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Berlin, May 2009

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ISSN: 1864-6689 (online)

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# Early retirement and inequality in Britain and Germany: How important is health?

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**Acknowledgements**
This paper derives from the work of two projects: `Health, Retirement and Inequality: Can Germany and the UK learn from each other?' funded by the Anglo-German Foundation (grant number: 1462), and 'The dynamics of income, health and inequality over the lifecycle' (ECuityIII Project), which was funded in part by the European Community's Quality of Life and Management of Living Resources programme (contract: QLK6-CT-2002-02297). We would like to thank Martin Schellhorn (National Research Centre for Health and Environment, Munich) and Lynn Gambin (Institute for Employment Research, University of Warwick) for valuable help during these projects. We are also very grateful to Xander Koolman and Eddy Van Doorslaer for providing STATA code for the concentration curve analysis.

# Early retirement and inequality in Britain and Germany: How important is health?

**Abstract**

Both health and income inequalities have been shown to be much greater in Britain than in Germany. One of the main reasons seems to be the difference in the relative position of the retired, who, in Britain, are much more concentrated in the lower income groups. Inequality analysis reveals that while the distribution of health shocks is more concentrated among those on low incomes in Britain, early retirement is more concentrated among those on high incomes. In contrast, in Germany, both health shocks and early retirement are more concentrated among those with low incomes. We use comparable longitudinal data sets from Britain and Germany to estimate hazard models of the effect of health on early retirement. The hazard models show that health is a key determinant of the retirement hazard for both men and women in Britain and Germany. The size of the health effect appears large compared to the other variables. Designing financial incentives to encourage people to work for longer may not be sufficient as a policy tool if people are leaving the labour market involuntarily due to health problems.

**Keywords:** health, early retirement, hazard models.

**JEL codes:** J26, I10, C23, C41.

**Word count: 7055**

## 1. Introduction

Much of the Western world has concerns about the ageing of the population and the level of finance needed to support the elderly. Britain and Germany are no exception, and the problem in these countries is exacerbated by increasing early exit of older workers from the labour market. The policy debate has focused on direct changes to retirement ages and incentives designed to encourage greater pension saving. This debate has neglected the important role of the health as a primary determinant of whether or not older workers remain in the labour market.

Potential explanations for the trend towards a decreasing retirement age include more generous social security systems and increases in wealth compared with some decades ago. In addition more generous health and disability insurance systems reduce the adverse financial consequences for individuals in poor health who drop out of the labour market. The 'disability route' into retirement has been identified as an important phenomenon of the labour market in both countries (Riphahn, 1997; Blundell, Meghir and Smith, 2002).

Despite shared pressures there are differences between the two countries. Labour force participation of workers aged 55-64 is around 58% in Britain and only 43% in Germany. Of the economically inactive in this age group 13% describe themselves as retired in the UK and 14% as ill or disabled, whereas in Germany these figures are 29% and 4% respectively (Frerichs and Taylor, 2005). It is likely that these differences are a result of, *inter alia*, differences in the countries' pensions and benefits arrangements, rather than differences in health per se.

The primary motivation of this paper is to understand the effect of health on the decision of older workers to leave the labour market. While some evidence exists for Britain and Germany, there is no systematic comparative work to assess whether the impact of ill-health on early retirement varies between the countries and in particular whether it varies according to levels of social protection offered by the pension and transfer schemes.

We use comparable longitudinal data sets to estimate hazard models of the effect of health on early retirement. We condition on a broad set of socio-economic characteristics such as education, pension entitlement, housing tenure, and income; we also take account of spouse health and employment status. We make efforts to deal with the potential endogeneity of health, as well as the reporting bias that may result from our use of self-reported health measures. We also take care to ensure that our variables, and thus our results, are comparable across the two countries.

Another important issue is the fact that both health and income inequalities have been shown to be much greater in Britain than in Germany[1]. One of the main reasons seems to be the difference in the relative position of the retired, who, in Britain, are much more concentrated in the lower income groups. Hence, we also examine concentration curves for income related health inequalities and early retirement.

This analysis reveals that while the distribution of health shocks is more concentrated among those on low incomes in Britain, early retirement is more concentrated among those on high incomes. In contrast, in Germany, both health shocks and early retirement are more concentrated among those with low incomes. It seems that the income gradient in early retirement in Britain is offsetting the inequality in health shocks. The results from our models show that health is a key determinant of the retirement hazard for both men and women in Britain and Germany. The size of the health effect appears large compared to the other variables, and in particular in relation to the pension entitlement effects in both countries.

Designing financial incentives to encourage people to work for longer may not be sufficient as a policy tool if people are leaving the labour market involuntarily due to health problems. Indeed in this context even raising the statutory retirement age may have a lower effect than anticipated. Instead there is a need to improve the health of the work force and put resources into facilitating continued work for people with health problems and disabilities.

This paper is structured as follows. Section 2 outlines the background to our work, Section 3 explains our methods and Section 4 describes our data and variables. The results are presented in Section 5 and discussed in Sections 6. Section 7 concludes and considers the policy implications of our work.

## 2. Background

Individuals have preferences over current and future leisure which depend in part on current and expected health status (see for example Lazear, 1986, Disney et al., 2006). Poorer health may increase the disutility of work, reduce the return from work and entitle the individual to benefits that are contingent on not working. All of these factors will reduce the probability of continued work. However, poorer health may increase consumption requirements and therefore necessitate higher income; but if poorer health also reduces life expectancy then the annualised consumption available from existing wealth is raised, and this may still lead to earlier retirement.

Health effects operate within the pensions and benefits system, and there is an enormous literature on the importance of these financial incentives in determining retirement behaviour[2]. However, Lindeboom (2006)

[1] See various papers from the Ecuity projects at http://www2.eur.nl/bmg/ecuity/

[2] See Lumsdaine and Mitchell, 1999 for a review and French (2005) for an important recent contribution. Also see Borsch-Supan and Schabel (1997) for Germany and Blundell et al (2002) for the UK.

in a comprehensive review, argues that a number of studies have shown that health is the most important determinant of an older persons' labour supply. A survey for the UK Department for Work and Pensions (Humphrey et al 2003) found that 50% of people aged between 50 and 69 were not seeking work due to ill-health, and 20% had been forced to retire because of ill-health. For Germany, Siddiqui (1997a, 1997b) finds strong effects of health on retirement behaviour. Individuals reporting a chronic condition or a disability are four times more likely to leave employment than healthy individuals.

Our focus is on health but it is important to stress some of the key differences between Britain and Germany in relation to pensions and benefits. In both countries disability benefits are available before statutory retirement age. In Germany, the rate depends on the extent of disability and an earnings test. Eligibility tends to have been interpreted generously and has been used as a device to keep unemployment rates down. In Britain, Incapacity Benefit (IB) is available to those unable to work because of ill-health or disability; it is paid at one of three rates, depending on the length of time the individual has been unable to work. IB replaced Invalidity Benefit in 1995, accompanied by stricter eligibility criteria, in response to a rapid growth in the number of recipients. These changes reduced economic incentives to retire via the 'disability route' and in principle strengthened the link between true work-related disability and inactivity. However, Berthoud (2004) and Peasgood et al (2006) find that after controlling for health, the probability of leaving IB declines with age and the majority of economically inactive people aged 50 to 65 are in receipt of IB.

In general, except in the case of very low earners, Germany has a more generous pension system than Britain. At almost all earnings levels the net replacement rate (NRR) is much higher in Germany[3]. For example, at average earnings, the NRR is 72% in Germany and only 48% in Britain (OECD, 2005)[4]. While private pensions in Britain compensate to some extent, these are only held by 25% of men in our sample and 12% of women. This two tier pension system contributes to inequality, compared to the more homogenous pension benefits available in Germany. In Britain around 33% of pensioners claim means tested benefits whereas in Germany it is less than 5% (Oswald, 1999; p10). However, inequality and poverty among older people in Germany are expected to increase as a result of pressures on the pension system (Nagaele and Walker, 2002). Work from the ECuity projects has shown that older people are among the poorest and least healthy in most European countries, so as populations age the potential for increased inequality is clear.

