during the previous year have an increased probability of exiting the labour market. Once more, lower probabilities of retiring are associated with women having suffered from a health shock (figure 6).

Figure 1 - Kaplan-Meier Survival Estimates of the Proportion of Men Not Leaving the Labour Force by Health Limitations

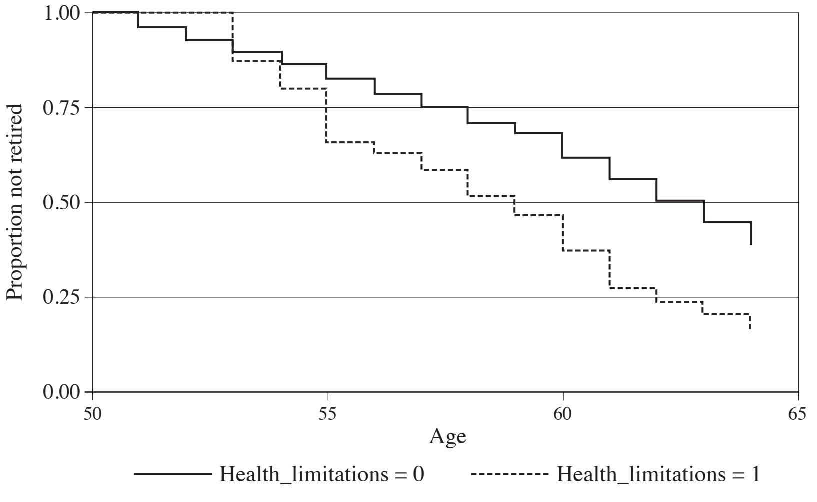


Figure 2 - Kaplan-Meier Survival Estimates of the Proportion of Men Not Leaving the Labour Force by Self-assessed Health

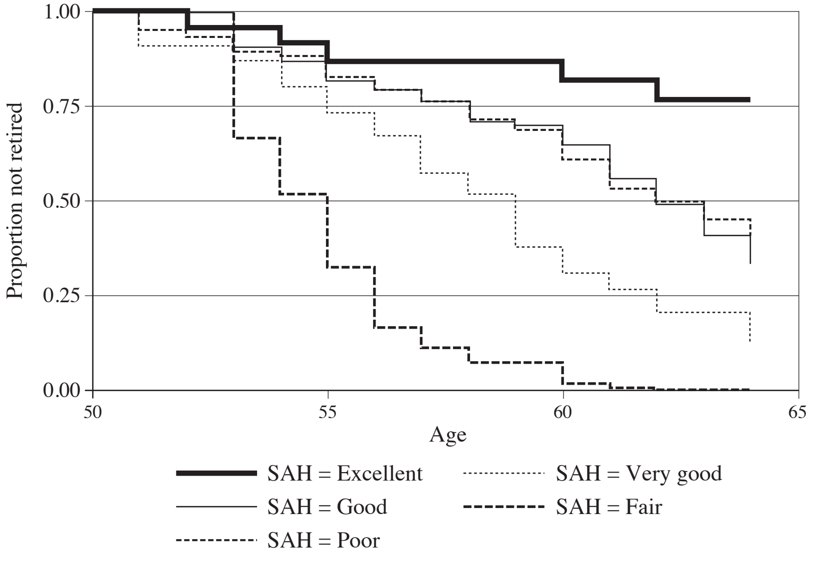


Figure 3 - Kaplan-Meier Survival Estimates of the Proportion of Men Not Leaving the Labour Force by Health Shocks

