RETIREMENT, FINANCIAL INCENTIVES AND HEALTH

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Abstract
This paper aims to assess empirically the relative size of incentive effects and health for the retirement decision. We specify and estimate a dynamic model for retirement behaviour that explicitly takes account of eligibility conditions and replacement rates of alternative exit routes from the labour force, and health. A range of health instruments are constructed from estimates of a model for health dynamics and these are used to assess the effect of reporting errors and of endogeneity of health on the estimates of the retirement model. Our results provide evidence that health and retirement are endogenously related. Health matters but the size of the health effect depends crucially on the health measure used. We find that subjective health measures overstate the effect of health on retirement and that endogeneity of health suppresses the health effect. Incentive effects are relatively insensitive to alternative specifications for health. The incentive effects are strong for Early Retirement schemes. There is evidence that income streams in alternative exit routes are compared in the retirement decision and that alternative exit routes act as substitutes.

1 INTRODUCTION

Although the decline in the labour force participation rate of elderly is a trend observed in most OECD countries, the Dutch participation rate are exceptionally low. Only 60% of men and 21% of women aged 55-59 are still at work and this percentage falls to 20% and 7% for the 60-64 age group. In 1970 the corresponding numbers for the older age group were 72 and 12%. The drop in participation for men has been among the highest of all OECD countries (OECD 1995). Since the early seventies the social security system expanded and employer provided early retirement schemes were introduced. It has been argued that these provisions are to a large extent responsible for this drop in the Dutch elderly participation rates (see for instance Aarts and de Jong (1990)).

The main objective of this paper is to examine the importance of eligibility conditions and replacement rates of the Dutch exit routes in explaining individual retirement behaviour. For this purpose we use a model in which the individual decision to stop or continue working depends on a comparison of retirement options that come available over time. Retirement options are characterized by retirement date (age) and route (Early Retirement schemes, Disability Insurance and Unemployment Insurance). In our analyses we take account of the specifics of these schemes. Health enters the model because it is likely to affect relative preferences for income and leisure. In turn, decisions regarding work may also affect health.

With respect to health, most retirement studies find large and dominant effects on individual retirement behaviour. Although health is undoubtedly an important determinant, it has been argued that its effect might have been overstated because of the subjective nature of the health measures that are commonly used in empirical analyses and because of the endogenous interrelation between health and work. There is a substantive literature on biases in retirement models due to subjective health measures, see e.g. Lambrinos (1981), Anderson and Burkhauser (1985), Bazzoli (1985), Butler et al. (1987), Stern (1989), Bound (1991), Kerkhofs and Lindeboom (1995) and Bound et al. (1998)). Obvious economic incentives or a desire to conform to social norms might explain why subjective responses concerning health may depend on labour market status. In addition, health and work may be endogenously related. There may be direct effects from health on retirement (bad health may induce individuals to stop working) and effects going the other way from work on health (health of working individuals may deteriorate faster). Furthermore, health and work may be indirectly related through common, unobserved, components. All these effects may bias parameter estimates in behavioural models of the relationship between labour market status and health.

A second objective of this paper is to assess the relative importance of health and to examine the consequences of using alternative health measures on the parameter estimates of our retirement model. To this end we specify and estimate a model of health dynamics. This model provides insight in the way in which work history and current labour market status affect health and sheds more light on the relationship between health and retirement. Estimates of this dynamic health model are used to construct a range of health measures. The retirement model is estimated with the traditional subjective health measure, a more objective health measure and a range of instruments derived from our model for health dynamics. Comparison of these alternative estimates will enable us to say more about the relative importance of health and financial incentives on the decision to stop working.

The next section gives a brief description of the social security and early retirement opportunities in the Dutch welfare state. Our theoretical framework is laid out in section 3. Section 4 describes the panel survey used. Section 5 deals with the empirical specification and estimation of a model for retirement behaviour and health. Section 6 summarizes and concludes.

2 A BRIEF INTRODUCTION TO THE DUTCH SYSTEM

Dutch benefit programmes can be divided into Social Security benefit programmes and employer provided Early Retirement (ER) programmes. Social Security programmes consists of Unemployment Insurance (UI) and Disability Insurance (DI) programmes. Unemployment Insurance programmes can be divided into Unemployment Benefit (UB) programmes, to build a safety net to protect those who lose their income due to involuntary unemployment, and social assistance (SA) provisions.

UB entitlement period depends upon previous job tenure and work experience and are provided up to a maximum of 5 years. Benefit replacement rates are a fixed percentage (seventy percent) of previous gross earnings. Benefit recipients have to be in active search for employment to maintain (full) benefits. Recipients of 57,5 years and older are exempted from the active search requirement. As a result UB is often a pre-pension retirement income for elderly workers. After exhaustion of the UB entitlement period, the unemployed can apply for SA. The drop in unemployment benefit levels may be substantive as SA benefit are seventy percent of minimum wages (monthly gross minimum wage was 2,163 Dutch guilders in 1994). SA benefit is provided up to the mandatory retirement age (65 years).

Disability Insurance (DI) is provided to protect those who have a physical and/or mental inability to perform gainful employment. Up to the summer of 1993, benefit levels were 70 percent of gross earnings and in practice were provided up to the mandatory retirement age. Though not designed for that purpose, in the past, DI schemes have specifically been used as an exit route for elderly workers (healthy and unhealthy) with consent of the employer, the worker and the DI administrators (see for instance, Aarts & de Jong (1990)). To reduce the number of DI beneficiaries the government tightened DI regulations in the Summer of 1993 and introduced a limited benefit entitlement period and medical examinations at regular times to assess whether the disability status of the recipient. Due to political pressure beneficiaries of 45 and older were exempted from the tighter rules. Since 1993 the DI entitlement period depends on age and ranges from 0 to 6 years. After this initial entitlement period benefits levels are lowered. The reduction in benefits is a function of previous wages, minimum wages and age. We refer to Appendix I for specifics on UI and DI benefit levels.

Early Retirement (ER) schemes, introduced in the late seventies, are employer provided schemes and were initially designed as programmes to induce elderly to retire early in order to make room for young unemployed workers. ER replacement rates vary per sector or even per firm, but are generally financially very attractive. In some cases net replacement rates may be close to one. The average replacement rate is eighty percent of previous gross earnings. ER eligibility conditions typically depend on age and/or job tenure. Since 1957 all residents of The Netherlands are entitled to a flat rate social security benefit at age 65. The monthly benefit amount is tied to the government mandated minimum wage. Almost all workers can supplement these basic social security benefits with mandated employer pension benefits. Meuwissen (1993) estimates that 80 percent of households with a head aged 65 and over received some form of supplementary occupational pension in 1989. Kapteyn and De Vos (1997) report that almost all occupation pensions are defined benefit plans (usually making pension benefits depend on final year's earnings) and that, together with social security benefits, they replace between 60 and 69 percent of the median retiree's pre-tax earnings.

Outflow rates from the stock of non working individuals appear to be extremely low for Dutch elderly. For elderly UI and DI recipients active search for (re)employment is not a requirement for eligibility, and ER recipients actually lose retirement benefits upon reentering employment. This makes UI, DI and ER effectively absorbing retirement states for elderly workers.

3 THEORETICAL CONSIDERATIONS

Individual retirement behaviour can be seen as a dynamic process in which the decision to stop or continue working depends on a comparison of retirement options that come available over time. Retirement options are characterized by retirement date (age) and route (ER, DI, UI) and consists of packages of retirement years of leisure and retirement income streams. Health enters the model because it directly affects individual utility (for instance health limitations may change individual taste). As ER, DI and UI are absorbing non-working states the optimization problem is essentially an optimal stopping problem.