There is also a weight of evidence supporting the importance of the joint determination of the retirement decision of husbands and wives[5] (see for example Michaud, 2003; Gustman and Steinmeier, 2000; Jimenez-Martin et al 1999; Blau and Riphahn, 1999). The effect of the health status of both partners on each others

[3]The NRR is a measure of individual pension earnings divided by pre-retirement earnings, taking into account personal income taxes and social security contributions.
[4] The average OECD NRR at average earnings is 69% (OECD, 2005).
[5] The use of the terms husband and wife does not imply anything about the legal status of the relationship and is also applied here to people living as couples who are not legally married.

retirement decision has been largely neglected. This is an important omission because, for example, early retirement can be caused by the necessity to provide care for a dependent spouse.

## 3. Methods

Estimating the effect of health on early retirement is not straightforward, especially using the subjective measures of health that are generally available in longitudinal data sets. First, there may be simultaneity between self-assessed health (SAH) and labour market status. Secondly, SAH is based on subjective judgements which may not be comparable across individuals (Lindeboom and van Doorslaer 2004). Thirdly, since ill-health may represent a legitimate reason to be economically inactive, respondents who are not working may cite health problems as a way to rationalize behaviour (Kerkhofs and Lindeboom 1995; Kreider, 1999). Fourthly, individuals for whom the financial rewards of continuing in the labour force are low, have an incentive to report ill-health as means of obtaining disability benefits. While measurement error will lead to downward bias in the estimate of the effects of health on labour market status, the other effects will lead to upward bias (Bound 1991). The common assumption in the literature seems to be that the latter outweighs the former but Bound *et al.* (1995) point out that the empirical evidence is mixed.

We employ a method first used by Stern (1989) and Bound (1991), which was implemented in Bound *et al.*, (1999) and subsequently adopted by Au *et al.*, (2005) and Disney *et al.*, (2006). In common with many studies of health and socio-economic status, the SAH measure used in our models provides an ordinal ranking of perceived health status. For example, the data for Britain is derived from the question: " …would you say that your health has on the whole been excellent/good/fair/poor/very poor?". The method involves estimating a model of this ordinal SAH variable as a function of a set of health indicators (see Data section) to define a latent 'health stock' variable. This predicted health variable is then used as an indicator of health in the model of retirement. Adopting this instrumental variable-type procedure where a proxy with error is used to instrument an endogenous and error-ridden variable is a standard way of dealing empirically with errors-in-variables (see also, Griliches, 1974 and Fuller, 1987). To investigate the robustness of our results we use alternative measures of health; for Germany we use SAH directly, and for Britain we use a measure of health limitations, which is arguably less prone to reporting bias than SAH.

We use the duration model approach of Jenkins (1995) to estimate the effect of health on the probability of early retirement. The transition to retirement is represented as a discrete time hazard model. This method relies on a reorganisation of the data so that the unit of analysis is changed from the *individual* to the *time at risk of an event* (in this case retirement), thus allowing a complex sequence likelihood to be simplified to standard estimation for a binary outcome. The approach also controls for the stock sampling of only those people who are in the labour market at the first time we observe them. These individuals can then either stay

in the labour force or exit into retirement. The assumption here is of a single exit (retirement) from the initial state, modelled as a binary response (probit).

We specify a complementary log-log hazard rate, the discrete-time counterpart of the hazard for an underlying continuous-time proportional hazards model (Prentice and Gloeckler, 1978). The baseline hazard is modelled as a step function, using dummy variables to represent the age our stock sample of individuals is at risk. This non-parametric form leads to a semi-parametric specification of the discrete-time duration model. The model can be generalised to account for unobserved heterogeneity uncorrelated with the explanatory variables (Narendrenathan and Stewart, 1993). All estimation is carried out in STATA using the *pgmhaz* routine (Jenkins, 1997).

Of further relevance is whether a change in labour market status is best identified by a health shock or by, for example, a slow deterioration in health[6]. Modelling health shocks is a convenient way to eliminate one source of potential endogeneity bias caused through correlation between individual-specific unobserved factors and health because differencing the data over consecutive time periods eliminates unobserved individual effects.

We include a measure of lagged health together with initial period health in our models. By conditioning on initial period health the coefficient on lagged health represents the effect of a health shock. It also seems plausible that lagged health may be more informative about the decision to retire because transitions take time. This also reduces fears of endogeneity bias, exploiting the timing of events by observing the effect of health shocks prior to the time of retirement (for example, see Abring and van den Berg, 2003).

Attrition is generally a problem with longitudinal data and this may be health-related[7], or be related to labour market status (for example, see Zabel (1998) and Ziliak and Kniesner (1998)). A systematic relationship between health and labour market participation and attrition will lead to bias in our empirical models. To test for such bias we use a simple variable addition test as proposed by Verbeek and Nijman (1992, p. 688). The test variable we use is an indicator for whether the individual responds in the subsequent wave. This is regressed, together with the set of conditioning variables, on the retirement indicator using the discrete-time duration framework. A test of the significance on the corresponding parameter estimate provides a test for attrition bias[8].

[6] We use the term health shock, as it has been traditionally used in the literature, to mean deterioration in health over a set time period (usually one or two years in our analysis).
[7] See Contoyannis, Jones, and Rice (2004) and Jones, Koolman, and Rice, N. (2006) for a discussion of health-related attrition and the consequences for models of the determinants of health using the BHPS.
[8] It should be noted that the test has low power and is not intended to correct for any observed attrition bias (Verbeek, 2000).

As well as duration models for retirement, we also examine concentration curves (CCs) for income related health inequalities and early retirement. This takes the sample of older workers who are 'at risk' of early retirement and looks at the incidence of subsequent health shocks that may be associated with subsequent early retirement. The CCs provide measures of relative income-related health inequality (Wagstaff, Van Doorslaer and Paci, 1989). These measures capture the socioeconomic dimension of health inequalities, use information from the whole of the distribution rather than just the extremes and give the possibility of visual representation.

## 4. Data and Variables

Three main data sources are used in this study. The first two are nationally representative longitudinal surveys for Britain and Germany that include a rich set of socio-economic variables. In the German Socio-economic Panel (GSOEP) the same private households have been surveyed annually since 1984, when 5,921 households containing 12,290 respondents participated in the 'SOEP West' survey. This was expanded in 1990 to include the former German Democratic Republic, and this 'SOEP East' sample included 2,179 households with 4,453 respondents. The British Household Panel Survey (BHPS) started later in 1991. The first wave achieved a sample of around 5,500 households, covering approximately 10,300 adults. Additional samples of 1,500 households for Scotland and Wales were added in 1999, and 2,000 in Northern Ireland in 2001.

While the BHPS and GSOEP are generally thought to be equivalent types of data they do not have cross-national comparability as a survey goal. We supplement the individual country surveys with information from the Cross National Equivalent File (CNEF). This is the result of collaboration between researchers working with longitudinal data from individual countries[9]; the aim of which is to produce compatible data sets for use in cross-national research. The CNEF unites comparably defined variables from the BHPS and the GSOEP that can be used independently or in tandem with the original survey data. In addition, it provides a set of constructed variables that are not immediately available in the original data (for example 'pre- and post-government' household income[10]). Distributions of key variables were produced to check for data quality and compatibility between the three data sets.