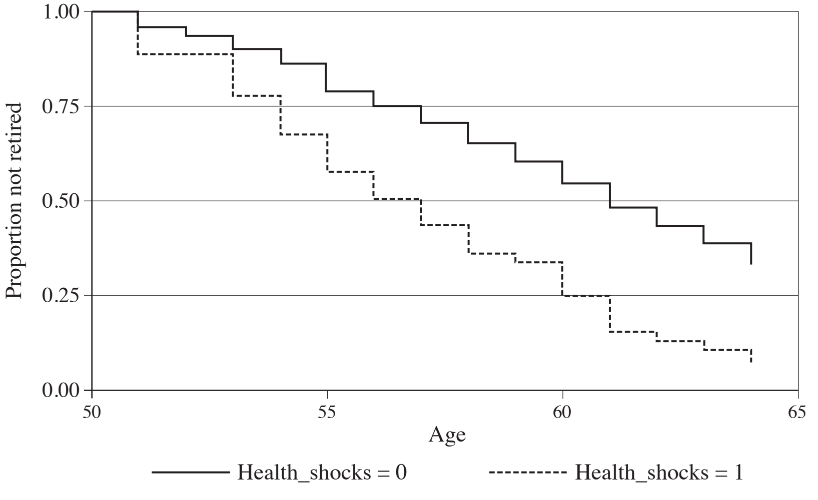


Figure 4 - Kaplan-Meier Survival Estimates of the Proportion of Women Not Leaving the Labour Force by Health Limitations

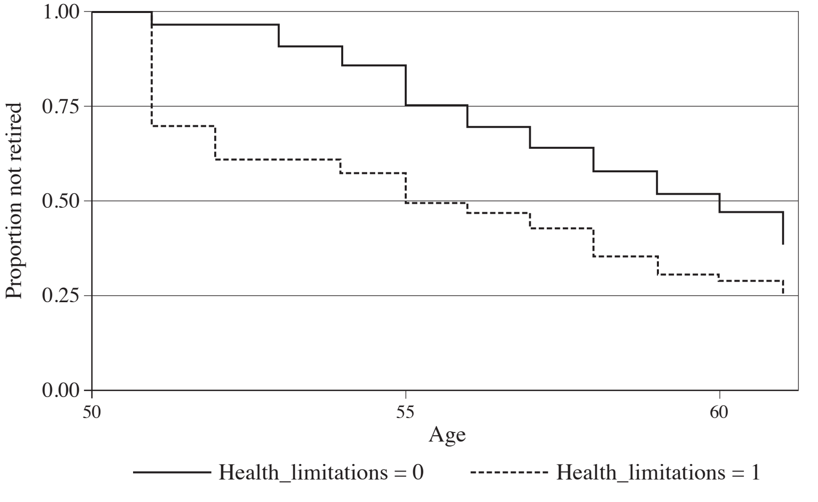


Figure 5 - Kaplan-Meier Survival Estimates of the Proportion of Women Not Leaving the Labour Force by Self-assessed Health (SAH)