More specifically, we take time, t, as a sequence of discrete time periods with length one. The starting date of the process is taken at $t = \tau_0$ and ends at $t = \tau_T$. Both τ_0 and τ_T may vary per individual. For each labour market state we define $U^k_t = U(Y_k(t),H(t),t)$ as the per period utility flow of being in labour market state k at time t. U^k_t depends on income Y, health H and leisure. Leisure is implicitly defined by the decision period t. Relative preferences (tastes) for income $(p(t))$ and leisure may depend on health. Note that retirement income of a specific route r, $r \in \{ER,DI,UI\}$, depends upon the date of retirement, as entitlement regulations and replacement rates vary over time. In section 4, when discussing data issues, we will be more precise about the income flows associated with retirement options. Access to specific retirement routes at different points in time is determined by eligibility conditions, hence:

$$U^r_t = \begin{cases} U(Y^r(t),H(t),t) > 0 & \text{, if the individual is eligible for route } r \text{, at time } t \\ 0 & \text{, otherwise} \end{cases} \tag{1}$$

To allow for observed heterogeneity in retirement patterns (conditional on observed characteristics) random components ε^r_k may be introduced to enter the model. For instance if ε^r_t enters additively, we can write for an individual eligible for route r, at time t: $U^r_t = \bar{U}(Y^r(t),H(t),t) + \varepsilon^r_t$. ε^r_t may represent uncertainties associated with retirement date and routes, such as utility specific random components, individual heterogeneity and optimization errors.

Given the model structure, the workers retirement decision can be written as a sequence of per period decisions to stop working and obtain:

$$V_t^r = U_t^r + \beta E V_{t+1}^r, \quad r \epsilon A_t \quad \textit{for a given set of options } A_t \subset \{ER, DI, UI\} \tag{2a}$$

or to continue work and obtain:

$$V_t^W = U_t^W + \beta E \max\{ \{V_{t+1}^r\}_{r \in A_{t+1}}, V_{t+1}^W\} \tag{2b}$$

A, is the set of retirement option for which the individual is eligible at time t and is determined by the eligibility conditions of the alternative exit routes. β is the time discount factor and E is the expectations operator. V^w_t is the value of continued work.

Assumptions regarding the nature of unobserved heterogeneity in the model (ε^k_t), $k=\{W,ER,DI,UI\}$, determine the essentials of the model. Suppose we assume perfect foresight about future retirement options, and take ε^r_t to account for optimization errors and/or utility specific shocks known to the individual worker, but not to the researcher. Under these assumptions the model boils down to a single optimization problem concerning retirement date and exit route taken at the starting date. Alternatively, uncertainty concerning future stopping dates and routes may enter the model. Suppose that this uncertainty is represented by stochastic terms ε^k_t and that current drawings of ε^k_t are known to the searcher, but future drawings are not. Under these assumptions the model is similar to the dynamic program/optimal stopping model of Daula & Moffitt (1995).

Decisions regarding work affect an individual's health. We summarize work decision at time t by $L(t)$. Furthermore, some people may be intrinsically more healthy than others. We denote this usually unobserved factor by γ. Individual decisions regarding health related behaviour (Z) will also have an affect on an individual's health. Z will typically contain elements, such as smoking, drinking, exercising, working out, etc. Health related behaviour will depend on the individual's attitude towards risk and the individual's time discount rate. Note that these variables may be unobserved in practice. In line with this we may specify the following health function:

$$H(t) = F(H(0), L(0), .. L(t), Z(0), \ldots Z(t), \gamma) \tag{3}$$

The retirement model (1)-(2) may be 'solved' by the individual subject to a health equation (3). Each period the individual worker will make decisions regarding work and non-work, considering the alternative exit routes which are then available and the income streams which go with each of these options. The worker takes into account his or her present health condition and will recognize the effect of work choices on future health.

The structure of our empirical retirement model is in line with the above. Individual's make choices regarding the optimal retirement date and these choices are updated. We will, however, not explicitly impose the utility structure on the empirical model, i.e. U^r_t will not be specified directly. On the other hand, we explicitly incorporate the specifics of the Disability Insurance and Unemployment Insurance schemes and employer provided Early Retirement Schemes and allow health and retirement to be endogenously related.

4 DATA

Data are obtained from the first two waves of the CERRA panel survey. The CERRA panel survey is a Dutch survey that is designed specifically for the analysis of health and retirement issues and resembles the Michigan Survey Centre's well known Health and Retirement Survey (HRS). The first wave was held in the Fall of 1993 and consists of 4727 households in which the head of the household (i.e. the main income earner) was between 43 and 63 years of age at the date of the interview. In each household both head and partner, if existent, were interviewed. In the Fall of 1995 the same respondents were contacted for a second interview. Approximately 74% of the first wave respondents participated in the second wave, which resulted in about 3500 households. For each wave extensive information is obtained on labour history and current labour market status, sources of income, attitude towards retirement, housing, health and a variety of socio-economic variables.

Internal evaluations of item non-response and representativeness of the first wave of data show them to be of high quality. In general, item non-response was not a problem. Non-response was, however, relatively high for the income questions, with a non-response rate of up to 30 percent for some income sources. The CERRA data were compared to data from The Netherlands Central Bureau of Statistics and found comparable based on age, sex, labour market status, and education.

The *health* variables in the sample contain, among others, the commonly used subjective measures like 'how good would you rate your health' and 'does your health limit you in your ability to work'. There is a substantive literature on the use of subjective health measures such as these in retirement models (see for instance Bazzoli (1985), Anderson and Burkhauser (1985), Stern (1989), Bound (1991), Kerkhofs and Lindeboom (1995) and Bound et al. (1998)). It is argued that responses concerning health may depend upon labour market status, due to economic incentives or because respondents want to conform to social norms. If health responses do depend on labour market **status** this will seriously distort parameter estimates in behavioural models examining the relationship between labour market status and health.

The CERRA data also contain responses to the Hopkins Symptom Checklist (HSCL). The HSCL is a validated objective test of general health used in the medical sciences to assess the psychoneurotic and somatic pathology of patients. The HSCL consists of 57 items and is known to have an excellent rate of internal consistency, meaning that the test results are highly correlated with objective medical reports on the patients health status. The responses to these 57 questions result in a mental score, a physical score and a total health score. In our analyses we will use the total health score. The advantage of this HSCL measure over a subjectively, self assessed health measures is that it is free of reporting errors that may depend upon the respondent's labour market status. Table Al provides more information on the HSCL scores and relates it to a self reported, work related, health measure.

Table 1 presents cross-tabulations of age and labour market status in our sample in 1993. The table is obtained from information of the full sample (i.e. the 4727 respondents of the 1993 wave). Disability Insurance (DI), Unemployment Insurance (UI) and Early Retirement (ER) are the three exit states that we consider].

TABLE 1 ABOUT HERE

From table 1 (which also distinguishes self employed respondents) it can be seen that participation rates already start to decline at age 45. At these for retirement studies relatively young ages Disability Insurance (DI) recipients account for the larger part of the non-participation. The fraction of individuals in UI and DI increases with age, which to a large extent reflects the absorbing nature of retirement in the Netherlands. From age 60 onward Early Retirement becomes the dominant mode for retirement. Table 2 provides the corresponding Kaplan-Meier estimates of the transition rate from work into the non-work states ER, DI and UI. The table reports these transition rates for different age categories over the period 1988

'The UI category includes all non-working states other than DI and ER. UI not only has Unemployment Insurance beneficiaries but also people on pension plans and out of the labour force for various other reasons. A distinction of the separate modes of retirement within UI is not feasible given the data at hand.

to 1994[2]. Note that transition rates for ages 58-61 in the years 1988-1990 are based on a small number of observations as the primary sample of the first wave of the CERRA retirement survey included only respondents aged between 53-63 in 1993.

TABLE 2 ABOUT HERE

Table 2 shows again that at early ages retirement predominantly takes place through DI and or UI. ER transitions become large and dominant at higher ages, but well before age 60. Note that UI and DI transition rates are slightly increasing over the ages, whereas ER transition rates show a strong increase at age 59. Eligibility is a function of age and tenure in most ER schemes. Apparently an increasing number of individuals meet the ER eligibility conditions at ages starting at 58. There is little variation in the transition rates over the period 1988-1994.