We consider the same time period for Britain and Germany, from 1991 to 2002. The econometric analysis uses a stock sample, which consists of those individuals who were aged 50 or over and had a full interview and were in the labour force (employed or self-employed) in wave 1 of the survey. For Britain we start with 641 men and 494 women, and for Germany 790 and 396. The samples are reduced over time by attrition, which largely arises through refusal, non-contact and because people become ineligible to participate. For

[9] The US, Germany, Britain, Canada and Australia provide longitudinal data for the CNEF.
[10] Pre- (post-) government income is household income before (after) taxes and transfers.

both the BHPS and the GSOEP we start with just over 1100 people and this is reduced by over one third by the end of the period. At this time almost half of the original sample is retired.

All variable codes and definitions are summarised in the Appendix. The dependent variable is retirement status and in line with previous work, the definition of retirement is self-reported[11]. We model the first transition out of labour market activity[12]; it is a dichotomous variable that takes a value 1 if the individual is retired and 0 otherwise.

The key explanatory variable is health status and this is constructed using the general SAH question from the BHPS and the GSOEP[13]. For the BHPS the standard question is 'over the last 12 months, compared to people of your own age, would you say your health on the whole has been: excellent, good, fair, poor, very poor'. For the GSOEP the question is 'how would describe your current state of health: very good, good, satisfactory, poor, bad.' Unfortunately, as is often the case in longitudinal studies, there are some inconsistencies in these questions over time in both countries[14]. This leads us to construct a 4-point SAH classification for each wave, as shown below:

| **SAH_4** | **BHPS** | **GSOEP** |
|---|---|---|
| **1** Poor health | very poor & poor | bad & poor |
| **2** Fair health | fair | satisfactory |
| **3** Good health | good | Good |
| **4** Excellent health | excellent | very good |

This SAH variable is used to create a latent health stock variable as described in the Methods section, for use in our duration models of early retirement. For the UK we estimate health stock by regressing SAH (via an ordered probit model) on a set of 'specific health problems'. Here the respondent is asked whether or not they have any of the problems listed: arms, legs or hands, sight, hearing, skin conditions or allergies, chest/breathing, heart/blood pressure, stomach or digestion, diabetes, anxiety or depression, alcohol or

[11] As has already been noted in the literature (e.g. Bardasi et al 2002; Disney et al 1994) retirement is not a well-defined state. We have cross checked self-reported retirement status data with income source data (for Britain) and time use data (for Germany) in order to assess its reliability. While certainly not perfect as an indicator of retired status, the self-reported measure is suitable for our analysis.

[12] Of those people aged over 50 and retired in any one wave, a small proportion are participating in the labour market again in subsequent waves. Subsequent transitions could be analysed but, due to the small sample sizes, we have chosen not to pursue this.

[13] We rejected the CNEF health variable on the grounds of poor comparability across the two countries.

[14] In the BHPS there is a change in wording for wave 9 only to '*In general would you say your health is: excellent, very good, good, fair, poor*.' To achieve consistency over all waves we base our 4-point reclassification on the analysis in Hernandez-Quevedo, Jones and Rice (2005). In the GSOEP the question was not asked in 1991 or 1993; in these years the 11 point 'satisfaction with health' question was available, so the distributions for these variables were matched to our constructed 4 point scale in 1992 and 1994 in order to create data for the missing years. In addition the 5 point scale health question was not asked in 1991 for East Germany so the 1990 values are used in its place.

drugs, epilepsy, migraine or other. For Germany, fewer health indicators are available thus the constructed health stock measure is obtained by regressing SAH on all available socioeconomic variables (except labour market status), formal disability rating and satisfaction with health[15]. The estimated latent health stock is then used as an indicator of health in the model of retirement[16].

In addition to the models using latent health stock for both countries, alternative health measures have been examined. For the UK, we use self-reported functional limitations, based on the question "does your health in any way limit your daily activities compared to most people of your age?"[17], which is arguably less prone to reporting bias than the general SAH question. For Germany, an alternative health measure is not available so the original ordinal SAH scale is used directly in estimating the retirement hazard rates.

As well as individual's own health, the models for the UK include spousal health defined as either the latent health stock index or functional limitations. The models for Germany include either spousal SAH or the latent health stock index. Both models also include a dummy for whether or not the spouse is employed.

Education is classified as a series of binary dummies. In Germany, the distinction is made between individuals who have received only mandatory schooling (the reference group) and those with higher levels of education. For Britain, the reference group are people with no formal qualifications, and dummy variables are defined for O-levels and CSEs, HND and A-level and higher education and beyond.

For the BHPS we distinguish three categories of pension: state pension only (base), private and employer pension. It is expected that the latter category results in the most generous retirement income and reliance on a state pension is likely to result in the lowest post-retirement income. In the models for Britain we also include dummy variables for employment sector and occupational classification which act partly as proxies for pension benefits: industrial sectors are private companies, civil service and local government, and other the baseline is self-employment. Occupational categories are management and administration, professional, clerical and secretarial, craft or related, personal services, sales, plant operative and other occupations. For the GSOEP there is less heterogeneity in pension coverage and the important distinction is between Class 1 civil servants and everyone else, since the civil service pension has more generous benefits. The German models also include dummies for industrial sector (agriculture, energy, manufacturing, construction, trade, transport, banking and services, and the baseline, mining).

The housing tenure variable is used to proxy for wealth and social class. For the BHPS we define four binary dummies: own house outright (base), own with a mortgage, live in private rented accommodation, live in

[15] Formal disability rating is an official registration made by the German Pension Office which classifies the degree of disability on a continuous scale. Health satisfaction is an 11 point scale ranging from "not at all satisfied" to "completely satisfied" with own health.
[16] In the interests of concise exposition the results of the ordered probit models used to estimate latent health stock are not reported here.
[17] This question is not asked in wave 9. In our analysis we assume wave 8 values hold in wave 9.

housing association or local authority rented accommodation. For the GSOEP we have two binary dummies: owner occupier and those who live in subsidised housing.

For Britain, the income variable is the individual specific mean of log equivalised household income across all waves prior to retirement. We use only pre-retirement waves in order to minimise endogeneity problems (as income will normally change significantly at retirement). For Germany the equivalent variable is the mean of the log of household post-government income.

We distinguish those people who are married or living as a couple from those who are single, widowed or divorced. Dummies are included for each age prior to statutory retirement age (65 for men and 60 for women). Regional dummies are used to control for local labour market conditions. There are 18 regions defined for the UK and dummies for the North and South of Germany; the estimated coefficients are not reported. In Germany there are also variables that denote a person originally being from East Germany and that the individual does not have German citizenship.

## 5. Results

The descriptive statistics in Table 1 show key measures for the two countries disaggregated by gender and by pre- and post-retirement. Overall for both countries just over one-third of the sample retires during the time period under observation. The health profiles are similar, although a larger proportion of the German sample report health in the 'excellent' category, with slightly less in 'very good or good'. For both countries, the post-retirement sample exhibits worse health. In Britain substantially more men than women have a private or employer pension. Around 25% of men and 50% of women have only a state pension. In Germany around 10% of men and 2% of women have the more generous Class 1 civil servants pension entitlement.

Figures 1 and 2 display Kaplan-Meier estimates of the probability of survival (not retiring) by SAH status separately for (a) men and (b) women in both countries. For men in the UK there seems to be a clear relationship with the probability of retiring (at all ages) increasing with worsening SAH. For UK women the relationship is not clear. In Germany, while both men and women with the lowest SAH status have the greatest probability of retirement at all ages there is no clear gradient for the other health levels. Kaplan-Meier curves for the alternative health measure (the dichotomous health limitations variable)) which are not reported here, show a very a clear relationship for both sexes for both countries, in that people who report health limitations have a greater propensity to retire at all ages than those who do not report health limitations. Thus this simple bivariate analysis suggests that health (especially classified as health limitations) is important the timing of retirement.