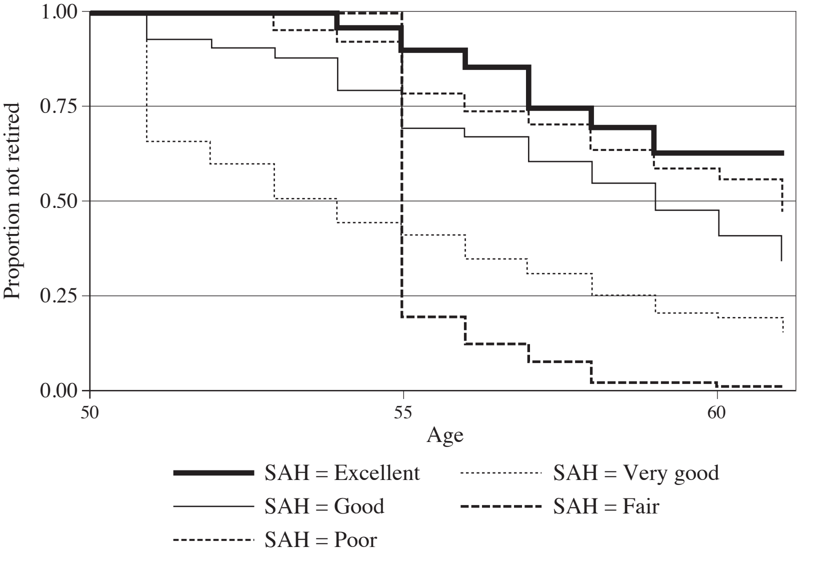
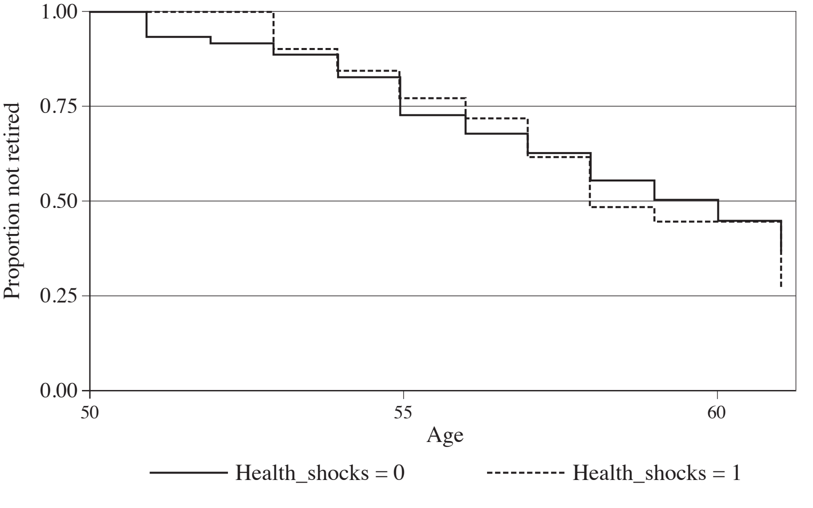


Figure 6 - Kaplan-Meier Survival Estimates of the Proportion of Women Not Retired by Health Shocks



5. Results

Health-stock Measure

Table 7 presents results for the latent health stock obtained by regressing self-assessed health (SAH) on a set of more specific measures of health using pooled ordered probit models. The set of health measures used as regressors in the latent health stock model includes variables that capture different degrees of functional limitations, role-physical limitations and various levels of bodily pain. These models were estimated on men and woman separately on data from the stock sample used for the labour market exits models. As expected, both for men and women, the vast majority of the estimated coefficients display positive signs. As the self-assessed health variable used is increasing in ill-health, reporting health problems is positively associated with poorer self-rated health.