5 EMPIRICAL ANALYSES

5.1. Sample selection and the empirical specification of the retirement model.

We start with the specification of the retirement model, conditional on individual health. We will turn to the health model in subsection 5.3. A convenient way of incorporating the structure sketched in section 3 is by means of a competing risk model for employment duration. The "risks" are retirement through the alternative exit routes: ER, DI and UI. This framework is particularly convenient as it allows us to deal with censored observations (individuals still at work at the end of the observation period) and time varying regressors associated with alternative retirement dates. Important time varying regressors are age, health, eligibility conditions and benefit replacement rates. Time dependent eligibility rules for the exit routes and the time varying nature of life cycle income is explicitly acknowledged. With respect to the latter, Burkhauser (1978) was the first to argue that not only current income but also future income streams are important for the retirement decision. In making individual retirement decisions the present value of income streams for work and alternative retirement options should be compared. We acknowledge that at different points in time different retirement options are open. The present value of the associated income streams also vary over time. We therefore need to generate income profiles for each option over an individual's

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[2] The numbers for 1988 to 1992 are derived from (retrospective) information in wave I. The transition rates for 1993 and 1994 are obtained from wave II.

remaining life cycle.

Wage income profiles over the life cycle are obtained from a simultaneous panel data model for wage income and labour force participation over the years 1991 to 1995. From the model estimates of life cycle income profiles are derived for each respondent at each point in time. We refer to Heyma (1998) for details.

Benefit income streams for alternative retirement options are derived using ER eligibility rules and social security rules. ER eligibility conditions are typically simple functions of age and/or tenure. ER replacement rates are a fixed percentage of previous gross earnings. Replacement rates and eligibility conditions may be sector- or even firm specific. They are issues for collective bargaining between employer and employee organisations and may therefore vary over time. We obtain direct information on ER eligibility rules and replacement rates from individual responses in our survey. Using gross replacement rates and a simplified version of our tax system we constructed net replacement rates. The average net ER replacement rate in 1991 was 83%.

DI and UI entitlement periods depend on age and tenure and benefit levels change after an initial entitlement period. Specifics about DI and UI benefit replacement rates are in Appendix I.

We do not observe whether individuals apply for DI and/or UI schemes. In the analyses we therefore assume that DI and UI applications are directly awarded[3]. This is different for ER, for which we have detailed information on the eligibility conditions of the scheme relevant to the respondent. More specifically the hazard rate out of work can be written as:

$$\theta(t;X_t,\ Z,\ \beta) = \theta_{DI}(t;X_t,\ Z,\ \beta_{DI}) + \theta_{UI}(t;X_t,\ Z,\ \beta_{UI}) + \theta_{ER}(t;X_t,\ Z,\ \beta_{ER}) \tag{4}$$

where θ_{ER} is non-zero only if an individual is eligible for ER at time t and zero otherwise. The other hazards, θ_{DI} and θ_{UI}, will depend on the set of retirement options open to the individual at time t and in the future. X_t and Z are vectors of time varying and time constant regressors, respectively. The parameter vectors associated with each of the exit rates are denoted by β_k, $k \in \{ER, DI, UI\}$.

Other time varying covariates that are used in the analyses are calender time, a variable denoted as 'time-

[3] Note that the work of Aarts & de Jong (1991) indicates that for elderly workers eligibility criteria for DI and UI entrance were virtually absent.

to-Early Retirement' and an indicator showing whether individuals are eligible for ER. The last two variables are, of course, only included in the DI and UI hazard rates. Individual retirement decisions are governed by a trade-off between income and leisure and individuals may prefer a financially less attractive option, such as DI or UI, if they will not be eligible for ER in the near future. The calender time variables reflect business-cycle effects. As explained in section 2, DI regulations were tightened for younger workers in the Summer of 1993. One can see this as a political or social change in attitude towards the DI program which makes it likely that DI conditions will be tightened even more in the future. This may affect their retirement behaviour if this is expected by elderly workers. Calender time effects are expected to reflect this.

Our model captures the effect of social security by using variations in benefits replacement rates and eligibility across individuals as well as variations for an individual over time. The model is estimated on a sample over the period 1991-1995. So any behavioural effect of institutional changes in DI that may have occurred in 1993 is accounted for by the calender time variables or by the social security incentives effect.

Wealth is not included in the model. It proved to be difficult to obtain accurate information (wealth questions have a high non-response rate). Moreover, less than 20% of the households in the sample had any financial assets. This is in line with other Dutch results. It has been argued that the availability and the generosity of social security and pension system in the Netherlands provides little incentives to hold financial assets.

The model will be estimated on the subsample of heads of households (defined as main income earners) that have a paid job. This includes both male and female heads of households. In the Netherlands only 14% of elderly females (55 years and older) are employed. These are mainly full-time long tenured workers and there is little reason to expect that the labour market behaviour of female heads of households is different from males. We will, however, allow for differences between males and females in the analyses.

The survey information allows an accurate reconstruction of individuals' employment histories up to the first interview (October 1993) and monthly information on labour market states from 1993 up to 1995. We restrict our analyses to the period 1991-1995 because that is the period for which reliable information on relevant regressors is available. This relates mainly to time varying regressors, and most importantly to the ER eligibility conditions and replacement rates. Table A2 in Appendix II presents sample means of the main explanatory variables used in the analyses.

To avoid sample selection problems that are typical for stock sampled duration data, we restrict the sample to individuals who were employed in 1991. The distribution of previous employment durations of non-working respondents in 1991 may be tedious to derive and estimate. Expressions for stock sampled durations of a duration variable of interest can be obtained from, for instance, Ridder (1984) and Lancaster (1990). We use a likelihood based on the distribution of durations beyond the selection date (1991), conditional on the duration elapsed up to the selection date. The expressions are tractable and the likelihood remains relatively easy to estimate.

Retirement behaviour of self-employed is expected to differ substantially from that of other workers. As we observe only few self-employed we excluded them. Duration is measured as duration in months in the job that the individual held in October 1991. We experimented with competing risk models allowing for duration dependence by taking step functions. These did not significantly contribute to the explanation. As calender time, age, eligibility and 'time-to-ER' are all time varying regressors, much of the time dependence patterns is already accounted for. Also the ER eligibility indicator is relevant. In many retirement schemes (elapsed) duration of employment is an important determinant of ER eligibility.

The specification of *health* in the model deserves special attention. We start with an initial specification in which a health dummy is included which equals 1 if an individual states that his/her health limits the ability to work. In this (naive) specification we included the health measure as observed at the first date of the interview (October 1993)[4]. This measure is problematic for 3 reasons.

Firstly, the health measure is observed in 1993 whereas we start to track the individuals retirement record from 1991 onwards. As a consequence it will be difficult to interpret it as a predictor of retirement behaviour, as health in 1993 may have been determined by retirement behaviour that takes place between 199 1-1993. Secondly, the health measure is a self assessed measure. It has been argued extensively (see Bound (1991) for a review) that responses concerning health may depend on labour market status. Previous work of Kerkhofs and Lindeboom (1995) indicates that notably DI recipients systematically overstate health problems. Thirdly, health and labour market behaviour may be endogenously related. Health has an effect on labour market behaviour, and vice versa. Bad health may induce individuals to retire, but harsh and physically demanding work may take a toll on health. There may also be unobservables that simultaneously

[4] Note that we only observe health at the interview dates, i.e. October 1993 and October 1995. The time frame that we use to analyse retirement behaviour is 1991-1995. We loose a substantial number (about 50%) of observed transtions if we restrict ourselves to 1993- 1995.

affect labour market behaviour and health.

We will estimate a retirement model that includes this self-reported subjective health measure as a benchmark estimation[5]. In addition to a specification with the self rated health measure, we will also report estimates of a retirement model using a range of alternative health measures in subsection 5.4. We will present specifications that include scores from the objective HSCL and instruments derived from a panel data model for health dynamics. The specification with the self-rated health measure is a fair benchmark to compare and to evaluate the merits of alternative specifications.

5.2. Estimates from a retirement model with a subjective measure for health.

The maximum likelihood results of the competing risk model are presented in Table 3. The columns present estimates of the transition rate from work to Early Retirement, Disability Insurance and to Unemployment Insurance and other non-work states. Positive coefficients are associated with high transition rates, negative coefficient with low rates.

