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HEALTH AND RETIREMENT DECISIONS:

An Update of the Literature

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ABSTRACT: This paper surveys the relation between labour supply and health of the elderly and is based both on major earlier studies and new literature. Most empirical literature on the topic is based on US data, although new European datasets have enabled analysis in several EU countries. The paper complements previous surveys in that it includes those recent European results and overviews most recent developments in micro-modelling issues. The quest for unbiased estimates of the effect of health on retirement is characterised by several challenges. A first important challenge is the endogenous character of the relation. A second challenge is the reporting bias that certain health measures may be prone to. The empirical literature surveyed suggests that poor health reduces the capacity to work and has substantial effects on labour force participation. The exact magnitude, however, is sensitive to both the choice of health measures and identification assumptions. For that reason a comparison of health effects between different studies is difficult. An old myth that objective health measures are superior to subjective health measures has proven to be interpreted with care.

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1. Introduction

In 1984 Anderson and Burkhauser wrote that the appropriateness of the use of self reported health measures was "the major unsettled issue in the empirical literature on the labour supply of older workers (Anderson and Burkhauser, 1984). During that last 20 years the relation between health and labour force participation has been widely studied for developing countries (see Strauss and Thomas, 1998). As developed countries have a higher life expectancy, a more developed pension system and disability benefit channels it is important to consider them separately. In a volume of the *Handbook of Labour Economics* Currie and Madrian (1999) wrote an excellent chapter covering the very many relations between health, health insurance and the labour market. In that chapter they also summarized the results of 31 studies covering the relation between health and labour force participation. It is recommended to read their chapter; this survey is to a certain extent based on its content and its structure. There is however some important value adding differences in our approach. Currie and Madrian (1999) concentrated mainly on evidence from the U.S. and summarized findings of the literature of the eighties and the first half of the nineties. This survey covers the newest literature on developed countries and wants to be complementary to previous work as its focus is on the evidence of European countries. A further difference is that we pick out only one specific health topic, namely the relation between health and labour force participation of the elderly.

The literature suggests that health has an effect on most outcomes of interest to labour economists including wages, earnings, labour force participation, hours worked, retirement, job turn over and benefit packages. For certain groups like single mothers and older people health is thought to be a major determinant of wages, hours and labour force participation. It is sure that health is very important in retirement decisions although there is no consensus about the magnitude of the effects or about the size relative to other effects of other variables. An important distinction to make is the one between health events that lead to inability explaining retirement decisions fully and declining health that leaves the option to stay in the labour market. To have an idea of the extent of retirement choice it is crucial to control for the health of an individual. An understanding of the effects of health on labour market activity is important for three other reasons: Firstly, to evaluate the cost effectiveness of interventions designed to prevent or cure disease. Secondly, to assess the effectiveness and solvency of those programs as relationship between health and labour

market is mediated by social programs and thirdly this will become more important in ageing societies as more individuals reach the age where health has the greatest impact on labour market outcomes.

Incorporating health problems into a standard retirement model is complex. Health status, defined as the physical and mental ability to perform work is likely to affect retirement age choices in many ways. Poorer health often has a negative impact on productivity and can reduce earnings. Health can also affect preferences. Relevant are its effect on utility of consumption and leisure. Health also affects people's remaining time horizon, in that some conditions alter life expectancy and hence years available to choose between retirement and work (Grossman, 1972). To sum up, the predicted effects of poor health on the optimal retirement age are theoretically ambiguous (Sammartino, 1987).

Based on empirical evidence we can conclude that poor health leads to earlier retirement because its effects on preferences and productivity dominate. The empirical literature on health and retirement can be divided into three categories based on the health variables included in the retirement model: (1) Self reported health status or self reported work limitations, (2) objective measures of health such as information on medical conditions or subsequent mortality and (3) instrument for self reported measures using objective measures. Based on recent empirical studies the understanding of the relation between health and retirement has become clearer although the main problem is that it is very difficult to obtain unbiased estimates (see Appendix D for an overview). Although the traditional health of Europeans has improved and its relation with participation of the elderly has weakened, the declining psychological well-being and institutional changes may explain why health factors are still a major determinant of retirement.

The structure of the paper is as follows. Section 2 approaches health as human capital Section 3 covers health measurement issues. Section 4 describes empirical evidence of the relation between health and retirement. Section 5 handles gender differences and within household dynamics. The overall conclusions are presented in section 6.

2. Health as human capital

Becker (1964) compared investment in "health capital" with other forms of human capital such as education. Grossman (1972) elaborated that idea. In his model consumers are assumed to maximize an inter-temporal utility function. The stock of health today depends on past investments in health, and on the rate of depreciation of health capital. Health is valued by consumers both for its own sake and because being sick is assumed to take time away from market and non-market activities. Non-market time is an input into both health production and the production of other valued non-market goods like leisure activities. His model can be solved to yield a conditional labour supply function in which labour supply depends on the endogenous health variable. From an empirical point of view, the main implication of the model is that health must be treated as an endogenous choice. As many investments in the health occur later in life, endogeneity in health may be a greater potential source of bias than the endogeneity of education.

Most of the literature treats health as an exogenous variable. The assumption is that exogenous shocks to health are the dominant factor creating variation in health status in developed countries. This may be reasonable as current health depends on past decisions and on habits that may be very difficult to break and the fact that individuals have imperfect information about the health production function at the time of making decisions. However relatively little research has been devoted to assess the empirical importance of the potential endogeneity bias. Examples include Bound (1991) and Bound et al. (1999), and the more recent analysis of Lindeboom (2003).

There are several reasons why poorer health status will, ceteris paribus, reduce the probability of continued work: (1) Poorer health may raise the current disutility of work, (2) Poorer health reduces the return from work if there is a relationship between poor health and low wages. (3) Poor health may entitle the individual to non-wage income such as disability benefits, which is contingent on not being in work. An opposite effect can evolve if poor health raises consumption requirements and requires higher income than the received disability insurance benefits. If on the other hand poorer health is associated with lower life expectancy, the annualised consumption available from existing wealth is raised and might induce earlier retirement.

3. Measurement issues of health

The concept of health has been compared to the concept of "ability", everyone has some idea what is meant by the term but it is remarkably difficult to measure. Failure to properly measure health leads to a bias similar to the ability bias (Griliches, 1977) in standard human capital models. The size of the health bias can vary with different health measures and getting an idea of the magnitude may be as difficult as in the case of the "ability bias" (Currie and Madrian, 1999, p.3313-4).

3.1. Different health measures

Ideally we need a measure of health that relates to labour force participation in that it covers the "work capacity". Currie and Madrian (1999) divide the usual health measures into 8 categories: (1) self-reported health status (is your health very good, good, fair, bad, very bad); (2) whether there are health limitations on the ability to work; (3) whether there are other functional limitations such as problems with activities of daily living (ADL's); (4) the presence of chronic and acute conditions; (5) the utilisation of medical care; (6) clinical assessment of such things as mental health or alcoholism; (7) nutritional status (height, weight, body mass index) and (8) expected or future mortality. Studies concentrating on development countries usually use the latter 4 measures whereas studies of developed countries mostly use the first 5 measures. The choice of the measure should largely depend on the question to be solved although it is always necessary to check for robustness as different measures may produce different results. A relevant reason for robustness checks with different measures may for example be that the physical health of Europeans has been improving but that the mental health has been deteriorating (see also Ettner et al., 1997).

3.2. Biases

Estimates of the effects of health on labour supply are quite sensitive to the measure used. Each measure can vary in at least two dimensions. (1) The first dimension captures the link between productivity and health. A stronger link should increase the explanatory power of regression models. (2) The second dimension shows that certain measures may be more subject to reporting biases. The main problem with self-reported measures is not that they don't correlate enough with the "work capacity" but that the measurement error is unlikely

to be random. Potential problems with survey measures that lead to different kind of biases:

(1) Responses may not be independent of labour market outcomes (endogeneity :overestimates). Individuals that reduced participation or exited the labour force may have a higher probability to report that they have a poor health status, functional limitations, various conditions, or that they utilize health care. There are two main reasons for that:

> (A) Mentioning health limitations to justify their reduced labour supply or to rationalize behaviour. The so called *justification hypothesis* says that the estimated health effects using subjective measures may be mis-estimated if individuals use health as a justification for leaving the labour force early (Bound, 1991; Anderson and Burkhauser, 1985; Bazzoli, 1985; Chirikos and Nestel, 1984). When subjective health assessments measure leisure preferences instead of 'true health capacity', estimates of health effects will tend to be biased in the direction of poorer reported health driving retirement. More specifically, people who enjoy their work will downplay their health problems and work longer, while those who dislike their work may exaggerate health problems and retire sooner.
>
> (B) Government programs can give individuals a strong incentive to say that they are unhealthy. Identify yourself as disabled can financially be rewarding. (the dependence of self reported health on economic (environment) characteristics will bias estimates of the impact of economic variables on participation, even if one correctly measures the impact of health itself). Biased estimates of health's impact on outcomes will also bias coefficients on any variable correlated with health.