Table 7 - Pooled Ordered Probit Models for SAH

	Men		*Women*	
Latent health index	*Coef.*	*S.E.*	*Coef.*	*S.E.*
Physical functioning				
Vigorous activities/limited a little	0.438 ***	(0.048)	0.335 ***	(0.059)
Vigorous activities/limited a lot	0.785 ***	(0.066)	0.536 ***	(0.076)
Moderate activities/limited a little	0.156 **	(0.068)	0.173 **	(0.074)
Moderate activities/limited a lot	0.132	(0.142)	0.0529	(0.161)
Lifting or carrying groceries/limited a little	0.251 ***	(0.080)	0.262 ***	(0.079)
Lifting or carrying groceries/limited a lot	0.442 ***	(0.167)	0.354 **	(0.179)
Climbing several flights of stairs/limited a little	0.290 ***	(0.053)	0.284 ***	(0.056)
Climbing several flights of stairs/limited a lot	0.695 ***	(0.122)	0.351 ***	(0.126)
Climb one flight of stairs/limited a little	0.0266	(0.091)	0.193 **	(0.097)
Climb one flight of stairs/limited a lot	-0.0202	(0.178)	-0.106	(0.200)
Bending, kneeling or stopping/limited a little	0.0612	(0.048)	-0.0856	(0.056)
Bending, kneeling or stopping/limited a lot	-0.247 **	(0.097)	-0.175	(0.123)
Walking one kilometre/limited a little	0.246 ***	(0.070)	0.345 ***	(0.071)
Walking one kilometre/limited a lot	0.523 ***	(0.138)	0.463 ***	(0.162)
Walking half kilometre/limited a little	0.0304	(0.105)	-0.177	(0.123)
Walking half kilometre/limited a lot	-0.0684	(0.197)	-0.137	(0.237)
Walking 100 metres/limited a little	-0.0548	(0.121)	0.0904	(0.144)
Walking 100 metres/limited a lot	0.0792	(0.238)	-0.326	(0.304)
Bathing and dressing/limited a little	0.141	(0.101)	0.444 ***	(0.152)
Bathing and dressing/limited a lot	-0.420 **	(0.206)	0.182	(0.265)
Role-Physical				
Less work	0.252 ***	(0.085)	-0.0206	(0.092)
Accomplish less	0.215 ***	(0.070)	0.390 ***	(0.082)
Limited in the kind of work	-0.0689	(0.087)	-0.124	(0.097)
Difficulties working	0.208 ***	(0.078)	0.386 ***	(0.092)
Bodily pain				
Mild bodily pain	0.284 ***	(0.048)	0.279 ***	(0.059)
Moderate bodily pain	0.470 ***	(0.081)	0.428 ***	(0.091)
Severe bodily pain	0.549 ***	(0.130)	0.692 ***	(0.145)
Pain interferes slightly with work	0.246 ***	(0.053)	0.158 ***	(0.060)
Pain interferes moderately with work	0.206 **	(0.090)	0.134	(0.104)
Pain interferes a lot with work	0.327 **	(0.131)	0.291 *	(0.154)
Observations	3552		2615	
Log-Likelihood	3779.61		-2709.83	

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

For men, we observe the largest effects, in terms of the size of the coefficients, for functional limitations related to vigorous activities, climbing several flights of stairs and walking one kilometre as well as for higher levels of bodily pain. For women, large effects are observed for a similar set of problems to those observed for men.

Duration Analysis

Results for the discrete-time hazard models of labour market exits are displayed separately for men and women in tables 8a-8b and tables 9a-9b respectively. Each table contains results for health limitations and self-assessed latent health and show the estimated coefficients, standard errors and hazard ratios for each variable. The hazard ratio measures the proportional effects on the underlying hazard of leaving the labour force of a unit change in the value of a given variable. Hazard ratios are centred around 1, all possible decreases in the probability of leaving the labour market lie between 0 and 1 while all possible increases in the risk of leaving the labour force lie above 1. The models were estimated incorporating unobserved heterogeneity (frailty) using alternatively a Gamma mixture distribution (Meyer, 1990) and a normal distribution.[9] Neglecting unobserved heterogeneity in duration models may lead to serious biases. It may lead to an overestimation of the negative duration dependence or to an underestimation of the effect of the explanatory variables on the hazard (Lancaster, 1990; van den Berg, 2001). However, evidence suggests that the misspecification of the unobserved heterogeneity distribution in discrete-time duration models does not seriously affect the estimation results: it does not affect duration dependence or the covariate coefficients (Nicoletti and Rondinelli, 2006). This appears to imply that while frailty must be taken into account when estimating discrete-time duration models, the exact specification is less important.

Table 8a - Hazard Model for Labour Market Exits – Men

	Health Limitations			*Latent Self-assessed Health*		
	Coef.	*S.E.*	*Hazard Ratio*	*Coef.*	*S.E.*	*Hazard Ratio*
Health variables						
Health limitations (0)	0.786***	(0.269)	2.195			
Health limitations (t-1)	0.159	(0.231)	1.172			
Latent health (0)				0.0518	(0.173)	1.053
Latent health (t-1)				0.410***	(0.154)	1.506
Other covariates						
Education/degrees	0.495*	(0.291)	1.641	0.645**	(0.315)	1.907
Education/certificate	0.233	(0.217)	1.263	0.302	(0.237)	1.352
White collar (0)	-0.169	(0.254)	0.845	-0.128	(0.272)	0.880
Blue collar (0)	0.339	(0.271)	1.403	0.301	(0.298)	1.351
Log household income (t-1)	-0.872***	(0.194)	0.418	-0.727***	(0.205)	0.483
Household wealth	0.002	(0.001)	1.001	0.001	(0.001)	1.001