TABLE 3 ABOUT HERE

The results in the first column indicate that hardly any of the included variables seem to affect the ER transition rate. Health seems to be only of limited importance. Bad health does increase the probability to retire, but size and significance are limited. The replacement rates have the expected sign. Higher ER replacement rates induce the individual to use Early Retirement schemes, whereas higher UI and DI replacement rates decrease the ER hazard rate. This indicates that, as suggested previously in Dutch studies (Trommel and De Vroom (1990), Bolweg and Dijkstra (1992)), that income streams of alternative exit routes are taken into account in the retirement decision and alternative exit routes act as substitutes. Changes in the costs and benefits of one exit route have an effect on other exit rates.

Given the generosity of most employer provided ER schemes, one would expect to find more effect from

[5] Bound (1991) shows how each of the solutions proposed in the literature leads to different kind of biases. Using mortality information as a proxy will tend to underestimate the effects of health and overestimate the effects of economic variables, whereas if it is used to instrument subjective health measures the impact of health is correctly estimated, but the effect of economic variables is underestimated. On the other hand the sign of the biases is ambiguous if subjective health measures are used. Bound (1991) concluded that self reported, work related health measures may be preferred over more objective general measures for health.

the ER replacement rate. From the data it can be seen that 583 out of the 2560 respondents retired through an ER scheme in a 4 year time period. This number is much larger than those for DI and UI. Furthermore, closer inspection of the total sample of ER recipients revealed that about 80% retired directly through ER as soon as they became eligible for an ER benefit. The remaining 20% retired within 1.5 years. This indicates that ER is a very attractive retirement option for the average worker.

In the estimates this shows through the effect of the ER eligibility indicator in the DI and UI hazards, as well as in the comparatively much higher average size of the ER hazard. The effect of the ER replacement rate in the ER hazard reflects the effect of differences in financial attractiveness of ER schemes. The positive sign confirms that workers will retire earlier in ER schemes with a higher replacement rate, but the estimated coefficient is not statistically significant. Most likely this results from the limited amount of variation in ER replacement rates, which are about 80 to 90 percent for most workers.

The results of the second column of Table 3 confirm that bad health is a major determinant in the decision to retire through DI. Apart from health and age little else seems to matter. Note that we observe a relatively small number of transitions into DI.

The UI transition rate signals significant effects of age and the eligibility indicator for ER. The hazard rate decreases with a factor of 2.97 (exp(-1.09)) when individuals become eligible for ER. This is the mirror image of the picture provided by the results for ER. Given the very low UI transition rate (cf the constant term) this effectively implies that individuals do not leave the labour force to go on UI allowance if they can get an ER benefit.

The results of Table 3 point towards strong incentives effects of Early Retirement schemes. However, the results could be severely biased because of the health measure used in the analyses. The DI transition rate seems to be dominated by the health indicator. Yet, there is substantial evidence that the DI scheme has been used as a retirement route with the mutual consent of employer, worker and DI administrators (Aarts & De Jong (1990), see also section 2). This implies that a significant part of the DI recipients need not have severe health impairments, and one would expect to find other factors to be relevant for the transition into DI. We turn to the specification of health in our retirement model.

5.3 *The construction of health measures: specification and estimation of a panel data model for health dynamics.*

Recall that the health measure used in the previous subsection is problematic for three reasons. Firstly, we use a measure of health in 1993, whereas our retirement model describes retirement patterns for the period 1991-1995. So, the health measure observed in 1993 may be affected by retirement behaviour that takes place between 1991 and 1993 rather than determining retirement behaviour. Secondly, health may be endogenously related to retirement, either by direct effects or by indirect effects through unobservables. Thirdly, the health measure is a subjective measure of health and individual response behaviour is expected to be determined by the labour market status that individuals are in. Below we will construct a number of instruments that are less sensitive to some or all off these drawbacks.

The Hopkins Symptoms Checklist (HSCL) is a validated objective test of general health. The advantage of this HSCL measure over a subjectively, self assessed health measures is that it is free of reporting errors that depend on labour market status that individuals are in. Its disadvantage is that it is a measure for general health, whereas a work related health measure would be more appropriate for retirement models.

Subjective measures may overstate the effect of health on work. Health instruments based on the HSCL will help us to correctly estimate the effect of health. The extent to which financial effects are biased depends on whether other included exogenous variables in the retirement model (age, education etc) are able to correct for the fact that we use a measure of general health instead of a work related health measure. A comparison of specifications with a subjective health measure (Table 3) and a specification with the HSCL measure will shed more light on the importance of reporting errors. Note however, that the endogenous relationship between health and labour market status may still obscure the estimation results. We therefore also construct instruments derived from a panel data model of health dynamics.

The dependent variable in this dynamic health model is the HSCL measure and the model is estimated on survey information of the full sample, i.e. the 3641 respondents that participate in both waves. The empirical counterpart of the health stock equation (3) is a relationship that relates (omitting the index for ***i)*** health h_t to a function of labour market status $f(L_t)$, a vector of exogenous variables X_t and unobservables γ:

$$h_t = \alpha_0 + \alpha f(L_t) + \beta_1' X_t + \gamma + \varepsilon_t \qquad (5)$$

ε_t is an iid error term that is independent of $f(L_t)$, X, and γ. The function $f(L_t)$ is indexed by t, but it should be noted that this may exhibit the labour market state at time t, and also the entire labour market history up to that point. The empirical specification of $f(.)$ will depend on the data at hand. y is an unobserved individual specific time constant component associated with health status. The unobserved individual component y encompasses elements of the initial stock of health and decisions made in the course of the life cycle regarding labour market status and health. As a consequence labour market status, or rather $f(L_t)$, may be correlated with y

One could opt for estimation of (5) jointly with the model for retirement behaviour to take account of the correlation between y and $f(L_t)$. Joint estimation of a model like (5) with a continuous time frame work is not straightforward. We continuously track individual labour market behaviour from October 1991 - October 1995 and only observe health at two points in time. Likelihood expressions will be relatively tedious to derive and estimate. Moreover, as we sample from an ongoing process, initial condition problems may arise in the sense that y may not be orthogonal to the included regressors in X_t. This would be particularly relevant if X, included aspects of health related behaviour (like smoking, drinking, exercising etc) or aspects of working conditions.

We take a pragmatic approach and separately estimate a fixed effect panel regression model on the two waves of the CERRA panel survey and then use the estimation results of this model to construct instruments for health. Next these instruments are used in the estimation of the retirement model.

The fixed effect specification is convenient as correlation between $f(L_t)$, X, and y is allowed for without imposing assumptions regarding these correlations. Under the model assumption the first difference of equation (5) could be taken and used to consistently estimate α and β_1. First differenced time constant variables included in X will cancel from the specification. To estimate these we recover the fixed effect y from $\hat{\gamma} = \bar{h} - \hat{\beta}\bar{V}$, with $V=[f(L_t)$ IX,], $\bar{V}$ is the average for an individual over time, and $\beta=[\alpha,\beta_1]$ (see Hsaio (1986)). The estimated fixed effects are then regressed on a vector of time constant exogenous variables (such as cohort variables, gender, and life style variables) which were excluded in the first stage (i.e. the regression of the first differenced equation). We refer to Kerkhofs and Lindeboom (1997) for details about the estimation procedure and the derivation of the correct variance covariance matrix for this two stage procedure.

The instrumenting procedure introduces additional problems as instruments are used in a non-linear model. Identification is obtained by functional form assumptions unless valid exclusion restrictions can be imposed. In general it will be very difficult to come up with proper instruments. We nevertheless believe that the procedure will be valuable as it can be compared with alternative instrumenting procedures, such as for instance the procedure suggested by Smith and Blundell (1986). We will return to this in subsection 5.4 where we implement the instrumenting procedures.