(2) A second influence on self-reports may be the health treatment, which in turn may be affected by education, income, employment and health insurance status.

(3) A third concern is that utilization of medical care typically increases with income, even though persons with a higher income are generally in better health.

(4) A fourth concern is that individuals who have health limitations may choose jobs in which their health does not limit their ability to work. This would be expected to bias the estimated effect of "limits" towards zero".

(5) A fifth concern the lack of comparability between respondents (underestimates) and the reporting heterogeneity. Ordered responses on health questions may however differ across populations or even across subgroups of a population. This reporting heterogeneity may invalidate group comparisons and measures of health inequality because of a problem called *state dependent reporting bias*[1]. This bias occurs if sub-groups of a population use systematically different threshold levels when assessing their health, despite having the same level of 'true' health. These differences may be influenced by age, sex, education, language, personal experience of illness and other factors. It means that different groups use different reference points when they are responding to the same questions. Sen (2002) noted there seems to be a strong need for scrutinising statistics on self reported illness in a social context by taking note of levels of education, availability of medical facilities and public information on illness and remedy. The best way to do this is to formalise the problem of heterogeneous reporting behaviour and to formulate tests for its occurrence in the context of subjective health information. A test for differential reporting in ordered response models has been proposed by Lindeboom and van Doorslaer (2003) and allows us to distinguish between cut-point shift and index shift. They find clear evidence of index shifting and cut-point shifting for age and gender, but not for income, education or language.

Longitudinal analysis of the impact of health on retirement will tend to exacerbate the above problems: since one is unlikely to experience many dramatic health status changes over short periods, many observed changes may be spurious. An additional issue to mention is that the measurement error for indicator variables is more problematic than it is for continuous ones. More detailed health indicators may be less susceptible to measurement and endogeneity problems, since the questions are narrower and more concrete. Including each of the detailed health measures as explanatory variables makes maximum use of the available information on health status.

3.3. Interpretation

The problem is that difficulties in interpretation may arise because of different reasons (Bound et al., 1999): (1) There is no obvious way to quantify the marginal effect of changes in

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[1] Next to the term 'state-dependent reporting bias' this problem has also been called 'scale of reference bias', 'response category cut point shift', 'reporting heterogeneity' or 'differential item functioning'.

health on the outcomes of interest. (2) The various detailed measures are collinear to some degree (due to co-morbidity) and such collinearity would also complicate interpreting the estimated coefficients on particular health measures. (3) Even if most health measures only party describe individual health: they are subject to measurement error. They cover prevalence of specific conditions but provide little info on severity. (4) We are limited by the data. The richest datasets contain data for the US (HRS). Most data sets don't cover rich financial and rich health variables, but concentrate on one of these categories. Several surveys done -like the health2000 survey for Finland- are cross-sections and only few have annual waves.

3.4. Evidence of non-random measurement errors

There is a lot of evidence that concerns about non-random measurement errors are justified. Currie and Madrian (1999) sum up older empirical literature: Bazzoli (1985) finds that a report of work limitations prior to retirement had no influence on the probability of retirement before age 65 whereas at the time of retirement it had a strong effect. Sickles and Taubman (1986) find that changes in Social Security benefits and eligibility for transfers influence self rated health as well as the probability of withdrawal from the labour force.

The first systematic discussion of the statistical issues involved in the comparison of different health measures has been presented in a very influential article by Bound (1991). One possible solution to both the endogeneity and measurement error problem is to instrument self-reported measures using objective measures as in Stern (1989). But the procedure cannot be used to examine the relative importance of health and other determinants of the labour supply if the measurement error is correlated with other variables in the model. The analysis of Bound (1991) illustrates this problem using the following example:

$$LFP = \lambda_1 \eta + \beta_1 w + \varepsilon_1 \quad (1)$$

$$H = \lambda_2 \eta + \beta_2 w + \varepsilon_2 \quad (2)$$

$$D = \lambda_3 v + \varepsilon_3 \quad (3)$$

$$w = \lambda_4 \eta + \varepsilon_4 \quad (4)$$

$$\eta = v + u \quad (5)$$

Where LFP is labour force participation, H is a self-reported health measure, D is a more objective measure, w is the wage, and η is true health status. If in equation (1), H is used as a measure of η and D is used as an instrument for H, than we will purge H of dependence on ε_2, and λ_1 will be estimated correctly. However, β_1 will still be underestimated by an amount $\beta_2\lambda_1$. The intuition is that we are using the projection of H onto D and w as a proxy for η, while what we need is the projection of η itself on D and w. Note that given another objective measure of health status, one could use D as a proxy for health in equation (2), and instrument D using the second measure thereby producing an unbiased estimate for β_2 that would allow one to calculate β_1.

Anderson and Burkhauser (1985) found an indirect effect of wages on the probability of working via health. According to their results the net effect of wages on participation is similar when either measure of health is used, as long as the dependence of health on wages is accounted for. Kreider (1996) uses an alternative estimator, which is based on the idea that unlike non-workers, workers who report health limitations have no incentive to systematically over-report such limits.

To summarize, estimates of health on labour supply may be very sensitive to the measure of health used and to the way in which the estimation procedure takes account of potential measurement error. Although many studies attempt to go beyond ordinary least squares in order to deal with measurement error and the endogeneity of health, it is difficult to find compelling sources of identification. The majority of these studies rely on arbitrary exclusion restrictions, and estimates of some quantities appear to be quite sensitive to the identification assumptions. In a structural approach, identification depends on the validity of exclusion restrictions.

4. Empirical evidence of health and retirement

4.1. Overview and trends

The general empirical retirement models can be divided into (1) static models, (2) multinomial probit and logit models, (3) Duration models (dynamic approach) and (4)

structural models (option value models or dynamic programming models) (see also Spartaro, 2002). This section concentrates on important empirical results of the relation between health and labour supply of the elderly. More specifically, different generations of literature can be distinguished: The first generation uses subjective health measures and treats them as exogenous variables. The second generation treats health as an endogenous variable and uses objective health measures or instruments. The third generation uses dynamic programming models. A fourth group of literature overlaps previous groups and introduces dynamic aspects by analysing the effect of health shocks.

Poor health may decrease wages but it may also reduce effective time endowments and affect the marginal rate of substitution between goods and leisure. Gustman and Steinmeier estimate that the onset of a serious health problem steepens the indifference curve by about the same amount as 4 additional years of age (Gustman and Steinmeier, 1986). As mentioned before the effects of health on labour force participation are theoretically ambiguous, although most research seems to assume that poor health will decrease participation. The estimated effects of health on labour force participation in Europe are summarized in Table A. 1. As Madrian and Currie (1999) we find that there is little consensus reached on the magnitude of the effects. This may be (1) due to the variation in used health definitions but also (2) due to the fact that the relationship may be highly socially determined. Costa (1996) finds that health is now a less important determinant of retirement than it was in the past. This finding is inline that health has a bigger influence on wages in development countries than in developed countries. It should be noted however that the body mass index - a cumulative measure of health and nutritional status that can be related to mortality risk- covers only certain aspects of a broader health concept. The size of the estimated effect may also be sensitive to age, cohort, gender, and family circumstances of the sample individuals.

For men trends in objective measures of health - such as mortality - do not seem to match well with trends in labour force participation (Parsons, 1982). This could be explained by the introduction and the expansion of social insurance programs and its mediation in the relationship between health and participation. That is probably also why those in poor health are more likely to withdraw from the labour market than they were previously. However, trends in labour force participation may be in line with health trends if one considers the rising mental health problems over time (Ettner et al, 1997). This relevancy of changing institutions implies that the estimates of the relation between participation and

health can be very sensitive to samples, time frames, and omitted variables biases of various types. The literature that studies the relation between health and labour force participation can be divided into different overlapping generations. different approaches include (1) treating health as exogenous, (2) treating health as endogenous, (3) taking into account dynamic aspects by modelling health shocks and (4) using dynamic programming models.

4.2. Health as exogenous

The first group of literature uses self-reported health status or self reported work limitations and concluded that self reported poor health seemed to be a major determinant of labour force participation when health was treated as an exogenous variable in an OLS model.

$$y_{it} = \eta_{it}\lambda + X_{it}\beta + \varepsilon_{it} \qquad (6)$$

4.3. Health as endogenous

A next group of earlier studies compared subjective health measures with more objective ones[2]. Roughly it would be expected that the health effect on retirement is overestimated in the case of systematic reporting errors and underestimated in the case of substantial endogeneity. The literature concluded that self-reported measures overstate the health effect and understate the financial incentive effect on labour force participation. It was therefore appropriate to search for unbiased measures and soon objective measures were used and their effects were interpreted as being superior to that of subjective health variables.