[9] Models were estimated in STATA using the pgmhaz8 routine (Jenkins, 1998) which includes unobserved heterogeneity as a Gamma mixture distribution as well as using the xtcloglog command which assumes normally distributed unobserved heterogeneity. Results were very similar, hence we choose to report estimates from only one of the two model specifications (the one with Gamma distributed frailty). The complete set of results is available upon request.

Table 8a - Hazard Model for Labour Market Exits – Men (continued)

	Health Limitations			*Latent Self-assessed Health*		
	Coef.	*S.E.*	*Hazard Ratio*	*Coef.*	*S.E.*	*Hazard Ratio*
Renting home (t-1)	-0.171	(0.327)	0.843	-0.203	(0.371)	0.816
Born overseas	-0.296	(0.215)	0.744	-0.153	(0.227)	0.858
Living in a major city	-0.0350	(0.197)	0.966	-0.130	(0.210)	0.878
Married/couple (t-1)	0.188	(0.271)	1.206	0.169	(0.296)	1.184
Dependent children (t-1)	-0.541 **	(0.228)	0.582	-0.648 **	(0.252)	0.523
Age 53	0.666	(0.521)	1.947	0.809	(0.618)	2.246
Age 54	0.495	(0.521)	1.641	0.274	(0.645)	1.316
Age 55	1.095 **	(0.488)	2.990	1.268 **	(0.573)	3.552
Age 56	0.686	(0.526)	1.985	0.883	(0.610)	2.417
Age 57	0.716	(0.522)	2.046	0.715	(0.619)	2.044
Age 58	1.034 **	(0.509)	2.811	0.994	(0.615)	2.703
Age 59	0.503	(0.553)	1.654	0.709	(0.640)	2.033
Age 60	1.411 ***	(0.500)	4.101	1.616 ***	(0.593)	5.032
Age 61	1.671 ***	(0.510)	5.315	1.927 ***	(0.607)	6.872
Age 62	1.529 ***	(0.544)	4.616	1.506 **	(0.649)	4.508
Age 63	1.495 ***	(0.555)	4.460	1.649 **	(0.664)	5.201
Age 64	1.912 ***	(0.576)	6.764	2.012 ***	(0.683)	7.481
Observations	2760			2340		
LR test for gamma variation	12.619			8.725		
P-value	0.000			0.001		
Log likelihood	-655.305			-547.242		

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 8b - Hazard Model for Labour Market Exits – Men

	Health Limitations			*Latent Self-assessed Health*		
	Coef.	*S.E.*	*Hazard Ratio*	*Coef.*	*S.E.*	*Hazard Ratio*
Health variables						
Health limitations (0)	0.750 ***	(0.234)	2.116			
Latent health (0)				0.289 **	(0.133)	1.335
Health shocks	1.427 ***	(0.235)	4.167	1.360 ***	(0.246)	3.896
Other covariates						
Education/degrees	0.494	(0.310)	1.640	0.466	(0.316)	1.594
Education/certificate	0.337	(0.236)	1.401	0.320	(0.245)	1.377
White collar (0)	-0.116	(0.276)	0.891	-0.0337	(0.284)	0.967
Blue collar (0)	0.368	(0.295)	1.444	0.330	(0.313)	1.391
Log household income (t-1)	-0.867 ***	(0.213)	0.420	-0.711 ***	(0.215)	0.491
Household wealth	0.002	(0.001)	1.002	0.001	(0.001)	1.001
Renting home (t-1)	-0.466	(0.367)	0.628	-0.434	(0.383)	0.648
Born overseas	-0.292	(0.232)	0.747	-0.259	(0.239)	0.772
Living in a major city	-0.0837	(0.211)	0.920	-0.0919	(0.216)	0.912
Married/couple (t-1)	0.182	(0.298)	1.200	0.264	(0.310)	1.302
Dependent children (t-1)	-0.562 **	(0.248)	0.570	-0.645 **	(0.260)	0.525
Age 53	0.765	(0.567)	2.149	0.810	(0.618)	2.248
Age 54	0.333	(0.576)	1.395	0.224	(0.639)	1.252
Age 55	1.243 **	(0.534)	3.465	1.221 **	(0.580)	3.391