Estimates of the model for health dynamics are reported in Table A3 of Appendix II. The discussion of the estimates will be brief, as our prime interest is in the construction of proper instruments for health to be used in a retirement model. Column 1 of Table A3 reports results of a specification of the health model in which we explicitly allow for the effect of labour market status and experience ($f(L_t)$). Also health of the spouse is included as a regressor. These variables are typically of an endogenous nature in the sense that in equation (5) these may be correlated with γ. Yet the estimation procedure yields consistent estimates provided that the model assumption (time constancy of γ and ε_t being independent of the included regressors) holds. As this assumption might be violated in practice, we also estimated a model in which potentially endogenous regressors were excluded. These estimates are reported in column 2 of Table A3. Estimates of both models will be used to construct instruments for health. A comparison of the performance of these health instruments in the retirement model will give additional insight into the validity of the assumptions underlying equation (5). We return to this in the next subsection.

High values of the HSCL scores are associated with bad health and hence negative coefficients indicate better health. The top part of Table A3 concerns time varying regressors, estimated from the first difference of equation (5). The results suggest that health deteriorates with age and that health status of family members is positively correlated. Family members share the same living conditions and typically have similar (health related) habits. The results also suggest that health improves for non-workers, consequently this suggest some sort of recuperation effect of leisure (i.e. not working)[6].

The time constant regressors in the bottom part of Table A3 are obtained from the second stage regression in which we recover the fixed effects and relate these to a range of variables. Cohort effects are measured by a quadratic function which shows a peak for the second world war generation. Average health

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“Simple cross sectional evidence gave the oposite effect and suggested that health improved while working. Clearly this is the result of the reversed causality: those in good health are able to perform work and are therefore observed to be working. This implies γ in the panel data model is able to capture a significant part of the simultaneity of health and work.

level is at its worst for cohorts born during this period. An obvious explanation would be that tensions and insufficient nutrition in early childhood years have long term effects on health. Individuals with partners are more healthy than singles and life style variables (drinking and exercising) have the expected effects. The percentage of lifetime worked, reflecting labour market attachment, indicates that a more active working life and good health are positively correlated.

The results of the second column in Table A3 capture a variety of effects which are difficult to interpret. We will therefore skip the discussion of column 2 of Table A3. The construction of proper health instruments requires a reasonable model fit. The R-squares of both specifications indicate that this is the case.

5.4. Estimates from a retirement model with a alternative health measures.

Alternative health measures are constructed as the predicted value for each individual in each year using the coefficients in the columns of Table A3. One of these instruments is constructed from specification II (the model with true exogenous regressors) of Table A2. Both first stage and the second stage regressions (top and bottom part of Table A3) are used. This instrument is denoted by Ha_{it}. Hb_{it} is in a similar way obtained from all coefficients of specification I. Note that one would expect to find (large) differences in the performance of these two measures in a retirement model in case the endogeneity of included regressors in equation (5) is not properly accounted for.

We also constructed a health measure from the difference between the HSCL score at a point in time and the time varying part (the top) of specification II of Table A3. In a way this measure is a residual that equals the total random variation (the fixed effect and transitory shocks) and as such captures all the sources of possible endogeneity in the health specification. We denote this instrument by $Hresid_{it}$. This approach is in line with the instrumenting procedure proposed by Smith and Blundell(l986) to deal with endogenous regressors in a tobit model. They suggest to include this measure into the specification along with the endogenous regressor. Intuitively the inclusion of $Hresid_{it}$ can be seen as a way to capture the endogenous variation of the health variable. The coefficient of $Hresid_{it}$ in the retirement model gives an approximate test for endogeneity of the health regressor[7].

[7] The test requires the time constant unobservables in the health equation to be proportional to the unobservable in the retirement model. Smith and Blundell derive their test in the context of limited dependent variable models, with normally distributed errors. The test requires an adaptation of the variance

TABLES 4a - 4b - 4c ABOUT HERE

Tables 4a-4c present results of the different health measures for the three exit routes that we consider. Across all specifications a high value of the health variable corresponds to bad health. The first specification (in the first column) has the subjective, work related health measure of 1993 (see table 3). The second specification includes the average individual HSCL score for 1993 and 1995. The third column adds the residual $Hresid_{it}$, averaged over 1993 and 1995, to the HSCL score specification of column 2. The fourth specification includes the time varying instrument Ha, derived from specification II of table A3. Finally specification 5 in the fifth column reports results based on the instrument Hb_{it}, derived from specification I of Table A3. It is difficult to compare the likelihood values of the fifth specification with the others because it is based on fewer observations. Specification I in table A3 has stronger data requirements and a substantial number of observations had to be dropped from the sample.

A comparison of column 1 with column 2 provides insight into the importance of reporting errors. This comparison is conditional on the endogeneity of health in the retirement model. Moreover, the HSCL is a objective measure for general health, whereas a work related measure would be more appropriate. Changes across the two specifications may therefore be a result of this and/or reporting errors. The specifications of columns 4 and 5 are included to account for the endogeneity of health. The use of these instruments will help us to correctly estimate the effect of health on retirement. A comparison of the health coefficients of column 2 with the coefficients of column 4 and 5 signals whether health is endogenous to the retirement decision. Recall that the instruments of column 4 and 5 are obtained from the HSCL, a measure for general health. Consequently, the extent to which the effects of financial incentives are correctly measured depends on whether the included regressors in the retirement model, like age, education gender etc, are able to absorb this effect. Finally, a significant coefficient of the generalized residual of column 3 signals directly whether health is endogenous to retirement.

We start with a discussion of Table 4a. Apart from the effect of health, the results of column 1 and 2 are very similar, so reporting errors are not of much influence. The coefficient on the health variables

covariance matrix. This is not straightforward in the context of duration models and it would go beyond the scope of this paper. We therefore used the standard variance covariance matrix and call this test an approximate test. We nevertheless feel that a specification with $Hresid_{it}$ can be valuable in a comparison with other health measures.

are difficult to compare directly. The marginal health effect could be calculated from the difference in the mean of the HSCL score of ER recipients reporting to have health limitations and ER recipients who do report not to have health limitations. This marginal effect is about 0.029[8]. So, the effect of health on retirement is wiped out when moving from column 1 to column 2. Reporting errors, endogeneity of health and the fact that the HSCL reflects general health rather than work related health may account for this. The residual ***Hresid*** in the third is significantly negative, indicating that health is endogenous to the retirement decision.

A valid instrument for health in the retirement model is the time varying variable obtained from the health dynamics model (columns 4 and 5). Column 4 reports results on an instrument based on truly exogenous variables. Estimation results based on this instrument are expected to give the correct effect of health. In this specification health matters (the marginal effect is 0.864, which is three times as large as the effect in column 1), but it has to be noted that the coefficient is only significant at the 10% level. The results of column 5 differ substantially from those of column 4 and, as a matter of fact, are quite in line with the results of column 2. This indicates that the instrument *Hb* is not capable of correcting for the endogenous nature of health. Specification 4 therefore seems to be the preferred specification.

Regardless of the effect of health, across all 5 specifications, the effect of the incentive variables are quite robust. Incentive effects matter for the decision to retire through ER schemes. High replacement rates of UI and DI schemes reduce the ER retirement probability. Income streams of alternative exit routes are taken into account in the decision to retire.

Table 4b present the results of alternative health specifications for the exit rate to Disability Insurance. In the specification of column 1 (this is the same as the specification in table 3) subjective health seems to be all that matters. The second column reports on the more objective HSCL measure. The marginal effect of health in column 2 equals 0.72 (=0.05*(23.4-9.0)), see Table Al for the means of the HSCL), which is substantially lower than the 3.11. Again, reporting errors, endogeneity and the fact that the HSCL is less reflective of work related health may play an important role in this. The test on endogeneity of health, presented in column 3 hints that endogeneity does not play an important role. Notice that the sum of the

[8] The mean of the HSCL score of individuals reporting to have health problems equals 23.4, the corresponding figure for those reporting to have no health problem is 9.0 (See Table Al). The marginal effectof health is calculated as (23.4-9.0)*0.002=0.0288This number should be compared with the number of 0.28 reported in column 1.

coefficient for health and the health residual in column 3 equals the health effect of column 2.