Before the econometric modelling it is useful to consider the extent of income related health and early retirement inequality in Britain and Germany. We use balanced samples for the concentration curve (CC)

analysis, based on our stock samples in wave 1. Individuals are ranked by socioeconomic status using equivalised household income in wave 1 ($R_i$)[18]. The analysis then proceeds in two stages. The first stage considers whether there is inequality in health shocks by initial socio-economic status. The relative income rank is plotted against the cumulative proportion of health shocks; health is measured using the original 5-point SAH scales present in the country specific data (see Data section) and a health shock ($H_i$) is defined as a 2-point deterioration on this scale[19]. The 45-degree line shows the line of perfect equality, where population shares of health shocks are proportional to income. There is said to be pro-poor inequality if the CC lies above the 45 degree line and pro-rich inequality when the curve lies below the line. The size of inequality can be summarised by the concentration index (CI), which is twice the area between the CC and the 45-degree line.

In the second stage, we consider whether there is inequality in health-related early retirement by initial socioeconomic status. Individuals are again ranked by equivalised household income in wave 1. We then combine the health shock indicators with an indicator of early retirement ($RET_i$ ) i.e. whether or not the individual retired before the prescribed state pension age. Combining the health shock ($H_i$) and early retirement ($RET_i$) variables we define the variable $HRET_i$ which equals 1 if a person suffers a health shock and retires early. Otherwise, this variable takes the value of 0. While this analysis does not imply causality, combined with our econometric analysis, it can help us to understand the relative position of older workers in relation to health related retirement.

In the balanced sample for Britain there are a total of 569 individuals (307 men and 262 women); of these, 11% of men and 7% of women experience a 2-point deterioration in SAH at some point between wave 1 and wave 12. 39% of men and 19% of women retire early; and 6% of men and 2% of women both retire early and suffer a health deterioration[20]. The balanced sample from Germany contains 567 men and 336 women. 9% of men and 7% of women suffer a 2-point deterioration in SAH. Early retirement is observed much more frequently in Germany than in Britain. More than two thirds of individuals in Germany retire before the prescribed state retirement age. 6% of men and 6% of women both retire early and experience a health deterioration.

The CCs for income related health shocks ($H_i$) are shown in Figure 3. For both countries pro-poor inequality is indicated by the fact the CC is predominantly above the diagonal, suggesting that the poorest experience a disproportionate share of the health deteriorations. The degree of inequality is greater for Germany than for

[18] Household income consists of labour and non-labour equivalised real income, adjusted using the Retail Price Index and equivalised by the McClement's scale to adjust for household size and composition.

[19] As a robustness check, we also defined a health shock in terms of the acquisition of a health limitation for the UK. These results are not reported but are very similar to those for 2-point SAH changes.

[20] Defining a health shock as a 1-point deterioration on the 5-point scale, instead of 2-points, results in larger sample sizes but does not substantively change the results of the inequality analysis.

Britain (CI 0.105 vs. -0.042). For both countries the CC does drop below the diagonal especially near the left-hand side. This suggests that at the very lowest end of the income rankings this group tend to experience a less than proportionate number of health shocks. This may be the result of our sample selection in which all respondents are working in wave 1.

The CCs for early retirement ($RET_i$) are quite different between the two countries as shown in Figure 4. In the UK the CC is predominantly below the diagonal indicating that early retirements are concentrated among the richest members of our sample. The CI reflects this with a value of 0.115. The opposite is found in Germany with the CC being wholly above the diagonal and with a CI of -0.059. The absolute level of inequality in early retirement is greater in the UK than Germany.

Combining early retirement and health shocks ($HRET_i$), Figure 5 shows that for Britain we observe pro-rich inequality (CI = 0.088); while for Germany the opposite is true (CI = -0.102). For both the UK and Germany health deteriorations are concentrated among the poorest sample members. The pro-rich inequality in early retirement and early retirement with a health shock in the United Kingdom indicates that moving into retirement before the state retirement age more commonly occurs amongst those with greater levels of household income. The reverse is true in Germany where there is pro-poor early retirement and early retirement with a health shock.

Results for the hazard models of retirement for Britain are reported in Tables 2a and 2b. These models are estimated allowing for unobserved heterogeneity[21]. The first set of columns presents results for health limitations and the second, for our predicted latent general health stock measure. Models for men and women largely show the expected gradient over age categories, with the hazard of retirement increases rapidly as statutory retirement age approaches. Of the income and wealth variables only log household income (prior to the retirement year) appears to have a significant effect. The hazard of early retirement increases with household income, for men this is true regardless of which health measure we use, whereas for women the income variable is only significant for health limitations and not for the continuous latent health measure. The education and occupation variables are largely insignificant for men and women, although for men having higher education seems to decrease the probability of early retirement if we measure health using the health limitation dummy.

For men, the employment sector variables are positive and contrast against a baseline of self-employment. Accordingly, the hazard of early retirement is greater for employees compared to the self-employed. The largest effect is observed for civil and local government, followed by the private sector and those employed

[21] The model incorporates a gamma mixture distribution to summarize unobserved individual heterogeneity, as proposed by Meyer (1990). For women the null hypothesis of no heterogeneity is not rejected but the results are very similar whether or not we allow for these effects.

in other sectors. The effects are reversed for women where the hazard is greater for the self-employed, however the effects are only statistically significant for the health limitations measure.

We also observe an effect of pension entitlements. These variables represent whether an individual has made a contribution into a private pension plan during the observation period and/or been a member of an employer's pension scheme. Compared to the baseline of a state-only pension, having a private pension is associated with around a 60% decrease in the hazard of retiring for men (75% for women). In contrast, having an employer pension increases the hazard of retiring for men and women, but this is not significant. For men if the spouse has a job the hazard of retirement is decreased by around 50% but this variable is not statistically significant for women. Marital status is not significant for either sex.

Our primary focus is the role of health. The health variables are lagged one period to avoid problems of simultaneity. We also condition on the first period health status so that the estimated effect of lagged health can be interpreted as a health shock. Further we consider the health of a respondent's spouse or partner. For men we observe a large, positive and highly significant effect for health limitations. This implies that the hazard of retiring is greater for individuals experiencing a shock to health that leads to a health limitation. For our constructed measure of underlying latent health (which is increasing in health) we observe a negative and significant coefficient implying that the retirement hazard increases as health decreases. For both models, while we observe the expected signs, the estimated coefficients on spousal health are not significant. Results for the health variables for women are similar to men and quantitatively the hazard ratios are of similar size. Again, the effect of spousal health is not significant.

The health effects are quantitatively important when compared to the pension effects. For example, having a health limitation increases a man's chances of retiring early by 460%. In comparison, a private pension decreases his chances by 60% and working in the civil service or local government increases his chances by 850%. Clearly, the civil service/local government dummy is partly reflecting the effect of pension entitlement and early retirement options in this sector, which are not encapsulated by our relatively blunt pension entitlement dummy variables.

The hazard model results for Germany are shown in Tables 3a and 3b[22]. The first set of columns presents the results for models where SAH was used directly. The second set of columns presents the estimates obtained using the predicted latent health stock. Models for men and women show the expected gradient over age categories. No significant effect of higher educational attainment is found. For men, the industry sector of employment has some significant impacts on the early retirement hazard. Compared to the reference sector, mining, the hazard of retiring early is significantly lower for men working in the trade or

[22] Models for women are estimated allowing for unobserved heterogeneity but those for men are not since the null hypothesis of no heterogeneity was not rejected and the results were unstable when heterogeneity was allowed for.

services sector. No significant effect of industrial sector is found for women. Working in the civil service does not have a significant on the retirement hazard despite the generous pension entitlements and early retirement incentives available in this sector.