Table 8b - Hazard Model for Labour Market Exits – Men (continued)

	Health Limitations			*Latent Self-assessed Health*		
	Coef.	*S.E.*	*Hazard Ratio*	*Coef.*	*S.E.*	*Hazard Ratio*
Age 56	0.707	(0.572)	2.028	0.725	(0.615)	2.065
Age 57	0.768	(0.574)	2.156	0.684	(0.623)	1.983
Age 58	1.171 **	(0.557)	3.226	1.051 *	(0.611)	2.860
Age 59	0.617	(0.608)	1.854	0.552	(0.660)	1.736
Age 60	1.582 ***	(0.548)	4.864	1.533 **	(0.599)	4.633
Age 61	1.876 ***	(0.554)	6.526	1.871 ***	(0.603)	6.493
Age 62	1.664 ***	(0.598)	5.282	1.439 **	(0.658)	4.218
Age 63	1.729 ***	(0.618)	5.635	1.723 ***	(0.665)	5.599
Age 64	2.165 ***	(0.630)	8.717	2.144 ***	(0.684)	8.536
Observations	2596			2383		
LR test for gamma variation	14.408			10.618		
P-value	0.000			0.000		
Log likelihood	-594.807			-550.551		

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

In order to assess the effect of individual health status in determining early exit decisions, we consider both a general measure of health limitations and the latent health stock measure 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 limitations and self-assessed latent health using an alternative measure of health shocks which identifies the presence of a serious injury or illness in the previous 12 months (tables 8b and 9b).

For men, we observe a large, positive and highly significant effect for the initial period health limitations variable (table 8a). This means that the hazard of leaving the labour force is greater for individuals suffering from physical limitations. We also observe a positive and significant coefficient for our measure of latent health-stock lagged one period. Since the measure is increasing with ill-health, this implies that the hazard of an early exit increases for individuals suffering from a health shock (defined in terms of a deviation from first period, wave 1, health stock). According to the computed quantitative effects (hazard ratios), the presence of limitations increase the hazard of leaving the labour force by 122 per cent whereas health shocks (lagged health stock variable), increase the same hazard by around 50 per cent (table 8a). The effects of the health and health shocks variables become larger using an alternative health shocks definition (table 8b). In particular, the occurrence of a health shock defined as serious injury or illness is associated with a 320 per cent increase in the probability of becoming non-employed in the model for health limitations and with a 290 per cent increase in the health stock model.

All models show the same gradient over the age categories with the hazard of an early exit becoming positive, larger and statistically significant as statuary pension age approaches. The quantitative effects of the age variables are particularly large: being 64 years old increases the likelihood of leaving the labour force between nearly six and eight times (tables 8a and 8b). As household income increases, the hazard of retirement decreases while the effects of total household wealth and housing tenure (renting home) do not appear to be statistically significant in any of the models considered.

Consistently across models, early exit decisions for men are a function of having dependent children but not of marital status. More specifically, the estimated coefficients for having dependent children are negative and significant. The effect is compared to the baseline category of not having dependent children. This suggests that for men, having to provide maintenance to dependent children decreases the likelihood of leaving the labour market by around 50 per cent (table 8a and 8b). However, living with a partner or being married does not seem to significantly influence the likelihood of an early exit (coefficients are positive but not significant).