The results with the time varying instrument for health of column 4 indicate that health is a dominant factor in explaining DI entrance. The marginal health effect equals 2.16 (=O. 15*(23.4-9.0), which is still substantially lower than the 3.11 of column 1, but also three times as large as the health effect of column 2. Specification 4 is expected to give a unbiased health effect. A comparison of this specification with column 1 and 2 indicates that reporting errors are very important. Endogeneity and/or the use of a general health measure bias the health effect downward, reporting errors give an upward bias to the health coefficient. The approximate test of column 3 indicates that endogeneity may not be important, so that it is likely that the relatively small health in column 2 is due to the use of a general health measure instead of a work related measure. As a final comment regarding Table 4b: note that calender time effects gain in importance when introducing time dependent health instruments. These calender time effects are in line with the tightening of DI regulations that took place in the summer of 1993. In accordance with those policy measures the 1993/1994 dummy shows a dip in the inflow into disability.

Across all specifications in table 4c we find similar outcomes. An exception is the health variable. Health does not play a role in the specification of column 1, whereas the time varying instrument in column 4 indicates that health is a very important factor. As argued previously, the health variable in column is subject to several kinds of biases, whereas the variable of column 4 is expected to give the correct results. The marginal effect from health, defined as above, equals about 1.3 (=0.09*(23.4-9.0)). The test for endogeneity in column 3 indicates that endogeneity is expected to play a limited role. Interestingly, as in Table 4b, the sum of the health coefficients in column 3 equals the estimate for total health in column 2. Most importantly, across all specifications of Table 4c, we find strong incentive effects for the variable Eligibility for Early Retirement. The hazard rate reduces considerably (the reduction factor is about 3) when individuals become eligible for Early Retirement benefits. This effect is however, not as large as the marginal effect of health of 1.3.

6 Discussion and conclusions

The previous paragraph discussed the estimation results of the retirement model with different health measures in order to assess the effect of reporting errors and endogeneity of health in a retirement model. Roughly, it would be expected that the effect of health on retirement is overestimated when reporting errors are important and underestimated when endogeneity is important. As far as endogeneity of health is concerned, we find strong effects on the estimates of the hazard to Early Retirement (Table 4a, column III and a comparison of II, V and IV). We prefer a time-varying truly exogenous instrument for health. The estimated health effect in this specification are much higher than the effects we find if we estimate the model with a subjective health measure (I) or a more objective measure such as the HSCL score (II). The estimated effects of financial incentives are robust under alternative specifications for health. Replacement rates of competing retirement routes (DI and UI) reduce the propensity to use Early Retirement schemes. Reporting errors hardly matter for the estimation of the ER transition rate.

In the estimation of the Disability Insurance hazard reporting errors are, on the contrary, very important. Health effects in a model with a subjective measure are much higher than the effects we find if we estimate the model with a objective measure such as the HSCL score (II) or an instrument based on the HSCL score (IV). The preferred estimates show a clear calender effect corresponding to stricter rules for entry into DI and a change of attitude towards DI use. We also find a stronger effect of age than was found with a subjective health measure. Again we find that effects of eligibility and financial incentives are not affected by the health measures that we use.

Comparing the alternative estimates of the UI hazards, we conclude that the results are mostly affected by the endogeneity of health measures. If we use a relatively exogenous time-varying instrument for health, estimated effect of health are more than six times higher than the effect found when we used an endogenous general measure for health or a subjective work related health measure. Again we find that the estimated effect of eligibility of financial incentives are by and large insensitive to reporting errors and the endogeneity of the health measures used.

Comparison of the different ways of instrumenting health show that it is essential to restrict the choice of controls to variables that are exogenous to the potentially simultaneous career and health related decisions in a household.

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APPENDIX I

DI benefit levels are 70% of previous earnings for a DI eligibility period. The DI eligibility period depends on age and varies from 0 to 6 years. After this period benefit levels are 70% of minimum wages plus (1.4*(age-15)) % of the difference between previous gross earnings w and the minimum wage. The replacement rate is derived as the ratio of the total undiscounted amount of DI benefits that an individual would obtain if he/she would remain in DI up to age 65 (mandatory retirement age) and the wage earnings from age at 1991 up to age 65. More specifically,

$$\text{DI rate} = \frac{0.7 * w_t * \text{DI entitlement period} + \text{DI Supplement}}{\text{Sum of } w_t \text{ to time at which the individual becomes 65}}$$

DI supplement = $0.7*\text{minwage} + 0.014*(\text{age}_t - 15)*(w_t\text{-minwage})*(65\text{-age}_t\text{-DI}$ entitlement period). Of course the supplement is only provided in case the individual has not reached the age of 65 (the mandatory retirement age) after exhaustion of initial DI entitlement.

The unemployment insurance benefit levels are 70 % of previous gross earnings for a period of 6 months. A benefit extension period can be obtained that depends upon the individuals work history. The benefit extension period ranges from 0 to 60 months. After exhaustion of UI eligibility, benefit levels drop to 70% of the minimum wage. The replacement rate is derived as the ratio of the total amount of DI benefits that an individual would obtain if he/she would remain in DI up to age 65 (mandatory retirement age) and the wage earnings from age at 1991 up to age 65. More specifically,

$$\text{UI rate} = \frac{0.7 * w_t * \text{UI entitl. period} + 0.7*\text{minwage}*(65\text{-age}_t\text{-UI entitl. period})}{\text{Sum of } w_t \text{ to time at which the individual becomes 65}}$$

APPENDIX II

Table Al Average value of Hopkins Symptoms Checklist score by labour market state in 1993 and self reported health condition[1]

	Work	UI	DI	ER	Total
Good health	9.2	10.3	21.1	6.5	9.0
Bad health	23.6	30.1	26.9	15.5	23.4

1 Bad health if individuals report to be restricted in their work or if health prevents them to have a paid job, good health otherwise.
HSCL scores range from 0 to 171. Low scores are associated with good health, high scores with bad health.

Table A2 Sample descriptives[1]

variables	mean
Female (1 /0)	0.10
bad health (l/O)	0.08
HSCL score (1 =very good -171 =very bad)	10.2
Transformed HSCL (1 = very good - 7 =very bad)	2.5
Age in years	54.0
Married	0.86
education (l-7)	3.62
White collar (1/0)	0.59
House owner	0.63
Partner works	0.29
ER replacement rate	0.83
Net yearly wage in 1991 (guilders)	43237.25
Fraction of censored cases	0.68
Elapsed time 1991 job up to 1991 (months)	228
Time from 1991 onwards (months)	35
Number of observations	2560

1 Unless stated otherwise, 1993 values

Table A3 Estimates of fixed effects panel data model for health[1]

	Specification I		Specification II	
i) Time varying covariates				
Age	1.87	(1.5)	-1.04	(0.9)
Age squared	0.02	(1.9)	-0.01	(1.4)
HSCL score of partner	0.05	(2.6)		
Family size	0.001	(0.0)	0.28	(0.7)
Unemploy. Insurance recipient	-0.29	(0.2)		
Disability Insurance recipient	-1.76	(1.2)		
Early Retirement recipient	-1.79	(2.2)		
Self-employed	2.46	(1.0)		
Other labour market state	-0.54	(0.4)		
# of months worked in past 5 yrs	0.002	(0.1)		
ii) time constant covariates[2]				
Constant	-175.62	(3.4)	-165.15	(4.0)
Year of birth	4.25	(2.5)	3.93	(2.8)
Year of birth[2]	-0.046	(1.9)	-0.04	(2.2)
Female	21.35	(0.5)	28.42	(0.8)
Partner	-3.91	(4.1)	-2.84	(3.4)
Age difference between partners	-0.09	(1.2)	-0.06	(1.5)
Participation rate 1[3]	0.97	(0.5)	0.48	(0.5)
Participation rate 2	-0.37	(0.6)	-0.43	(1.1)
Participation rate 3	1.53	(1.1)	1.53	(1.4)
Participation rate 4	-0.99	(1.7)	-0.64	(1.3)
Participation rate 5	-0.08	(0.1)	-0.004	(1 .0)
Dummy drinks	-3.06	(4.4)		
Dummy drinks > 4 glasses a day	-0.40	(0.5)		
Excercise	-2.18	(4.3)		
Profession[4]:				
White collar/high	2.83	(3.6)		
White collar/low	3.67	(3.5)		
Blue collar/high	2.19	(1.5)		
Blue collar/low	2.31	(2.8)		
Education:				
Low/general	2.32	(2.6)	2.20	(3.3)
Interm/general	-0.77	(0.9)	-0.75	(1.0)
Interm/vocat	0.66	(0.8)	0.28	(0.4)
High/general	-0.42	(0.3)	-0.96	(0.9)
High/vocat	-0.39	(0.5)	-0.26	(0.4)
University	0.18	(0.1)	0.43	(0.9)
% of life worked	-0.14	(16.9)	-0.13	(19.4)
R Square	0.5639		0.4948	