Being of foreign origin has a negative effect on the retirement hazard which is statistically significant for men. Household income has a significant negative impact on the hazard of retirement for men, but it is not significant for women. None of the other wealth proxies are significant.

The estimates for SAH are negative and statistically significant for all cases except excellent health for women. For the constructed measure of underlying latent health we observe a negative and statistically significant coefficient for men and women. No statistically significant effects are observed for spouse health or spouse employment status. Having a spouse increases the retirement hazard for men and lowers it for women but the effects are statistically significant only in the latter group.

Table 4 reports the results of the Verbeek and Nijman (1992) tests for attrition bias. For the BHPS models the 'next wave' variable is not statistically significant and we find no evidence of attrition bias. The same is true for the GSOEP models for women. For the GSOEP models for men there is evidence that sample attrition is related to retirement behaviour. However, inclusion of the 'next wave' variable results in little change to the coefficients on the conditioning set of variables, indicating that although attrition is related to retirement, its effect is likely to be negligible.

## 6. Discussion

The most striking result from the above models is that, regardless of the way we measure own health, it is found to be a key determinant of the retirement hazard for both men and women in Britain and Germany. The size of the health effect is large compared to the other variables, and in particular compared to the effects of pension entitlement in both countries. Indeed for the German models, despite the renowned generosity of the civil service pension, this variable is not statistically significant.

In most cases the baseline health measure is not significant but the lag is, suggesting that it is health shocks that are important rather than continual poor health. A 1 unit decrease in latent health is estimated to increase men's hazard of retirement by around 50% in Britain and around 20% in Germany, for women these figures are 55% and 45% respectively. The larger estimated effect of health in Britain may reflect increased incentives to utilise the disability route into retirement and this in turn may be due to an increased reliance on private sector pensions where people cannot access sufficient pension benefits before statutory retirement age and thus rely on other sources of income including disability insurance. However, it may also reflect the fact that it is easier for older workers with health problems to continue working in Germany. In

2002, Germany spent 0.3% of GDP on labour market programmes for people with disabilities compared to only 0.02% in the UK (Frerichs and Taylor, 2005).

While the alternative health measures cannot be compared directly, they do confirm the relatively large effects of health and the fact that the effects are larger in Britain. In Britain acquiring a health limitation increases the hazard of retirement by a factor of 4.6 for men and 4.1 for women. In Germany, for men if health changes from fair to poor the hazard of retirement increases by around 35%, deterioration from good to poor would increase the probability by around 45%, and from excellent to poor by around 50%.

The variables used to represent pension systems appear to have a greater effect on the hazard to retirement in Britain than in Germany. Our models do not contain detailed information on pensions and this is common in the literature that focuses on health effects, since detailed health and pension information is rarely available in the same data sets. A recent Department of Work and Pensions survey found that people had a very low level of knowledge about their pensions, which may cast doubt on the need for detailed pension information for our modelling objectives (Humphrey et al., 2003). Our main finding is that for both men and women in Britain the probability of retirement is reduced for people with a private pension. This result may be explained by the fact this group of older workers may have acquired private pensions at a relatively late stage in their working life in order to top up the state pension which they realised would be inadequate. Consequently as the benefits of private pensions are heavily dependent on the length of contribution period they encourage longer working lives for this group (Meghir and Whitehouse, 1997). It is also the case that to a certain extent our employment sector variables will reflect pension benefits and early retirement arrangements. So that the large positive effect of the civil service/local government variable for men in Britain is explained by arrangements in that sector that are conducive to early retirement; these may reflect pension entitlements and specific early retirement schemes such as those available to teachers. It is more difficult to explain the statistical insignificance of the civil service pension variable in Germany, however this is a small group (roughly 4% of the sample) and also the effects of the generous pension might be offset by better working conditions, and thus less disutility from work.

These results should be interpreted in the light of the inequality analysis presented above, which showed that while the distribution of health shocks is pro-poor in the UK (i.e. health shocks are more concentrated amongst those at the lower end of the income distributions) early retirement is pro-rich, in contrast to Germany where both health shocks and early retirement are concentrated among those on low incomes. For Britain, the income gradient in early retirement is offsetting the inequality in health shocks so that even though poorer individuals are more likely to have health shocks the combination of health shocks and retirement is 'pro-rich'. The income gradient may arise from the fact that the UK pension system is more reliant on private pension provision that Germany, and these benefits are heavily dependent on length of service and thus may deter people from retiring early. Only those who are financially well-off can afford to

retire early. This is also supported by the significant positive effect of household income prior to retirement and the negative effect of private pensions. Only the financially well-off will be able to afford early retirement. The negative effect for higher education for men in the UK is somewhat counter intuitive to this as we would expect this to be positively correlated with income. However, it may reflect the fact that people with higher education are in jobs that they are less likely to want to retire from and it is consistent with the predictions of human capital theory that more highly qualified people remain longer in the labour market to extend the payback period on their investment.

For Germany the effect of household income (prior to retirement) in the econometric models is negative (and significant for males) confirming the results of the inequality analysis; those with higher incomes are less likely to retire early after controlling for health status and other characteristics.

## 7. Conclusion and policy recommendations

Germany and the UK share concerns about the sustainability of the public pension system and potential labour shortages arising from the ageing of the population. Debates have centred on encouraging people to work for longer but this has neglected the important role of the health of older workers as a primary determinant of whether or not they remain in the labour market.

Our findings suggest confirm that health is an important determinant of the decision to retire in the UK and Germany. This is the case for both men and women and is observed for both latent health status and alternative health measures. The effects of spouse's health do not appear to be important but there is some evidence of an effect from having a working spouse.

The trend towards increasing early retirement has obvious fiscal implications as increasing numbers of older people become dependent on a shrinking working population. It can also be considered a waste of human capital if people with education and skills are leaving the labour force prematurely. Designing financial incentives to encourage people to work for longer may not be sufficient as a policy tool if people are leaving the labour market involuntarily due to health problems. Indeed, in this context, even raising the statutory retirement effect may have no effect if poor health is the underlying reason for inactivity.

Instead there is a need to improve the health of the workforce and to devote resources to facilitating continued work for people with health problems. More has been done in this regard in Germany than the UK, although it has not targeted older workers particularly (see Frerichs and Taylor, 2005). Optimism may come from early evaluation of the UK Pathways to Work scheme for people on IB, which suggests that this has been more effective with older claimants than younger ones (Adam et al, 2006). However, this programme only targets people who have already left the labour force whereas it may be more effective to design policy that helps older workers to remain economically active. Once individuals leave the labour

market their skills start to deteriorate so it is better to keep them in, by say allowing more flexible working arrangements to cope with health problems.