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 leaving the labour force (table 8a). The risk is also relatively large and positive for blue collar labourers 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.

Table 9a - Hazard Model for Labour Market Exits – Women

	Health Limitations			*Latent Self-assessed Health*		
	Coef.	*S.E.*	*Hazard Ratio*	*Coef.*	*S.E.*	*Hazard Ratio*
Health variables						
Health limitations (0)	-0.119	(0.325)	0.888			
Health limitations (t-1)	0.555 **	(0.254)	1.742			
Latent health (0)				-0.325	(0.234)	0.723
Latent health (t-1)				0.516 **	(0.206)	1.676
Other covariates						
Education/degrees	-0.141	(0.308)	0.869	-0.294	(0.369)	0.745
Education/certificate	0.0837	(0.251)	1.087	-0.0147	(0.314)	0.985
White collar (0)	-0.0532	(0.252)	0.948	-0.0276	(0.308)	0.973
Blue collar (0)	0.157	(0.322)	1.171	0.0938	(0.399)	1.098
Log household income (t-1)	0.666 ***	(0.199)	0.514	-0.895 ***	(0.242)	0.408
Household wealth	0.001	(0.001)	1.001	0.001	(0.001)	1.002
Renting home (t-1)	0.0631	(0.360)	1.065	0.154	(0.439)	1.167
Born overseas	-0.0524	(0.242)	0.949	-0.221	(0.303)	0.802
Living in a major city	0.373 *	(0.224)	1.452	0.446 *	(0.269)	1.561
Married/couple (t-1)	0.881 ***	(0.262)	2.414	1.178 ***	(0.324)	3.249
Dependent children (t-1)	-0.003	(0.248)	0.996	-0.001	(0.295)	0.999
Age 53	0.420	(0.515)	1.522	0.153	(0.652)	1.165
Age 54	0.610	(0.478)	1.841	0.855	(0.561)	2.351
Age 55	1.458 ***	(0.440)	4.298	1.682 ***	(0.533)	5.375
Age 56	0.933 *	(0.491)	2.542	0.989 *	(0.596)	2.688
Age 57	1.020 **	(0.491)	2.772	1.315 **	(0.583)	3.724
Age 58	1.432 ***	(0.493)	4.185	1.597 ***	(0.596)	4.937
Age 59	1.383 ***	(0.526)	3.988	1.635 **	(0.635)	5.127

Table 9a - Hazard Model for Labour Market Exits – Women (continued)

	Health Limitations			*Latent Self-assessed Health*		
	Coef.	*S.E.*	*Hazard Ratio*	*Coef.*	*S.E.*	*Hazard Ratio*
Age 60	1.192 **	(0.570)	3.295	1.696 **	(0.685)	5.451
Age 61	1.830 ***	(0.542)	6.236	2.124 ***	(0.663)	8.366
Observations	1997			1652		
LR test for gamma variation	6.431			9.025		
P-value	0.005			0.001		
Log likelihood	-554.944			-432.834		

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 9b - Hazard Model for Labour Market Exits – Women