A third group of literature tries to deal explicitly with the endogeneity and measurement error issues and instrument self-reported measures using objective measures. Examples are Stern (1989) and Kreider (1996). Most of these studies concentrate explicitly on the labour force participation decisions of the elderly rather than on the younger workers.

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2 For example Chirikos and Nestel (1984), Anderson and Burkhauser (1985), Bazzoli (1985).

Bound (1991) uses the Retirement History Survey to illustrate the impact that using the different health measures has on the estimated impact of both health and financial incentives on retirement. He presents a statistical model that is unidentified. To be able to identify it he uses external information. A general conclusion is that self-reported health problems exaggerate the impact of poor health on work potential. A second finding that supports the justification hypothesis is that retirees self assessed health was worse after retirement than before. Bound states that "the search for 'objective' or exogenous indicators of health status may have been a bit misplaced" and concludes that using self reported health may be better than more objective measures. The reason is that two different biases may cancel each other out as the self reported health measurement error in self-reported health biases the coefficient on health downwards whereas the endogeneity of health may bias the estimated effects upwards. To the extent that more objective measures of health are not very accurate measures of "work capacity", they are biased towards zero only.

Bound et al. (1999) use a latent model to construct a time varying individual health stock to strip the health term in the labour force participation equation of possible endogeneity of response (see also section 4.5 on health shocks for results). Using self-reported health status, h_{it} as a proxy for η_{it} directly will be biased if the reporting error term in equation (8) is correlated with terms in the labour force participation equation. However, simply entering the z_{it} vector in equation (7) directly into a labour force participation equation will likely induce errors in variables biases, because more specific health factors, even if accurately reported, may not predict current capacity to work. Bound et al (1999) argue that using the latent variable model in equation (9) is a standard measure of dealing with these problems. They use a proxy with error to instrument an endogenous and error ridden variable such as h*. Assume that individual's i health at time t is determined by a linear combination of exogenous personal characteristics X_{it} (such as age or education), a vector of detailed personal health indicators z_{it} (such as functional limitations) and unobservables υ_t uncorrelated with X_{it} and z_{it}. The impact of these characteristics is allowed to vary over time. This (unobserved) health state is denoted as η_{it}:

$$\eta_{it} = X_{it}\beta + z_{it}\gamma_t + \upsilon_{it} \qquad (7)$$

Although this health state is not observed, a self-reported health status can be observed as a categorical variable with five states: very good, good, fair, poor, very poor. Denote this categorical variable as h_{it}. The latent counterpart to h_{it} which is denoted by h^*_{it} is a simple function of η_{it} and a term reflecting reporting error:

$$h^*_{it} = \eta_{it} + \varepsilon_{it} \tag{8}$$

Crucially they assume that ε_{it} is uncorrelated with υ_{it}. It is however possible that the reporting error is correlated with the state in which the individual is located. By using this instrumental variable type procedure, they assume that the errors are uncorrelated with those arising when reporting specific health limitations. They write:

$$h^*_{it} = X_{it}\beta + z_{it}\gamma_t + [\upsilon_{it} + \varepsilon_{it}] \tag{9}$$

$$h^*_{it} = X_{it}\beta + z_{it}\gamma_t + u_{it} \tag{10}$$

Assuming that u_{it} is normally distributed equation (9) can be estimated as an ordered probit.

$$y^*_{it} = \eta_{it}\lambda + X_{it}\beta + \varepsilon_{it} \tag{11}$$

$$y_{it} = \begin{cases} 1 \;\; if \;\; y^*_i > 0 \\ 0 \;\; if \;\; y^*_i \leq 0 \end{cases} \tag{12}$$

Several studies suggest that individual fixed effects are important in modelling retirement (Meghir and Whitehouse, 1997; Blundell et al., 2002). Standard probit or logit identifies effects of all individuals, including those who are active or inactive over the whole period. Using fixed effects has the advantage that one can focus on people that transit states and establish a link between changing health status and retirement, as opposed simply to underlying in(activity). An alternative approach includes this person specific fixed (or random) effects α_i in equation (13) in order to capture unobserved characteristics that could be correlated with both health and labour force participation:

$$y^*_{it} = \alpha_i + \eta_{it}\lambda + X_{it}\beta + \varepsilon_{it} \tag{13}$$

Sickles and Taubman (1986) estimate a model of health and retirement in which health affects retirement, but not vice-versa. The random effects are assumed to be uncorrelated across retirement and health equations. The estimation technique is complex, involving 10-dimensional integration of the multivariate normal density function. The authors assume the following arbitrary exclusion restrictions: the age dummy and the "gain for postponing retirement" can be excluded from the health equation while the social security insurance eligibility and the social security benefits are excluded from the retirement equation. The authors find that poor health does indeed hasten retirement although the interpretation of the magnitude of the effect is not clear due to the definition of their health variable.

Blau et al. (1997) take this approach further by estimating models that include semi parametric random effects in order to account for unobserved heterogeneity that affects health and also employment at the time of the initial survey and attrition from the survey. These variables are assumed to depend all on the same set of random effects. The complete model is identified using non-linearities in these equations, as well as the fact that several variables assumed to affect health, initial employment, and attrition are excluded from the fourth equation for employment transitions. The inclusion of the random effects reduced the estimated effects of the self-reported health measures, although they remain important.

Dwyer and Mitchell (1999) explain the expected age of retirement[3] - an unusual dependent variable in the retirement literature[4] – by an array of subjective and objective health measures. Their approach belongs to the category of literature that wants to circumvent endogeneity problems by instrumenting subjective endogenous health measures by more objective health measures or by other instruments. They find little evidence for measurement error and justification hypothesis. Poor health is associated with earlier retirement plans. Functional limitations result in earlier expected retirement by one to two years. Self rated health measures are not endogenously determined with labour supply and seem not to be correlated with compensation variables.

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3 What is meant by the expected age in statistical terms is however not clear (footnote see Mc Garry (2003) p. 7). For those already out of the labour force actual retirement age is used what again causes a potential bias.

4 This variable is constructed by using the planned age of full retirement (69% of the sample), the other missing 31% of the sample used the expected age to begin receiving social security or pension benefits (19% of the sample) or the conditional (on age and experience) actual retirement age (12% of the sample).

Some papers compare the effects of financial variables and subjective health status on retirement. As Bound (1991) and Dwyer and Mitchell (1999), McGarry (2003) finds that the health variables effects are substantial stronger than the financial ones. It is however important to note that the comparability of the results is mostly reduced because of the difference in samples, statistical methods and dependent variables. Instead of a 0/1 variable indicating retirement, Mc Garry (2003) uses a new measure of labour force attachment, the subjective probability of continuing full time work till age 62. This variable can be viewed as a measure of strength of labour force attachment. The use of this variable allows for concentrating on employed only and so avoids the potential biases from the mis-reporting of health among those already retired, as well as any biases introduced by a relationship wherein changes in labour force participation induces changes in health. This approach does not however avoid biases introduced by unobserved individual effects that are correlated with the regressors. Because the expected probability of continued work is only observed for people in the labour force there arises a sample selection problem. The author first analyses a cross-section and then looks at the changes over time. Thereby different measures of health are used. Instead of mortality the author uses the probability with which the respondent expects to live to age 85. Next to subjective health measures alternative health measures used are: lagged health, diseases, activity limitations, multiple measures of health. The most important results of Mc Garry's analysis can be summarized in four points. (1) Despite the lack of justification bias, poor health has a large and significant effect on labour market attachment. (2) Self-reported health status continues to be significant when alternative measures of health are also included into the specification. Replacing self-reported health with alternative health measures to circumvent potential biases may therefore introduce a new bias due to omitted variable problems. (3) Most strikingly and opposite to most previous results the included measure of health does not affect the estimated effects of income and wealth. This is in line with results of Dwyer and Mitchell (1999). The author places her and the opposite previous results in a historical perspective and explains them by a change in the attitude towards early retirement. (4) Changes in retirement plans are strongly correlated with changes in health and only weakly related to changes in financial variables.

Kerkhofs et al. (1999) use a competing risk model for employment duration to specify their retirement model empirically. This model allows them to deal with censored observations and time varying regressors (age, health, eligibility conditions, benefit replacement rates) associated with alternative retirement dates. Their approach has several interesting aspects.

Firstly, it concentrates on three alternative exit routes for the Netherlands: early retirement (ER), disability insurance (DI) and unemployment insurance (UI). Secondly, the estimated retirement model uses different health measures and is able to assess the effect of reporting errors and the endogeneity of health to retirement. The authors find that endogeneity is important in the case of ER and UI and that reporting errors are very important in the case of DI. The authors conclude that health is dominant in explaining transitions into DI and UI schemes. Financial incentives are the most important in the choice to apply for an ER scheme. Their comparison of different health instruments – that they obtain from estimating a dynamic health equation - shows that it is crucial to restrict the choice of control variables to the ones that are exogenous to the potentially simultaneous career and health related household decisions. The estimated effects of the financial variables are robust to the use of the different health variables and their different measurement problems.