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***Table 1: Descriptive Statistics***

| | **BHPS** | | | | | | | **GSOEP** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Men | | | Women | | | | Men | | | Women | | |
| | All | Pre - Retirement | Post - Retirement | All | Pre – Retirement | Post - Retirement | | All | Pre - Retirement | Post - Retirement | All | Pre – Retirement | Post - Retirement |
| Retired | 0.324 | | | 0.365 | | | | 0.369 | | | 0.378 | | |
| *Own Health* | | | | | | | | | | | | | |
| Excellent SAH | 0.238 | 0.257 | 0.197 | 0.209 | 0.241 | 0.153 | | 0.315 | 0.339 | 0.275 | 0.347 | 0.382 | 0.289 |
| Good SAH | 0.486 | 0.485 | 0.488 | 0.521 | 0.514 | 0.535 | | 0.364 | 0.312 | 0.452 | 0.378 | 0.341 | 0.441 |
| Fair SAH | 0.213 | 0.2 | 0.24 | 0.209 | 0.193 | 0.238 | | 0.285 | 0.306 | 0.249 | 0.248 | 0.252 | 0.241 |
| Poor SAH | 0.064 | 0.058 | 0.075 | 0.061 | 0.053 | 0.075 | | 0.035 | 0.041 | 0.023 | 0.027 | 0.025 | 0.029 |
| | | | | | | | | | | | | | |
| *Spousal Health* | | | | | | | | | | | | | |
| Excellent SAH | 0.156 | 0.171 | 0.126 | 0.157 | 0.183 | 0.113 | | 0.352 | 0.371 | 0.32 | 0.368 | 0.397 | 0.309 |
| Good SAH | 0.431 | 0.437 | 0.419 | 0.338 | 0.356 | 0.307 | | 0.356 | 0.328 | 0.406 | 0.332 | 0.295 | 0.406 |
| Fair SAH | 0.191 | 0.192 | 0.191 | 0.171 | 0.161 | 0.187 | | 0.242 | 0.251 | 0.228 | 0.252 | 0.259 | 0.238 |
| Poor SAH | 0.085 | 0.084 | 0.088 | 0.062 | 0.059 | 0.068 | | 0.026 | 0.028 | 0.022 | 0.024 | 0.025 | 0.023 |
| | | | | | | | | | | | | | |
| *Covariates* | | | | | | | | | | | | | |
| Age | 61.8 | 59.5 | 66.6 | 61 | 58.7 | 64.9 | | 60 | 57.3 | 64.5 | 59.8 | 57.1 | 64.4 |
| Married or couple | 0.867 | 0.886 | 0.827 | 0.744 | 0.774 | 0.691 | | 0.876 | 0.877 | 0.875 | 0.743 | 0.791 | 0.662 |
| Spouse has job | 0.413 | 0.528 | 0.174 | 0.369 | 0.493 | 0.153 | | 0.419 | 0.491 | 0.296 | 0.56 | 0.629 | 0.445 |
| High education | 0.084 | 0.087 | 0.078 | 0.061 | 0.064 | 0.057 | | 0.176 | 0.185 | 0.162 | 0.093 | 0.087 | 0.103 |
| Medium education | 0.18 | 0.188 | 0.164 | 0.113 | 0.114 | 0.11 | | 0.519 | 0.497 | 0.554 | 0.394 | 0.408 | 0.371 |
| Low education | 0.736 | 0.725 | 0.758 | 0.826 | 0.822 | 0.833 | | 0.292 | 0.311 | 0.16 | 0.498 | 0.494 | 0.504 |
| Own house outright | 0.522 | 0.421 | 0.732 | 0.563 | 0.484 | 0.699 | | | | | | | |
| Own house with mortgage | 0.32 | 0.415 | 0.122 | 0.247 | 0.322 | 0.116 | | | | | | | |
| Private rented accommodation | 0.046 | 0.054 | 0.027 | 0.044 | 0.055 | 0.024 | | | | | | | |
| Local auth housing | 0.112 | 0.109 | 0.118 | 0.147 | 0.139 | 0.16 | | | | | | | |
| Owner occupier | | | | | | | | 0.472 | 0.447 | 0.514 | 0.436 | 0.426 | 0.453 |
| Subsidised housing | | | | | | | | 0.92 | 0.095 | 0.086 | 0.089 | 0.085 | 0.097 |
| Employer pension | 0.539 | 0.527 | 0.563 | 0.372 | 0.38 | 0.359 | | | | | | | |
| Private pension | 0.402 | 0.454 | 0.274 | 0.224 | 0.266 | 0.142 | | | | | | | |
| State pension | 0.249 | 0.232 | 0.287 | 0.594 | 0.484 | 0.541 | | | | | | | |
| Civil servant | | | | | | | | | 0.095 | | | 0.024 | |