[1] Heteroskedasticity corrected t-values in parentheses.
[2] The results for the time invariant regressors are obtained from a second stage analysis of the fixed effect (see equation (5))
[3] Participation 1: participation rates for 15-20 years old at the time that the respondent was 20 years. Part. 2: Participation rates of individuals aged 20-25 at the time that the individual was 25. Participation 3: participation rates for individuals aged 25 -30 at the time that the individual was 30. Participation 4: participation rates of individuals aged 30-39 at the time the individual was 35. Participation 5:participation rates of individuals aged 39-49 at the time that the individual was 45.
The participation rates are population numbers.
[4] Reference group consists of those who could not be placed in any of these groups (14 % of the sample)

TABLES IN TEXT

TABLE 1 cross tabulation of Age and labour market status in 1993 (percentages)

Age 1993	Work	UI	DI	ER	Self Employed
43	85.4	1.9	7.8		4.9
44	80.8	4.2	5.8		9.2
45	84.9	5.0	4.2		5.9
46	83.1	6.9	3.1		6.9
47	84.1	3.7	6.7		5.5
48	78.7	4.5	11.2		5.6
49	75.7	9.9	5.4		9.0
50	67.9	9.2	6.4		16.5
51	76.0	5.0	11.0		8.0
52	69.7	9.2	11.8	1.3	7.9
53	68.6	8.2	10.9	0.7	11.6
54	62.2	13.2	15.9	0.9	7.8
55	59.8	13.7	15.5	2.1	8.9
56	53.2	16.0	18.8	6.2	5.8
57	47.8	13.6	17.9	13.3	7.4
58	36.4	18.2	20.6	17.6	7.2
59	36.5	15.6	20.2	23.8	3.9
60	16.7	20.2	26.5	31.7	4.9
61	13.6	18.8	20.4	42.3	4.9
62	7.0	23.5	22.2	44.7	2.6
63	5.8	23.5	21.6	45.1	4.0
64	6.3	29.2	14.6	45.8	4.2

TABLE 2 Kaplan - Meier estimates (males and females) of hazard from work to UI, DI, ER[1]

	1988			1989			1990			1991			1992			1993			1994		
age	UI	DI	ER	UI	DI	ER	UI	DI	ER	UI	DI	ER	UI	DI	ER	UI	DI	ER	UI	DI	ER
50	1.8	1.8	0	0.9	1.3	0	0.9	1.4	0		1.9		0	1.3	0	0	0	0	4.8	0	0
51	1.3	4.4	0.4	0.9	1.3	0	1.4	2.7	0	0.5	1.9	0.5	0	0	0	3.7	5.6	0	3.3	1.7	0
52	0.5	1.9	0.5	0.9	1.8	0.9	2.3	3.2	0.5	2.8	1.4	0.5	1.5	1.0	0.5	0	2.5	0	2.0	0	0
53	1.4	1.9	0.5	0.9	1.9	0.9	0.5	1.0	0.5	1.4	1.4	0.5	1.9	1.0	1.0	2.8	0	1.4	2.6	2.6	0
54	1.4	4.7	2.4	0.5	2.4	3.4	1.9	1.4	4.8	2.9	2.4	3.4	2.9	0.5	2.4	1.3	0	4.0	1.4	2.1	6.4
55	1.1	2.7	2.7	1.5	1.5	2.5	5.2	2.1	3.1	5.2	2.1	5.7	4.8	2.1	4.8	3.4	0	4.1	1.4	2.1	2.8
56	1.6	1.0	11.5	2.3	3.4	2.3	1.0	1.6	5.8	2.9	4.0	8.0	1.2	1.2	9.9	4.9	2.4	8.9	3.7	0.7	6.7
57	3.8	2.5	7.6	2.4	2.4	7.8	1.2	2.5	13.0	2.3	2.8	6.8	1.3	0.7	19.5	1.8	0.9	15.8	4.7	0	19.8
58	2.4	2.4	12.7	1.5	3.7	19.3	0.7	0.7	17.0	0.7	0.7	20.1	1.9	1.9	23.9	3.0	1.0	16.0	0	3.2	10.6
59	0	4.8	23.8	9.6	1.5	38.0	2.0	3.9	43.1	4.2	1.7	35.8	3.8	0	42.9	1.2	2.5	38.3	1.2	0	39.0
60				6.3	6.3	31.3	5.1	3.8	43.2	7.3	1.9	31.5	4.2	0	35.2	2.3	7.0	48.8	4.2	4.2	39.6
61									44.4	2.2	2.2	44.4	3.1	0	34.4	8.6	0	22.9	0	5.3	52.6

[1]Self employed are excluded from the analyses. Only 7% of the original sample consists of self employed. This would be a too small sample to obtain reliable estimates.

Table 3 Maximum likelihood estimates of a competing risk model for the transition from work to Early Retirement (ER), Disability Insurance (DI) scheme and Unemployment Insurance and remaining non-work states (UI)

	ER		DI		UI	
i) Time constant covariates						
Constant	-2.99	(3.1)	-12.79	(2.9)	16.00	(8.4)
Female	-0.15	(0.6)	0.09	(0.2)	-0.10	(0.2)
Married	-0.09	(0.5)	-0.05	(0.1)	-0.28	(0.9)
Educational level (l-7)	0.02	(0.8)	-0.05	(0.7)	-0.03	(0.4)
White collar worker	-0.12	(1.3)	-0.04	(0.2)	0.08	(0.6)
Bad health'	0.28	(1.8)	3.11	(12.0)	0.21	(0.6)
ii) Time varying covariates						
Age in years	**0.01**	(1.1)	0.12	(3.3)	0.16	(6.0)
Replacement rate ER[3]	0.96	(1.3)	-1.47	(1.0)	0.61	(0.5)
replacement rate DI[3]	-0.56	(1.8)	-0.73	(0.5)	0.13	(0.2)
replacement rate UI[3]	-0.85	(2.6)	0.04	(0.0)	0.25	(0.5)
Time to Early Retirement*			0.02	(0.9)	0.01	(0.7)
Eligible for Early retirement			-0.95	(1.6)	-1.09	(2.7)
iii Calender time effects						
199211993	-1.04	(0.8)	-0.107	(0.4)	0.42	(1.7)
199311994	0.03	(0.0)	-0.538	(1.3)	0.29	(1.0)
199411995	0.02	(0.1)	0.136	(0.4)	0.15	(0.5)
-Log Likelihood		1758.4		463.0		829.8
# Transitions		583		77		158
# Observations		2560		2560		2560

1 Bad health is derived from the question 'would your health limit you in your work' The dumrnie variables equals 1 if health problems are present.

2 Measured in years. The variable equals zero in case an individual is eligible for ER benefits.

3 Replacement rates in fractions of net wage earnings. The specifics of the employer provided ER benefits are observed in the data. DI and UI replacement rates are derived from Social Security regulations, using generated income profiles over the life cycle. see Appendix II and III for details

Table 4a Maximum likelihood for the hazard from employment to Early Retirement: alternative health specifications.