The reduced form model of Lindeboom and Kerkhofs (2002) elaborates two equations of labour supply and health reporting from Bound et al. (1999) but adds a third equation for health production. It is an important European paper that circumvents endogeneity problems by integrating work decisions, health production and health reporting mechanisms. The authors estimate their model on Dutch longitudinal data using simulated maximum likelihood techniques. Three stochastically related parts are estimated: (1) A model for work where financial incentives and health can affect retirement behaviour, (2) a health production model where current health levels can be affected by past labour market outcomes and (3) a model for health reporting behaviour that translates the observed subjective health index into a health that is free of reporting errors. The index is used in the model for work. This methodology enables them to assess the causal effects of health and financial incentives on work, the effect of work history on general health and work related health and the extent to which subjective health measures are biased. The analysis finds strong effects of health on retirement. The use of subjective measures in labour supply models delivers biased results. This holds notably for disability insurance recipients. A very interesting result is that their health production model reveals that increased work efforts eventually lead to a deterioration of health. This finding suggests that pension and social security reforms that aim at increasing labour force participation of the elderly may have an adverse effect on the distribution of health among the elderly, with obvious health care consumption- and other effects.

4.4. Dynamic programming models

Another group of health and retirement models calculate a solution to a dynamic programming model. Berkovic and Stern (1991) estimate a model of retirement that includes not only unobserved individual effects, but also unobserved job-specific match-effects. Their model focuses on dynamics by comparing a version in which people consider the value of future income flows – calculated as the solution to dynamic programming model - and a static model in which this flows are ignored. Health is coded as 0 if there are no work limitations, as 2 if there are limitations, and as 1 if health status is uncertain. The model requires future health to be simulated which is done by assuming that people have a fixed probability of becoming ill, but that once they become sick they stay that way. Individuals are assumed to have no uncertainty about their future health, an important limitation of the model. The model is solved using simulated method of moments techniques. The results suggest that poorer health increases the value of retirement relative to either part-time or full-time employment. The dynamic model is found to provide a better fit to the data than a static alternative model, suggesting that it is important to take beliefs about future health into account.

Stern (1996) asks whether health influences labour force participation primarily through supply or through demand factors. In the semi parametric model "supply" can be seen as a participation decision while demand conditions are captured by the wage conditional on participation. The estimates indicate that self-reported health limitations on the ability to work have larger effects on labour supply than on labour demand. A potential problem may be that the self-reported health measure may be a better measure of a persons' attitude to work or of the available alternatives than of their productivity.

4.5. Health shocks

Recent research stresses the importance to take into account dynamic aspects of health and uses health shocks (changes in health) instead of health levels. Health shocks have been divided into three categories by McClellan (1998): (1) acute health events, (2) onset of a new chronic disease and (3) accidental injuries or falls. Anderson et al. (1986) and Bound et al. (1999) suggested that changes in labour market status should be associated with shocks to the individuals underlying health stock. Bound et al. (1999) construct a latent health stock or index of health for each individual as a function of personal characteristics and health indicators. They use this constructed variable to instrument self-reported health in a panel

data model and analyse the relationship between time variation in health and changes in work status. They analyse the relationship between health and labour force transitions of older workers based on the first three waves of the *HRS* (1992-1996). Their approach has two interesting characteristics: (1) it is indeed a (two lags) dynamic health approach modelling health shocks and (2) it does not concentrate solely on labour force exit (0-1 dummy) but considers three different transitions out of employment: labour force exit, job change and application for disability insurance. In a first stage they estimate an ordered probit-model for health using self reported-health status and a functional limitations variable. In a second stage they use a multinomial probit to examine the effect of health on labour force behaviour using the estimates of the health model. Their results confirm that not only poor health but also a decline in health is an important determinant of labour force patterns for older men and women. Poor health leads many old workers to withdraw from the labour force. Among people in poor health more than half of those who exit the labour force apply for DI. Among those who keep working many change jobs within several years of the onset of their poor health suggesting that changing jobs is an important way that older workers adapt to enable continued labour force participation. The results confirm the value of modelling alternative labour force outcomes, beyond the binary outcome of labour force withdrawal. Their results also suggest that the relationship between health and labour force behaviour is dynamic although no precise effect estimation attempt is made. Overall, the earlier a health shock occurs in their models, the less likely it is to lead to labour force exit.

The same two-step approach of Bound et al. (1999) is also used by Disney et al. (2003). The authors examine the role of ill-health in retirement decisions in Britain using fixed effect estimators. They show that adverse individual health shocks are an important predictor of individual retirement behaviour. Disney et al. (2003) argue that modelling health shocks eliminates any person specific association between characteristics and labour market outcomes, whilst using time-varying health and personal characteristics as a proxy for self-reported health status should ameliorate any reporting bias in the former. They find no convincing evidence for the importance of the partners' health for the individual retirement decision and no significant differences between men and women based on the inclusion of an additional interaction of health stock with a gender dummy. Finally the authors found some evidence of asymmetry in the sense that a worsening health has a bigger impact on flowing into retirement than an improving health has on flowing out of retirement. The approach of Coile (2003) using health shocks for both spouses is described in section 5.2. on the effect of health of family members on participation.

5. Gender differences and within household dynamics

5.1. Gender differences in the effects of health on participation

Relatively few studies examine both men and women in the same framework. Loprest et al. (1995) observe that the effects of disabilities on labour force participation are greater for men and single women than for married women. Ettner (1997) finds evidence that being out of the labour force is less stigmatizing for women then for men, so that there is less reporting bias among women. Analysing gender differences in retirement behaviour is certainly a field further to be explored as participation patterns of both men and women have been changing. It may further be optimal to take into account those differences in shaping the future pension system.

5.2. Health of other family members and participation

Although most literature on health and labour force participation focuses on the individual, there is a trend towards taking into account the health of other family members like children, parents but especially spouses. A recent development in the modelling of retirement decisions concerns the "couple approach". Adapting a "couple approach" can be supported by the fact that women's retirement decisions are not well understood yet and by the possibility of spousal spill over effects of retirement incentives. The traditional approach to analyze labour force behaviour of married couples is based on the family labour supply model. Behaviour is determined by the maximization of a single utility function subject to a family budget constraint in which income is pooled and the allocation of consumption between the spouses is not modelled. A second approach can be a bargaining model based on cooperative game theory. The growing empirical literature on couples' retirement consists of papers that estimate structural models of family labour supply and reduced form models that explore the cross effects of one spouse's characteristics on the other spouse's retirement decision. These papers typically find that complementary of leisure is much more important in explaining joint retirement than either correlation in preferences or shared household finances. Having a retired spouse increases the probability of retirement. Both sets of studies do mostly not control for health or do so using self-reported health status, subjecting to the critique that the resulting estimates of the effect of health are biased. Some couple approach studies that do pay attention are summarized below.

Favreault and Johnson (2001) analyse the retirement decisions of married couples in the United States and how they interact with spousal health and employment using the first 3 waves (1992-1996) of the HRS. They estimate for each sex a multivariate model of the retirement decisions. Next to the retirement decision, the spousal work status is treated endogenously as it may be determined jointly with the individual's own retirement decision. They find that employment and health status of the spouse appear to have important effects on retirement decisions for married women and men. When the spouse does not have health problems, women and men were more likely to retire if the spouse was not employed than if the spouse was still at work. However when the spouse had health problems, non-employment of the spouse generally reduced retirement rates for both men and women. The effects were generally larger when the spouse was not eligible for social security retirement benefits (younger than 62). No evidence was found that spousal care giving demands affect retirement decisions. These findings underline the importance of marriage in providing insurance for those who become disabled. The authors conclude that because of the correlation between unobservable factors it is important that labour supply decisions of married people are estimated jointly.

One of the first European couple approach papers analyzes labour force transitions of older married couples in West-Germany (Blau and Riphahn, 1999). A measure of subjective health satisfaction and the presence and the degree of an officially recognized handicap did not turn out to have an impact on the transition rates. In their final specification the authors included only a dummy for chronic disease; only a few point estimates of that variable were significant. They found that individuals with a chronic health condition are less likely to stay employed and more likely to exit the labour force. Wives are less likely to exit the labour force and more likely to enter the labour force if the husband has a chronic condition and is still working, and are in contrast more likely to exit and less likely to enter if the husband has left the labour force. The same pattern does not hold for men (evidence of asymmetries). Husbands are less likely to stop employment and less likely to re-enter employment if the wife has a health condition, a response that is independent of the wife's labour force status.