**Figure 1a: Kaplan Meier Survival Curves for the BHPS – Men**

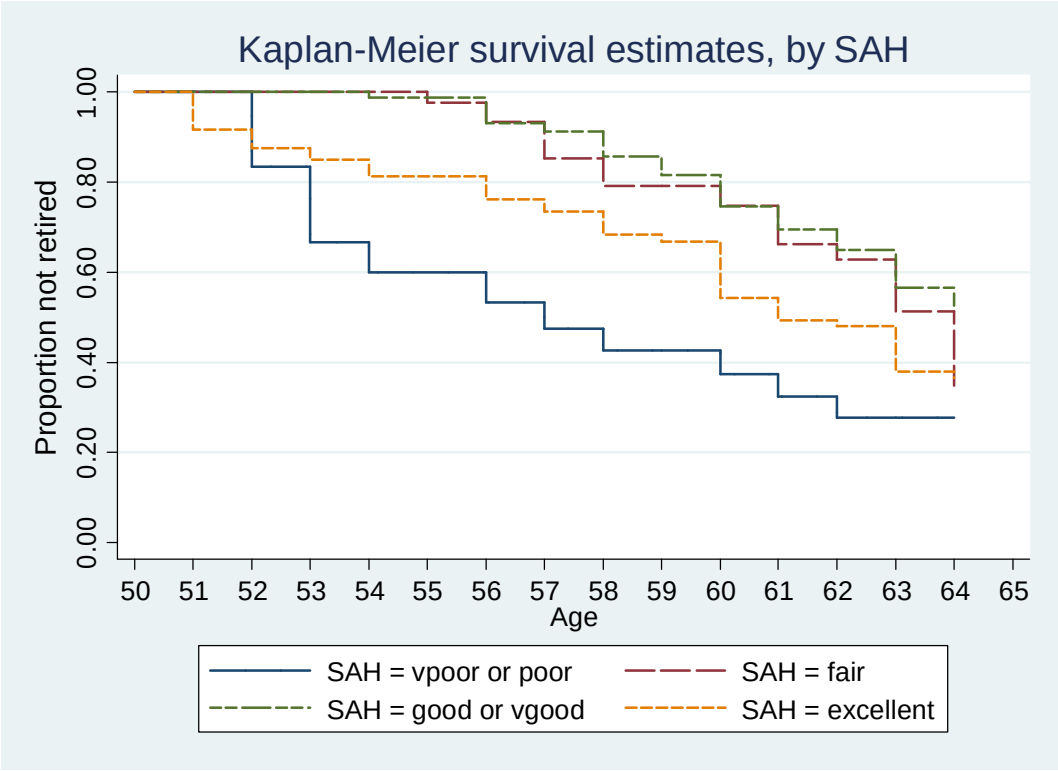



**Figure 1b: Kaplan Meier Survival Curves for the BHPS – Women**

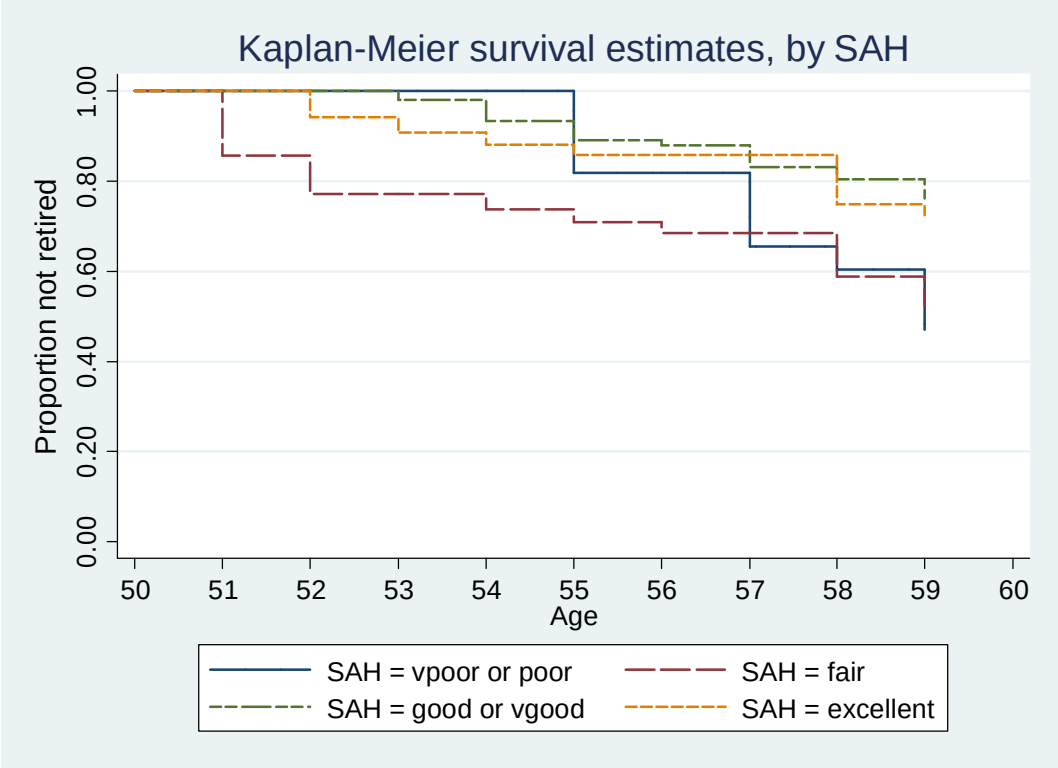


**Figure 2a: Kaplan Meier Survival Curves for the GSOEP – Men**

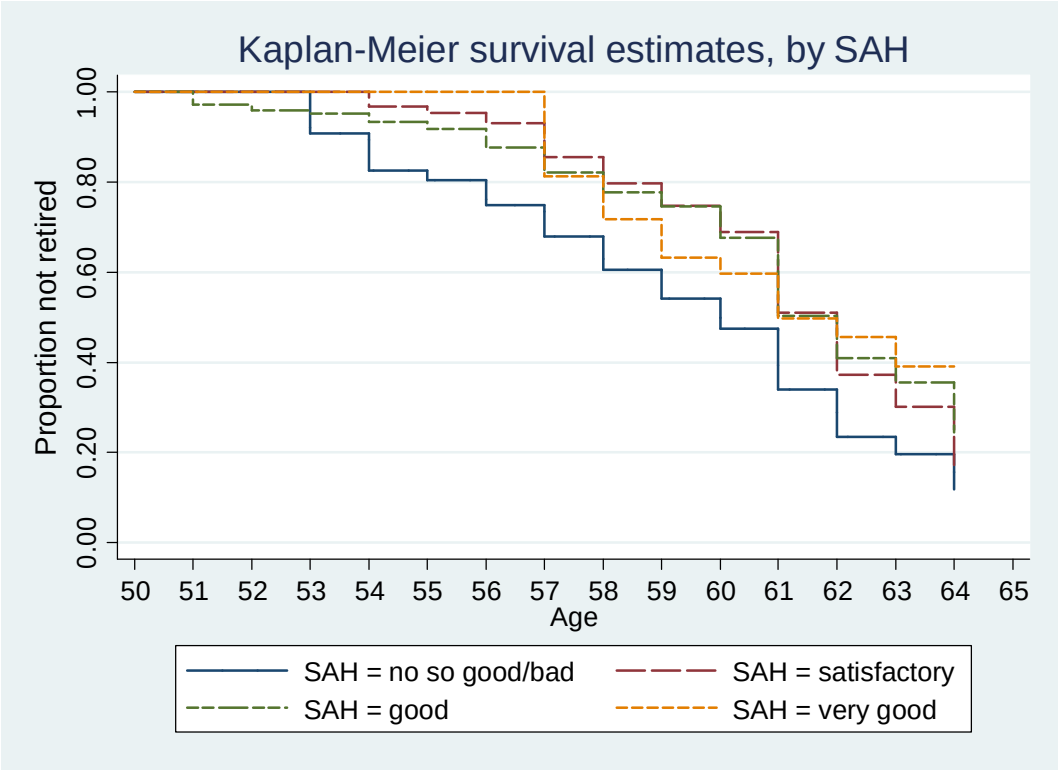



**Figure 2b: Kaplan Meier Survival Curves for the GSOEP – Women**

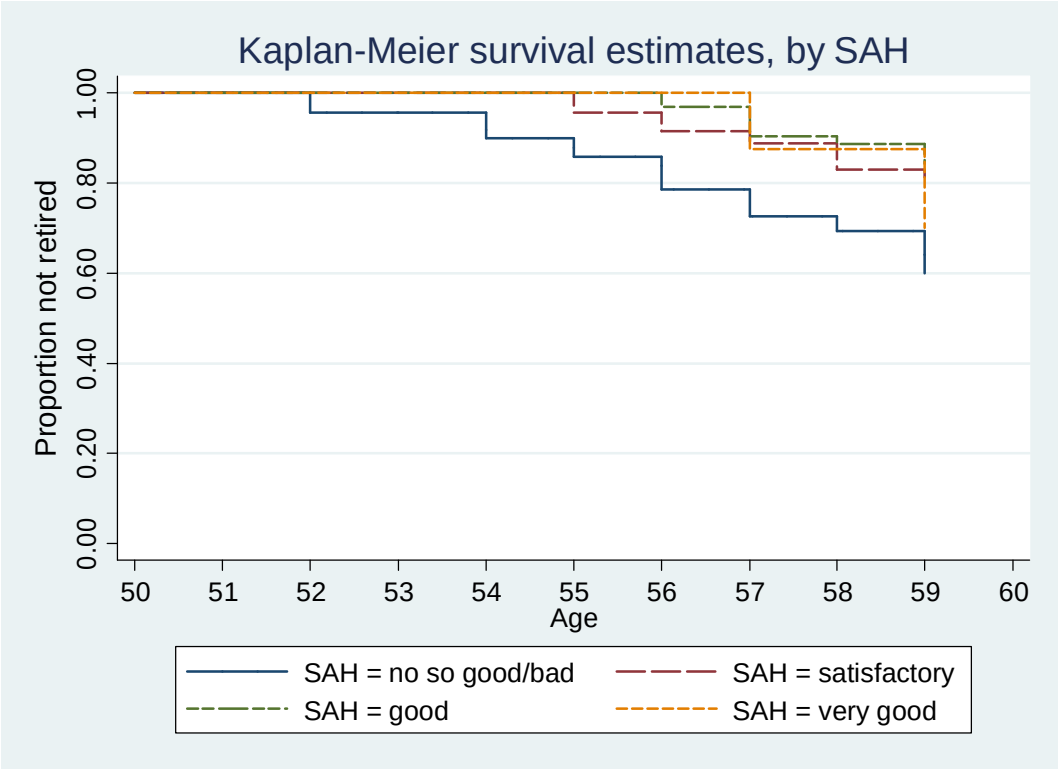


**Figure 3: CCs for 2-point deterioration in SAH for Britain and Germany.**

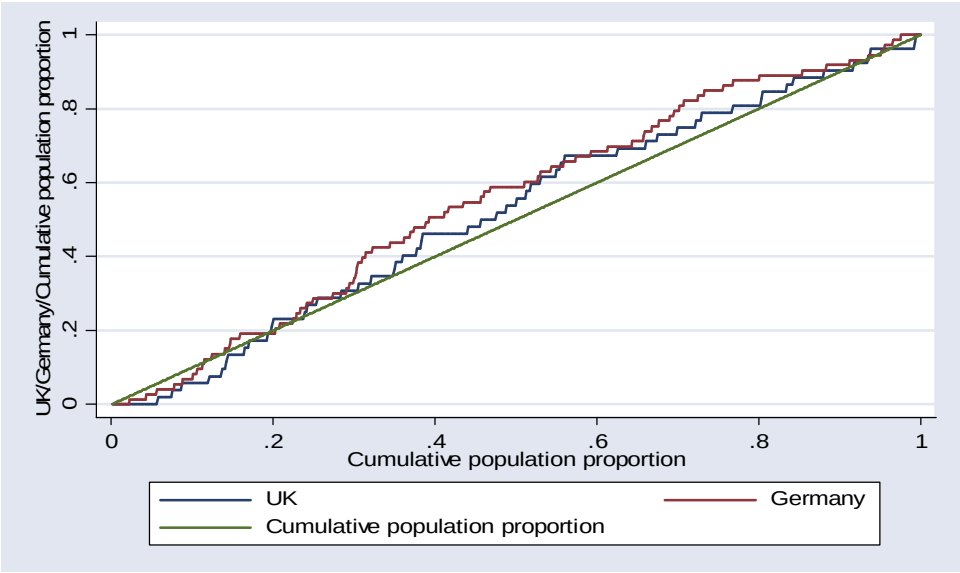



**Figure 4: CCs for early retirement (*RETi*) for Britain and Germany.**

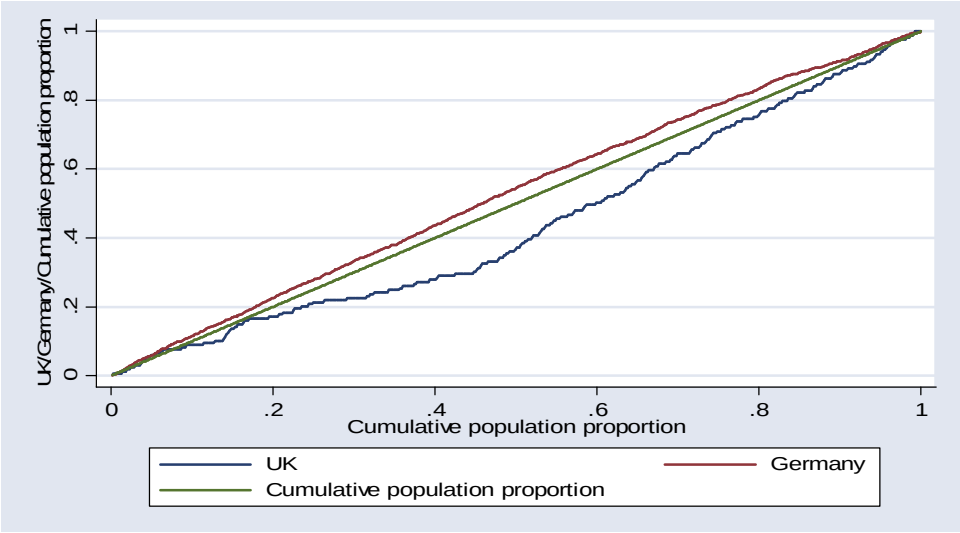
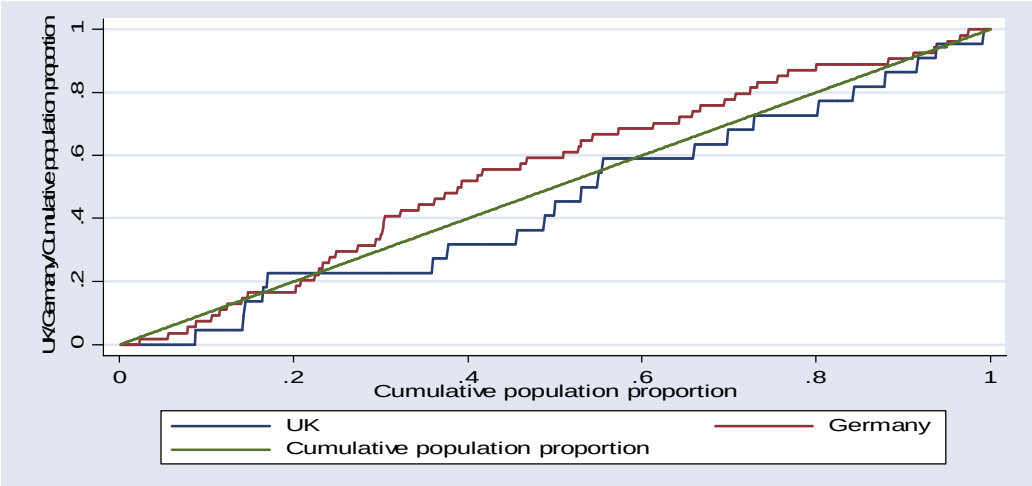



**Figure 5: CCs for early retirement and 2-point SAH shock for Britain and Germany.**



## Table 2a: Hazard model for retirement transition in the UK - Men

| | Health limitations N = 2,127 | | | (Latent) General Health N = 2,096 | | |
|---|---|---|---|---|---|---|
| | Coef | S.E. | Hazard ratio | Coef | S.E. | Hazard ratio |
| *Own Health:* | | | | | | |
| Health limitations (t-1) | 1.526* | 0.402 | 4.589 | -- | -- | -- |
| Health limitations (0) | 0.072 | 0.614 | 1.074 | -- | -- | -- |
| Latent health (t-1) | -- | -- | -- | -0.755* | 0.261 | 0.470 |
| Latent health (0) | -- | -- | -- | 0.0723 | 0.332 | 1.075 |
| *Spouse:* | | | | | | |
| Health limitations (t-1) | 0.078 | 0.332 | 1.081 | -- | -- | -- |