	Exit from employment to Early Retirement[1]									
	I		II		III		IV		V	
	Subjective measure		HSCL		HSCL, ***Hresid***		***Ha***		***Hb***	
i) Time constant covariates										
Constant	-2.99	(3.1)	-2.91	(3.1)	-4.25	(4.2)	-4.12	(3.5)	-2.70	(2.5)
Female	-0.15	(0.6)	-0.13	(0.6)	-0.11	(0.5)	-0.11	(0.4)	-0.15	(0.6)
Married	-0.09	(0.5)	-0.08	(0.5)	-0.09	(0.5)	0.07	(0.4)	-0.02	(0.1)
Educational level (l-7)	0.02	(0.8)	0.02	(0.9)	0.02	(0.6)	0.04	(1.4)	0.03	(0.9)
White collar worker	-0.12	(1.2)	-0.13	(1.3)	-0.15	(1.5)	-0.12	(1.2)	-0.12	(1.1)
Health (time invariant measure)	0.28	(1.8)	0.002	(0.6)	0.20	(3.3)				
Health residual ***(Hresid)***					-0.19	(3.3)				
ii) Time varying covariates										
Health							0.06	(1.7)	0.003	(0.1)
Age in years	0.01	(1.1)	0.01	(1.2)	-0.01	(0.4)	0.02	(1.6)	0.01	(0.4)
Replacement rate ER	0.96	(1.3)	0.92	(1.2)	0.94	(1.3)	0.93	(1.2)	0.98	(1.3)
Replacement rate DI	-0.85	(2.6)	-0.84	(2.6)	-0.98	(2.7)	-0.82	(2.6)	-0.98	(2.7)
Replacement rate UI	-0.56	(1.8)	-0.58	(1.9)	-1.17	(3.1)	-0.37	(1.1)	-0.27	(0.8)
iii Calender time effects										
199211993	-1.04	(0.8)	-1.02	(0.8)	0.70	(0.5)	-1.66	(1.3)	-0.41	(0.3)
199311994	0.002	(0.0)	-0.001	(0.1)	0.18	(1.3)	-0.05	(0.4)	0.03	(0.2)
199411995	0.02	(0.1)	0.02	(0.2)	0.31	(1.9)	-0.09	(0.6)	0.04	(0.3)
-Log Likelihood	1758.43		1759.85		1754.19		1758.47		1397.33	
# Transitions	583		583		583		583		583	
# Observations	2560		2560		2560		2560		2429	

[1] Asymptotic t-values in parentheses.

Table 4b Maximum likelihood for the hazard from employment to Disability Insurance: alternative health specifications.

	Exit from employment to Disability Insurance[1]									
	I Subjective measure		II HSCL		III HSCL, ***Hresid***		IV ***Ha***		V ***Hb***	
i) Time constant covariates										
Constant	-12.79	(5.3)	-15.99	(6.6)	14.83	(4.9)	-18.43	(6.4)	-17.46	(5.7)
Female	-0.08	(0.2)	0.53	(1.1)	0.55	(1.1)	0.44	(0.9)	0.56	(1.0)
Married	-0.05	(0.1)	0.25	(0.5)	0.18	(0.4)	0.82	(1.5)	0.40	(0.7)
Educational level (l-7)	-0.05	(0.7)	-0.02	(0.3)	-0.02	(0.3)	-0.03	(0.4)	-0.01	(0.1)
White collar worker	-0.03	(0.1)	-0.41	(1.4)	-0.43	(1.5)	-0.11	(0.5)	-0.47	(1.3)
Health (time invariant measure)	3.11	(12.0)	0.05	(9.3)	0.23	(0.8)				
Health residual ***(Hresid)***					-0.18	(0.6)				
ii) Time varying covariates										
Health							0.15	(2.6)	0.14	(3.2)
Age in years	0.12	(3.3)	0.17	(4.5)	0.11	(1.0)	0.20	(4.7)	0.19	(4.1)
Replacement rate ER	-1.47	(1.0)	-0.70	(0.6)	-0.68	(0.5)	-0.68	(0.5)	-0.72	(0.4)
Replacement rate UI	-0.73	(0.5)	-0.99	(0.6)	-1.09	(0.7)	-0.12	(0.6)	-1.15	(0.7)
Replacement rate DI	0.04	(0.0)	-0.02	(0.0)	0.01	(0.0)	-0.78	(0.6)	-0.77	(0.5)
Time to Eligibility for ER	0.02	(0.9)	0.03	(1.5)	0.03	(1.5)	0.02	(1.1)	0.02	(0.7)
Eligible for Early Retirement	-0.95	(1.6)	-0.87	(1.4)	-0.92	(1.5)	-0.92	(1.5)	-0.50	(0.8)
III Calender time effects										
199211993	-0.11	(0.4)	-0.21	(0.7)	-0.14	(0.4)	-0.31	(1.0)	-0.18	(0.5)
199311994	-0.54	(1.3)	-0.68	(1.7)	-0.54	(1.2)	-0.98	(2.4)	-0.78	(1.8)
199411995	0.14	(0.4)	-0.13	(0.4)	0.08	(0.2)	-0.57	(1.5)	-0.46	(1.1)
-Log Likelihood	462.99		501.63		501.42		526.00		393.90	
# Transitions	77		77		77		77		77	
# Observations	2560		2560		2560		2560		2429	

[1] Asymptotic t-values in parentheses.

Table 4c Maximum likelihood for the hazard from employment to Unemployment Insurance’: alternative health specifications.

	Exit from employment to Unemployment Insurance’									
	I Subjective measure		II HSCL		III HSCL, *Hresid*		IV ***Ha***		V ***Hb***	
i) ***Time constant covariates***										
Constant	-16.01	(8.4)	-16.38	(8.5)	-14.89	(6.4)	-18.53	(8.1)	-17.85	(7.6)
Female	-0.10	(0.2)	-0.10	(0.3)	-0.08	(0.2)	-0.17	(0.4)	-0.22	(0.5)
Married	-0.28	(0.9)	-0.26	(0.8)	-0.34	(1.0)	0.07	(0.2)	-0.08	(0.2)
Educational level (1-7)	-0.02	(0.4)	-0.02	(0.3)	-0.02	(0.3)	-0.01	(0.2)	0.01	(0.2)
White collar worker	0.08	(0.3)	0.05	(0.2)	0.04	(0.2)	0.11	(0.5)	-0.07	(0.3)
Health (time invariant measure)	0.21	(0.6)	0.02	(2.3)	0.23	(1.2)				
Health residual (*Hresid*)					-0.21	(1.1)				
ii) Time varying covariates										
Health							0.09	(2.2)	0.07	(2.1)
Age in years	0.16	(6.0)	0.16	(6.1)	0.08	(1.1)	0.19	(6.1)	0.17	(5.3)
Replacement rate ER	0.61	(0.5)	0.62	(0.5)	0.70	(0.6)	0.58	(0.5)	1.52	(1.0)
Replacement rate UI	0.13	(0.2)	0.11	(0.2)	0.08	(0.1)	-0.05	(0.1)	-0.01	(0.0)
Replacement rate DI	0.25	(0.5)	0.27	(0.5)	0.27	(0.5)	0.42	(1.0)	0.41	(0.9)
Time to Eligibility for ER	0.01	(0.7)	0.01	(0.7)	0.01	(0.7)	0.01	(0.6)	0.01	(0.4)
Eligible for Early Retirement	-1.09	(2.7)	-1.09	(2.7)	-1.15	(2.8)	-1.01	(2.5)	-0.79	(1.9)
iii ***Calender time effects***										
199211993	0.42	(1.7)	0.42	(1.7)	0.51	(1.9)	0.35	(1.4)	0.35	(1.2)
1993/1994	0.29	(1.0)	0.29	(1.0)	0.46	(1.4)	0.13	(0.4)	0.08	(0.3)
199411995	0.15	(0.5)	0.14	(0.5)	0.39	(1.1)	-0.08	(0.3)	-0.29	(0.8)
-Log Likelihood	829.79		827.68		827.03		827.67		680.09	
# Transitions	158		158		158		158		158	
# Observations	2560		2560		2560		2560		2429	

[1] Asymptotic t-values in parentheses.