The important couple approach analysis of Coile (2003) uses a broad range of health variables for the US and concentrates on health events. The study is based on the first 5 waves (1992-2000) of the HRS. The analysis estimates reduced-form models that measure the effect of each spouse's health events on the other spouse's labour supply (hours and

participation). It is the first paper that combines a broad range of health variables and a couple-approach. In doing so it links two important strands of retirement literature, the large literature on health and retirement and the small but growing literature modelling retirement in a family context. Coile examines the three types of health shocks of McClellan (1998) (see earlier this section). Other health variables used are the functional impairment index (the index is based on whether the individual reports any difficulty in performing a series of seventeen activities of daily living (ADL); the index ranges from 0 (difficulties in no activities) to 1 (difficulty in all 17 activities)) and the self-reported survival probabilities. The study exploits exogenous shocks to health between waves of the survey to explore the effect on health on one's own and spouse's labour supply. The two dependent variables used are the change in hours and the exit from the labour force (dummy). The spouse's response to health shocks has important financial implications for the family but can be crowded out by the available government benefits. Major findings of the paper are that health shocks have an important effect on own retirement. In the sample as a whole health shocks have no significant effect on the spouse's retirement either for men or women. This aggregate non-response may be explained by offsetting responses by different groups. This suggests that behaviour is affected by the need to provide health insurance, the presence of other potential caregivers, the importance of the lost income, and the availability of disability benefits. These offsetting responses are more often found for men suggesting that men may respond more to their spouses' health shocks then women. Finally there is evidence of substantial crowding out of spousal labour supply by disability insurance benefits.

6. Conclusions

Health plays an important role in retirement models although there is no consensus about the magnitude of the effects or about the size relative to other effects of other variables. Estimates of health on labour supply may be very sensitive to the measure of health used and to the way in which the estimation procedure takes account of potential measurement error. Although many studies attempt to go beyond ordinary least squares in order to deal with measurement error and the endogeneity of health, it is difficult to find compelling sources of identification. The majority of these studies rely on arbitrary exclusion

restrictions, and estimates of some quantities appear to be quite sensitive to the identification assumptions. Most complete models take into account correlations between participation, health reporting and health production. They take into account different available health measures to test for robustness.

Different trends in the literature have appeared as new data and new estimation techniques became available. A first trend is the use of very detailed health data in new databases. A second trend explores the panel nature of data and introduces dynamics into the models by modelling participation transitions and health shocks. A third trend takes into account different institutionally defined pathways towards retirement as health can play a "path dependent" role. A fourth trend includes health effects of both spouses in the explanation of an individuals' participation. A final broader trend is the use of dynamic programming techniques in retirement models. Research of European data is still small but rapidly expanding. The future development of the SHARE database project (see Appendix C) will certainly intensify analysis and understanding of the complex relationship between health and participation of elderly Europeans.

Thus the current conclusion of the literature is that health has an important effect on retirement, but there is no perfect method for estimating the magnitude of the effect. Aiming at unbiased effects is however crucial as an understanding of unbiased health and financial incentive effects is crucial for simulations and solid economic policy advice.

Bibliography

Anderson, Kathryn H.; Burkhauser, Richard V. (1984), "The Importance of the Measure of Health in Empirical Estimates of the Labour Supply of Older Men", *Economics Letters*, 16, p.375-80.

Anderson , K.H. and R.V. Burkhauser (1984), 'The importance of the measure of health in empirical estimates of the labor supply of older men', *Economics letters 16*, p. 375-380.

Anderson , K.H. and R.V. Burkhauser (1985), 'The retirement-health nexus: a new measure of an old puzzle', *Journal of Human Ressources 20*, p. 315-330.

Anderson K.H., Butler J. S., Burkhauser Richard V. (1986),'Testing the Relationship Between Work and Health: A Bivariate Hazard Model', *Economic Letters, v. 20*: p. 383-386.

Bazzoli, G.J. (1985),'The early retirement decision: new empirical evidence on the influence of health', Journal of Human Resources 20, p. 2 14-234.

Becker, G.S. (1964), *Human Capital* (Columbia University Press, New York).

Berkovec, James and Steven Stern (1991), 'Job Exit Behavior of Older Men", Econometrica, 59(1): p. 189-210.

Blau, D.M., D.B. Gilleskie, C. Slusher (1997),'The effects of health on employment transitions of older men', unpublished paper at the University of North Carolina, Chapel Hill.

Blau, D.M and R.T., Riphahn (1999), 'Labour Force Transitions of Older Married Couples in Germany', *Labour Economics*, 6, p. 229-252.

Blundell, R.; Meghir, C., Smith, S. (2002), 'Pension incentives and the pattern of early retirement', Economic Journal, 112, March , C 153-170.

Booth, A.L. (ed.) (1999), 'The health, wealth and work of older people' (Economics of Aging, International Health and Retirement Conference, 7-8 August 1997, Amsterdam, The Netherlands), *Labour Economics* , vol. 6, no. 2, June 1999.

Börsch-Supan, Axel (2000), 'Data and Research on Retirement in Germany', Mannheim Research Institute for the Economics of Aging, Universität Mannheim, *Discussion Paper Series*, *nr.00-20*, 18p.

Börsch-Supan, Axel; Kohnz, Simone; Schnabel, Reinhold (2003), 'Micro Modelling of Retirement Choices in Germany', In: J. Gruber and D. Wise (eds.), *Incentive effects of Public Pension Systems*, University of Chicago Press: Chicago, in press.

Bound, John (1991), 'Self-Reported versus Objective Measures of Health in Retirement Models', *The Journal of Human Ressources*, *26-1*, p.106-138.

Bound, J. and R. Burkhauser, (1999), 'Economic analysis of transfer programs targeted on people with disabilities', in O. Aschfelter and D. Card (eds), *Handbook of Labour Economics*, Volume 3C, Amsterdam: Elsevier Science, p. 3417-3528.

Bound, John; Schoenbaum, Michael; Stinebrickner, Todd R.; Waidmann, Timothy (1999), 'The dynamic effects of health on the labour force transitions of older workers', *Labour Economics*, 6, p.179-202.

Chirikos, T.N. and G. Nestel (1984), 'Economic determinants and consequences of self-reported work disability', *Journal of Health Economics 3*, 117-136.

Coile, Courtney and Jonathan Gruber (2000), 'Social Security and Retirement', *NBER Working Paper 7830*.

Coile, Courtney (2003), 'Health Shocks and Couples' Labour Supply Decisions', Centre for Retirement Research at Boston College Working Paper 2003-08, May 2003.

Costa, Dora L. (1996), 'Health and Labour Force Participation of Older Men, 1900-1991', *The Journal of Economic History*, *Volume 56, Issue 1*, p. 62-89.

Currie, Janet and Brigitte C. Madrian (1999), 'Health, Health Insurance and the Labour Market', in Orley C. Ashenfelter and David Card (eds.) *Handbook of Labour Economics, Volume 3C*, p. 3309-3416, Elsevier Science Publishers, BV, Amsterdam.

Disney, Richard; Emmerson, Carl; Wakefield, Matthew (2003), 'Ill Health and Retirement in Britain: A Panel Data Based Analysis', *The Institute for Fiscal Studies (IFS), Working Paper 03/02*, 28 p.

Dwyer, Debra Sabatini; Mitchell, Olivia S. (1999), 'Health Problems as Determinants of Retirement: Are Self-rated Measures Endogeneous?', *Journal of Health Economics*, *18*, p. 173-193.

Ettner S. (1997), 'Is working good for you? Evidence on the endogeneity of mental and physical health to female employment', Unpublished paper (Harvard school of public health).

Ettner S., Frank R., Kessler, R. (1997), 'The impact of psychiatric disorders on labor market outcomes', *NBER Working Paper Series*, nr. 5989.

Griliches, Z. (1977), 'Estimating the returns of schooling:some econometric problems', Econometrica 45: p. 1-22.

Grossman, M. (1972), 'On the concept of health capital and the demand for health', *Journal of Political Economy 80:* p. 223-255.

Gustman, A.L. and T.L. Steinmeier (1986), 'A structural retirement model', Econometrica 54, p.555-584.

Hakola Tuulia (2002), 'Economic Incentives and Labour Market Transitions of the Aged Finnish Workforce', *VATT-Research Reports*, *89,* 193 p.

Hakola Tuulia (2002), 'Alternative Approaches to Model Withdrawals from the Labour Market – A literature Review', *Working Paper Series, Department of Economics, Uppsala University*, *No. 2003:4*, 39 p .

Favreault, Melissa M.; Johnson, Richard W. (2001), 'Retiring together or retiring alone: The Impact of Spousal Employment and Disability on Retirement Decisions', Centre for Retirement Research at Boston College Working Paper 2001-01, March 2001.

Jiménez-Martín, Sergi; Labeaga, José M.; Martínez Granado, Maite (1999), 'Health Status and Retirement Decisions for Older European Couples', *Iriss working paper series*, no. 1999-01, 34 p.