	Health Limitations			*Latent Self-assessed Health*		
	Coef.	*S.E.*	*Hazard Ratio*	*Coef.*	*S.E.*	*Hazard Ratio*
Health variables						
Health limitations (0)	0.242	(0.289)	1.273	0.135	(0.155)	1.144
Latent health (0)						
Health shocks	0.274	(0.306)	1.315	0.106	(0.354)	1.112
Other covariates						
Education/degrees	-0.177	(0.320)	0.838	-0.309	(0.357)	0.734
Education/certificate	0.105	(0.260)	1.110	-0.0259	(0.295)	0.974
White collar (0)	-0.182	(0.260)	0.833	-0.158	(0.291)	0.854
Blue collar (0)	0.0316	(0.331)	1.032	-0.103	(0.375)	0.902
Log household income (t-1)	-0.710 ***	(0.207)	0.492	-0.840 ***	(0.232)	0.432
Household wealth	0.002	(0.001)	1.001	-0.001	(0.001)	1.000
Renting home (t-1)	0.141	(0.373)	1.152	0.295	(0.417)	1.343
Born overseas	-0.0596	(0.252)	0.942	-0.144	(0.285)	0.866
Living in a major city	0.373	(0.233)	1.453	0.363	(0.257)	1.438
Married/couple (t-1)	1.128 ***	(0.283)	3.090	1.326 ***	(0.320)	3.768
Dependent children (t-1)	0.0450	(0.261)	1.046	0.0495	(0.288)	1.051
Age 53	0.334	(0.569)	1.397	0.177	(0.594)	1.194
Age 54	0.843 *	(0.506)	2.324	0.765	(0.526)	2.150
Age 55	1.551 ***	(0.478)	4.717	1.483 ***	(0.497)	4.405
Age 56	1.018*	(0.531)	2.766	0.857	(0.562)	2.356
Age 57	1.196 **	(0.521)	3.308	1.148 **	(0.548)	3.151
Age 58	1.646 ***	(0.530)	5.185	1.452 ***	(0.562)	4.270
Age 59	1.443 **	(0.560)	4.231	1.416 **	(0.587)	4.122
Age 60	1.422 **	(0.612)	4.147	1.554 **	(0.656)	4.728
Age 61	1.893 ***	(0.576)	6.639	1.824 ***	(0.619)	6.200
Observations	1879	1676				
LR test for gamma variation	5.6531			7.50445		
P-value	0.008712			0.003077		
Log likelihood	-506.511			-438.962		

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

For women, ill-health and health shocks have weaker effects on early exit decisions. Only the coefficients for the lagged measures of health, health limitations and latent health stock, are positive and highly significant (table 9a). According to the hazard ratios for these variables, experiencing health shocks leading to health limitations increase the hazard of an early exit by around 74 per cent while a deterioration in the health stock (health shock) increase the same hazard by around 68 per cent. All other health and health shock related coefficients are not statistically significant (table 9a).

Contrary to men, for women exit decisions are a positive function of marital status. Being married or living with a partner substantially increases the hazard of leaving the labour force. However, having own dependent children does not appear to significantly influence women's early exits from the labour market. Age appears to be among the most important factors in women's early exit decisions: age categories from age 55 onwards are highly significant for all the models and the corresponding hazard ratios are particularly large. Qualitatively, the effects of the other non-health variables are the same as in the corresponding models for men.

6. Conclusions and Policy Implications

This paper examines and quantifies the role of ill-health and health shocks in determining decisions to leave the labour market among older working individuals. We concentrate only on early exits and we use a discrete-time hazard model to represent transitions to non-employment on Australian longitudinal data. We extend earlier analyses 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 health using pooled ordered probit models. We also define health shocks in two distinct ways and consider the effects of a number of socioeconomic characteristics on an individual's early exit decision.

Regardless of the health variables used, results consistently indicate that ill-health and health shocks are key determinants of early exit decisions among older working individuals. In particular, health shocks greatly increase the risk of an early exit from the labour market. Depending on the definition of a health shock, for men negative shocks to health increase the hazard of leaving the labour force by 50 to 320 per cent, whereas for women health shocks enhance the risk of an early exit by 68 to 74 per cent.

The effects of household type and composition are also of interest and imply a substantial asymmetry in labour market behaviour for men and women. Whereas having a partner increases the probability of leaving the labour market for women, it does not significantly increase the probability for men. On the contrary, having dependent children significantly decreases the risk of an early exit from the labour force for men but does not appear to affect women's exit choices.

Our results have important policy implications. They indicate that health must be taken into account when designing policies aimed at encouraging older individuals to remain in the labour force or younger retirees to re-enter the labour market.

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