Kerkhofs, Marcel; Lindeboom, Maarten; Theeuws, Jules (1999), 'Retirement, Financial incentives and Health', *Labour Economics*, *6*, p. 203-227.

Kreider, B. (1996),'Latent work disability and reporting bias', Unpublished paper, University of Virginia.

Lazear, Edward P. (1986), 'Retirement from the labour force', in Orley C. Ashenfelter and R. Layard (eds.) *Handbook of Labour Economics, Volume 1*, p. 305-355, Elsevier Science Publishers, BV, Amsterdam.

Lechner, Michael and Rosalia, Vazquez-Alvarez (2003), *The Effect of Health Status on Labour Market Outcomes: A case study of Germany with evidence from Matching*, preliminary draft, 42 p.

Leung, S.F. and Wong C.T. (2002), 'Health Status and Labor Supply: Interrelationship and Determinants', version of May 28, 2002, in mimeo, Hong Kong University of Science and Technology.

Lindeboom, M. and M. Kerkhofs; (2002), 'Health and Work of the Elderly, Subjective Health Measures, Reporting Errors and the Endogenous Relationship between Health and Work', Institute for the Study of Labor (IZA), Discussion Paper, No. 457, March 2002, 39p.

Lindeboom, Maarten; Doorslaer, Eddy van (2003), 'Cut-point Shift and Index Shift in Self-reported Health', Tinbergen Institute Discussion Paper, TI 2003-042/3, 24p.

Loprest, P., Rupp K., Sandell S. (1995), 'Gender, disabilities and employment in the health and retirement study', *Journal of Human Ressources 30*, p.293-318.

Lumsdaine, Robin L. and Olivia S. Mitchell (1999), 'New Developments in the Economic Analysis of Retirement', in Orley C. Ashenfelter and David Card (eds.) *Handbook of Labour Economics, Volume 3C*, p. 3261-3307, Elsevier Science Publishers, BV, Amsterdam.

Mastrogiacomo, Mauro; Alessie, Rob; Lindeboom, Maarten (2002), 'Retirement Behaviour of Dutch Elderly Households: Diversity in Retirement Patterns Across different Household Types', Tinbergen Institute Discussion Paper, TI2002-073/03 may 24-2002, 35p.

McClellan, Mark (1998), 'Health Events, Health Insurance, and Labour Supply: Evidence from the Health and Retirement Survey', in David A. Wise, ed., *Frontiers in the Economics of Aging*, Chicago: University of Chicago Press.

McGarry, Kathleen (2002), 'Health and Retirement: Do Changes in Health Affect Retirement Expectations?', *NBER Working Papers, nr. 9317*, November 2002.

Meghir, C. and Whitehouse, E. (1997), 'Labour market transitions and retirement of men in the UK', *Journal of Econometrics*, 79, 327-354.

Parsons, D.O. (1982), The male labor force participation decision: health, reported health and economic incentives', Economica, 49, p.81-91.

Riphahn, R.T. (1995), 'Disability Retirement Among German Men in the 1980s', *Münchner Wirtschaftswissenschaftliche Beiträge, Nr. 95-20*, Ludwig Maximilians Universität München.

Sammartino, F. (1987), 'The Effect of Health on Retirement', *Social Security Bulletin 50*, p.31-47, February 1987.

Sen, A. (2002), 'Health: perception versus observation', *British Medical Journal*, *324,* p. 660-1.

Sickles, Robin C.; Taubman, Paul (1986), 'An Analysis of the Health and Retirement Status of the Elderly', *Econometrica*, *Volume 54, Issue 6*, p. 1339-1356.

Spartaro, Luca (2002), 'New Tools in Micromodeling Retirement Decisions: Overview and Applications to the Italian Case', *CeRP Working Paper Series*, nr. 28/02, 41 p.

Stern, S. (1989), 'Measuring the effect of disability on labor force participation', *Journal of Human Resources 24*, p.361-395.

Stern, S. (1996), 'Semiparametric estimates of the supply and demand effects of disability on labor force participation', *Journal of Econometrics 71*, p.49-70.

Stock, J.H., and Wise, D.A. (1990), 'Pensions, the Option Value of Work and Retirement, *Econometrica* 58, p. 1151-1180.

Strauss, J. and D. Thomas (1998), 'Health, nutrition and economic development', *Journal of Economic Literature 36*, p.766-817.

Wooldridge, Jeffrey M. (2002), *Econometric Analysis of Cross Section and Panel Data*, MIT Press: Cambridge Mass.

Appendix A: Tables with results summary

Table A. 1: Individual approach results for European countries

Author/dataset/sample	Labour force and health measures	Estimation Technique	Results
Riphahn (1995) D: Germany: GSOEP, eight waves, 1984-1991 S: men, aged 46-62 no civil servants, miners and self-employed	LF: 3 states: working, disability retirement, non employment Health: -health satisfaction indicator -official degree of handicap indicator	-Approximation of a dynamic programming model -Joint estimation of 2 discrete time, competing risks hazard models with a set of 4 initial conditions equations, 1 wage equation and 1 health equation - control for permanent and time-varying unobserved heterogeneity	-Poor health Coefficient: -0.28928 (exit from work) -0.37206 (exit from non-employment) - Poor health status strongly increases risk of leaving the states of working and non-employment for disability retirement - Effect of poor health is much stronger than that of benefits - Estimates are fairly insensitive to the particular measure of health
Kerkhofs et al. (1999) D: The Netherlands: CERRA, first 2 waves: 1993 and 1995 S: males and females, individuals employed in 1991	LF: hazard rate out of work Health: self- reported subjective health measure health limitation (first wave) -objective HSCL -health instruments derived from a panel data model of health dynamics	- Competing risks (3 alternative retirement routes) model for employment duration -Dynamic fixed effects model for health -Maximum Likelihood -IV	-health matters (Coeff.: 3.11: disability insurance, (Coeff.:0.28: early retirement) (Coeff.: 0.21: unemployment insurance) -size of health effect depends on health measure used -subjective health measures overstate the effect of health -endogeneity of health suppresses the health effect -incentive effects are relatively insensitive to alternative specifications for health
Disney et al. (2003) D: Britain: BHP, 8 waves: 1991-1998 S: males and females, active and inactive, aged 50 to 64 in 1991 and reached 57 to 71 in 1998. Sample of 1712 individuals in 1991, reduced to 1253 by 1998	LF: Labour force participation (employed and self-employed) Health: deviations of individual health stock measure from average at t	- reduced form model of retirement -Two stage method: (1) ordered probit estimator for health stock (2) standard logit, linear and non-linear fixed effects logit estimators for LFP	Relative (good) health status (underlying health stock) is strongly positively associated with economic activity Coefficients of health stock: 0.279*** (fixed effects logit), 0.752*** (logit), 0.035*** (linear fixed effects)

Lindeboom et al. (2002): D: The Netherlands: CERRA, first 2 waves: 1993-1995 S: men and women, head of household aged 43 to 63. Sample of 4727 households, reduced to 3500 households by 1995	LF: 4 categories: (1) employed, (2) early retirement, (3) unemployment insurance, (4) disability insurance. Health: self- reported subjective health measure, health limitation (first wave) -objective HSCL -cleanset health index derived during the simultaneous estimation of three equations	-reduced form model -simultaneous estimation of three equations: (1)Participation equation: multinomial logit (2) Health reporting equation: ordered probit (3) Health production equation: linear random effects	-Rescaled coefficient of cleanset probability of bad health measure in participation equation (multinomial logit model with workers as reference category): Unemployed: -2.131 [-8.51], Disabled -2.261 [-9.76], -0.571 [-6.28]. -Coefficient of bad health dummy in multinomial logit model not taking into account endogeneity: Unemployed: -0.826 [-3.6], Disabled -4.179 [-17.25], -0.511 [-2.13]

***=significant at 1% level, **=significant at 5%level, *=significant at 10% level.

Table A. 2: Individual approach results for the U.S.

Author/dataset/sample	Labour force and health measures	Estimation Technique	Results
Bound (1991) D: RHS, first wave (1969) S (6022): men, aged 58 to 63 in 1969 worked or working for private sector	LFP: participation during 1969 survey week (dummy: 1 is in labour force) Health: -subjective health (dummy=1 if health as good or better than average) -functional limitations at work (dummy) -mortality (7 ordered categories, higher values correspond to later death)	- reduced form model - simultaneous system with unobserved LFP, health and mortality (identification from parameter restrictions) - OLS for LFP - IV for LFP	Marginal effect of health variable on LFP (OLS, IV, system): - poor health: (-1.45, 0.84, 0.50 to 0.76) - limits: (-1.37, 0.91, 0.51 to 0.76) - mortality (OLS): 1974-1979 (-0.26); 1973 (-0.31); 1972 (-0.52); 1971 (-0.92); 1970 (-0.95); 1969 (-1.02)
Bound et al. (1999) D: HRS, first 3 waves (1992-1996) S (6701): men (2875) and women (3826), aged 51 to 61 in wave 1 and employed in wave 2	Analysis by sex: LFP: 4 categories of labour force state transitions between wave 2 and 3: (1)applied for DI (2) employed at the same job (3) employed at a different job (4) neither employed nor applied for DI Health: - lagged health -self-rated health -health limits ability to work -ADL/IADL index - prevalence of various chronic diseases	Joint estimation of 7 equations: Simulated ML estimation (1)latent variable model to construct an index of health in each wave (3 ordered probit models) (2) 3 multinomial probit models (base case: work for same employer) (3) equation of baseline work status	Coefficients of health variables on labour force transitions (Different job, apply for disability insurance (DI), not employed and not applying for DI): *Men -contemporaneous health: (0.27, 1.83, 0.91) -once lagged health: (-0.03, -0.47, -0.42) -twice lagged health: (-0.20, -0.61, -0.32) *Women -contemporaneous health: (0.27, 1.58, 0.47) -once lagged health: (0.31, -0.24, -0.01) -twice lagged health: (-0.50, -0.55, -0.28)

Dwyer and Mitchell (1999) D: HRS, first wave (1992) S: men, aged 51 to 61 in 1992	LFP: Expected age of retirement Health: 5 different measures + specific health conditions: -work limitations -self-rated poor health -health conditions index -ADL/IADL/FL index -dichotomous ADL/IADL/FL Instruments for health: -Hospital nights -Weight/height -Parent died young -Parent needs help -Parent sick prior to dead -Parent alive -No. of children -Age	- OLS - IV estimates -cross section for wave 1 -changes over two waves	Poor health is associated with earlier retirement Plans. Functional limitations result in earlier expected retirement by one to two years Self rated health measures are not endogenously determined with labour supply and seem not to be correlated with compensation variables Little evidence of measurement error In the more objective health measures
McGarry (2003) D: HRS (1992-1994, 2 waves) Biennial survey data S: men and women, employed(not the self-employed and those in the military); Final sample consists of 5498 observations	LFP: - Expected probability of full time work at age 62 (C), – Δ Expected proba-bility of full time work at age 62 (C), Health: -subjective health measure -subjective survival probability to live till age 85 -lagged health -diseases -activity limitations -multiple measures of health - Δ above health variables	- Reduced form model - OLS	* Effect of health on probability of working full-time at age 62: - Baseline (reference excellent health): very good health: (-0.011) [sd:0.013]; good health: (-0.032) [sd:0.014]; fair and poor health: (-0.082) [sd:0.019] - subjective survival probability to live till age 85: (0.102) [sd:0.017] -Any disease condition: (-0.035) [sd:0.011] -Activity limitations: (-0.010) [sd:0.003] - Baseline effect of changes in health on changes in probability of working full-time at age 62: Subjective health better than last period (reference same health than last period): (0.013) [sd:0.018]; health worse than last period: (-0.041) [sd:0.019]

Table A. 3: Couple approaches results

Author/dataset/sample	Labour force and health measures	Estimation Technique	Results
European Union			
Blau and Riphahn (1999) D: GSOEP, Monthly data S: married couples with at least 1 spouse age 50 to 69 (1553 couples)	LFP: transitions between LF-states (D) Health: - Subjective health satisfaction, - Chronic disease	Competing risks Hazard model	Simulated effect of chronic disease dummy husband (H) and wife (W): **Both employed** to husband employed and wife out of labour force (OLF): (H:-0.0002, W: 0.0002) ,or to wife employed, husband OLF: (H:0.0001, W: -0.0007) **Husband employed , wife OLF** to both employed: (H:0.0001, W: 0.0032) ,or to both OLF: (H:0.0003, W: -0.0018) **Wife employed, husband OLF** to both employed: (H:-0.0066, W: -0.0009), or to both OLF: (H:0.0036, W: 0.0017) **Both OLF** to husband employed and wife out of labour force (OLF): (H:-0.0024, W: -0.0007), or to wife employed and husband OLF: (H:-0.0004, W: -0.0010)
Jiménéz-Martín et al. (1999) D: ECHP (1994-1995, 2 waves, 10 European countries:DK, BE, LU, FR, UK, IR, IT, GR, ES, PL S: Couples	LFP: -Couple dummy that captures transition information of both spouses -3 initial states of couple dummy - 2 possible states per spouse: In labour force and out of labour force Health: - subjective health - subjective good health dummy - chronic illness - being admitted in patient at a hospital - doctor visits	-Family utility model - Depending on the origin state of both spouses estimate: (1) Multinomial logit (2) Logit model 1 (3) Logit model 2	*Coefficients of health variable in the individual approach: - Good health (men: -0.089 [0.099], women: -0.205 [0.107]) - Chronic problems (men: 0.563 [0.100], women: 0.229 [0.113]) -Hospital dummy (men: 0.647 [0.128], women: 0.169 [0.169]) -Doctor visits 1-5 (men: 0.139 [0.123], women: -0.201 [0.141]) -Doctor visits 6+ (men: 0.345 [0.148], women: -0.139 [0.161])

United States			
Favreault and Johnson (2001) Sample: HRS (1992-1996, 3 waves) Biennial survey data	LFP: Retirement decision (1 if retired in next period) Spousal work status (1 if not employed in current period) Health: - Number of func tional impairments (C) - subjective health status (D) - interaction between health and unemployment of spouse	Multivariate model, recursively specified	
Coile (2003) Sample: HRS (1992-2000, 5 waves) Biennial survey data	LFP: Δhours (C) LF-exit (D) Health: - Acute event dummy -Chronic illness dummy -Accident dummy -Any health lags -Any health schock -Impairment index -Change in Index -Self reported probability to live till age 75 -Change in the last variable	OLS, probit	

Appendix B: List of used health variables

Self reported measures of health

Subjective health: Self reported answer to the question "How is your health?": very good, good, normal, bad, very bad. Previous studies have found very different effects for financial variables on labour force participation when subjective health status is replaced with data on eventual mortality. Mc Garry (2002) however has to conclude that changes in the included measure of health do not affect the estimated effects of income and wealth. In some surveys (like the BHP till 1998) health status questions ask the respondents to compare their health with other people of their age (Is your health better, worse, or the same as that of other people of your age?). The likely expected decline in health status as the panel ages should therefore not be picked up. In that case a significant coefficient on that health variable should be interpreted as indicating that individual specific variations in health have an impact on labour market activity.

Objective measures of health

Health conditions index: Index that counts the number of health conditions the respondent reports, including a wide range of functional limitations, chronic physical and mental disorders, and acute illness. This measure does not account for the severity of conditions experienced and uses the same weights for each condition. Since the variable is a count of conditions that are not likely independent, people with more severe symptoms tend to score higher.

Health utility index (HUI): Generic measure of health utility: *McMaster Health Utility Index Mark III*, is used to compute healthy life expectancies. This measure relies on self-reporting. One advantage is that respondents are the only required to classify themselves on eight health attributes. The overall individual health utility score on a scale of zero to one is derived using weights which are derived from a different valuation survey on a different sample of individuals. As, such it represents a more valid and reliable general health measure than the single SAH (Self-assessed health) question.

Hopkins Symptom Checklist (HSCL): The HSCL is a validated objective test of general health used in the medical sciences to assess the psycho-neurotic and somatic pathology of

patients. The HSCL consists of 57 items and is known to have an excellent rate of external consistency, meaning that the test results are highly correlated with objective medical reports on the patient health status. The responses result in a mental score, a physical score and a total health score. The advantage of this indicator in comparision with s subjective self assessed health measure is that it is less sensitive to reporting errors that may depend upon the respondent's labour market status.

Mortality: Eventual mortality of the individual has been used in past work. As a proxy for health it could affect the utility/disutility of employment or leisure. Second, a longer life span means ceteris paribus a longer potential retirement over which a worker must finance consumption and thus a need for greater retirement assets. An alternative measure here can be the expected probability to live to a certain old age.

Date of subsequent mortality: A commonly used proxy bound to be imperfectly correlated with health status. Even a moderate account of measurement error in such proxies can easily lead to the conclusion that the self reported measure will give a more accurate picture of the impact of health and financial incentives on labour supply.

Lagged health: One measure is subjective health in the period prior to observed retirement. Lagged health is generally found to have a smaller effect on retirement than post-retirement health status. This could indicate that individuals alter their subjective reports of health based on their labour status or alternatively that retirement is caused by health shocks that are not observable in the pre-retirement interview.

Diseases: Another measure of health that can be used is objective reports of specific conditions. Those reports are typically answers to the question: "Has a doctor ever told you that you have the following disease". The conditions vary from acute events to chronic conditions. As most conditions are rare their effects can be difficult to identify. When those measures are replaced with a summary measure indicating the diagnosis of any condition the effect becomes significant.

Activity Limitations or the presence of work limitations: Other measures used are responses to subjective questions about whether the respondent's health limits his ability to work. As in case of self-reported health status, these reported work limitations may suffer from justification bias. It may therefore be better to use measures of more general activity limitations or an indicator of different activities. Many researchers have expressed that endogeneity is more of a problem with functional limits than with subjective health (Bound, 1991, p.122).

Activities of daily living (ADL): these functional limitation measures are more closely tied to functional capacity for work and assess the respondents' difficulty performing 17 activities of daily living and instrumental activities of daily living IADL. There also exist variables that are based on ADL/IADL/FC (Functional capacity). Those can be expressed as a Dichotomous variable (1 if 1 positive answer) or as a hierarchical index (11 category index increasing in severity of ADLs, IADLs and FLs) (see Katz et al., 1963; Spector et al., 1987).

Health shocks (changes over time): The use of health shocks as an alternative to self-reported health status is appealing due to the concern that health status may not be independent of labour force outcomes if people seek to rationalize their retirement status by claiming a health problem.

Health Instruments: Hospital nights: Count of the number of nights spent in a hospital last year. Weight/height ratio; Mom died young; Mom/dad needs help; Mom/dad sick prior to dead; Mom/dad alive; No. of children; Age.

Appendix C: Overview of available data bases

United States

Retirement History Survey (RHS): follows a sample of men and unmarried women born between 1906 and 1911 for ten years (1969-1979).

New Beneficiary Survey (NBS): survey conducted by the Social Security Administration in 1992. the NBS surveyed persons born between 1910 and 1918, slightly later than the cohort interviewed by the RHS.

Health and retirement study (HRS): a recent Michigan Survey Centre's, nationally representative survey of the young elderly with extensive information on health, labour force status and demographics. The 6 waves (1992-2002) survey has been conducted every two years since 1992 and contains persons born between 1931 and 1941 (aged 51-61 in 1992) and their spouses.

European Union

The Centre for Economic Research on Retirement and Ageing panel survey (CERRA-panel): This panel survey is a Dutch survey that is designed specifically for the analysis of the effects of ageing on the labour market and resembles the HRS. The 2 waves panel has been conducted in 1993 and 1995 (University of Leiden). The first wave was consists of 4727 households in which the head of the household was between 43 and 63 years of age at the date of the interview. In each household, both head and partner, if present, 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. The health variables in the sample contain, among others, commonly used subjective measures and responses to the Hopkins Symptom Checklist (HSCL).

Dutch Socio-Economic Panel (SEP): Survey covering 17 waves from 1984 to 2000. It is administrated by Statistics Netherlands and contains approximately 5000 households a year. In structure and contents this panel survey is similar to the GSOEP and the American PSID. The aim of the SEP is to provide a description of the most important elements of individual and household welfare and to monitor changes in these elements over time. As such this survey is not specifically designed to cover retirement issues per se.

German Socio-economic Panel (SOEP): This important panel consists currently out of 20 waves (1984-2003) of data for more than 6000 German households. The panel includes the standard health variables like a measure of subjective health satisfaction, the presence and degree of an officially recognized handicap and the presence of a chronic disease. Recently extra health variables have been added.

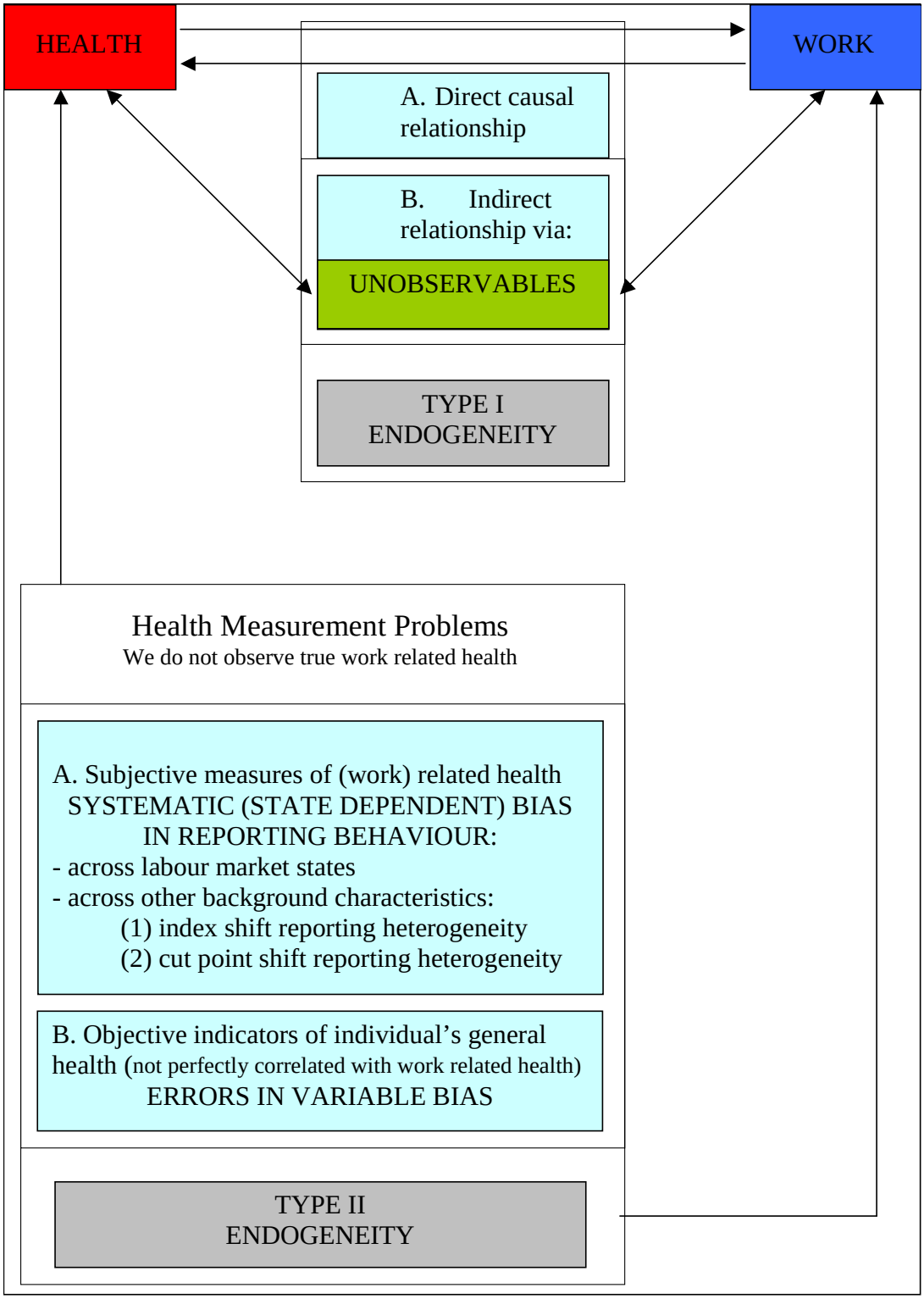
European Community Household Panel (ECHP): This dataset contains 8 waves that have been released from 1994 to 2001 for most EU-countries. The same questionnaire is adopted by the national data collection units in each participating country. The advantage of these country data is their high comparability level. The survey is composed of a household and a personal file, and the same individuals and families are interviewed over time. In the first wave (in 1994) a sample of some 60500 nationally representative households – approximately 130000 adults aged over 16 years and over – were interviewed in the EU Member States. Austria (1995) and Finland (1996) have joined the project since then. For the fourth wave of the ECHP, in 1997, the original ECHP surveys were stopped in three countries, namely Germany, Luxembourg and the United Kingdom. In these countries, existing national panels were used and comparable data were derived from the GSOEP and BHPS – back from 1994 onwards.

British Household Panel Survey (BHP): (1991-1998): 8 waves. This survey provides a sample that was selected to be representative of the population of England, Wales and Scotland (South of the Caledonian Canal). The question relating to health status changed in 1999.

Survey of Health, Aging and Retirement in Europe (SHARE): Project that will build up fundamental resource for science and public policy to help mastering the ageing challenge. The main aim of SHARE is to create a pan-European interdisciplinary panel data set covering persons aged 50 and over. The project brings together many disciplines, including epidemiology, sociology, statistics, psychology, demography, and economics. Scientists from some 15 countries work on feasibility studies, experiments, and instrument development, culminating in a survey of about 22.000 individuals. The multidisciplinary nature of the data will provide new insights in the complex interactions between economic, health, psychological and social factors determining the quality of life of the elderly.

Health 2000: Is a cross section of Finnish health data for the year 2000. An extensive list of health data are available.

Appendix D: Relation between health and labour force participation



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