| Latent health (t-1) | -- | -- | -- | -0.199 | 0.199 | 0.819 |
| Has job (t-1) | -0.640* | 0.287 | 0.527 | -0.746* | 0.294 | 0.474 |
| *Education* | | | | | | |
| Degree or higher degree | -1.228* | 0.646 | 0.293 | -1.097 | 0.637 | 0.334 |
| HND or A levels | -0.225 | 0.399 | 0.799 | -0.202 | 0.401 | 0.816 |
| O levels or CSEs | -0.241 | 0.408 | 0.786 | -0.182 | 0.419 | 0.834 |
| *Income & Wealth :* | | | | | | |
| Own house with mortgage (t-1) | 0.279 | 0.288 | 1.322 | 0.390 | 0.287 | 1.477 |
| Local auth or housing association (t-1) | -0.002 | 0.552 | 0.998 | 0.053 | 0.548 | 1.054 |
| Private rented housing (t-1) | -0.966 | 0.801 | 0.381 | -1.035 | 0.814 | 0.355 |
| Log household income | 1.135* | 0.367 | 3.111 | 1.059* | 0.368 | 2.882 |
| *Pensions :* | | | | | | |
| Private pension | -0.944* | 0.309 | 0.389 | -0.998* | 0.319 | 0.368 |
| Employer pension | 0.551 | 0.444 | 1.734 | 0.547 | 0.450 | 1.727 |
| Private sector (0) | 0.639 | 0.517 | 1.894 | 0.603 | 0.523 | 1.827 |
| Civil service/Local Government (0) | 2.142* | 0.675 | 8.520 | 2.000* | 0.692 | 7.389 |
| Other sector (0) | 0.553 | 0.702 | 1.739 | 0.504 | 0.713 | 1.655 |
| *Occupational dummies* | | | | | | |
| Professional (0) | -0.867 | 0.976 | 0.420 | -1.081 | 1.002 | 0.339 |
| Management and administration (0) | -0.853 | 0.454 | 0.426 | -0.879 | 0.464 | 0.415 |
| Clerical and secretarial (0) | -1.017 | 0.919 | 0.361 | -1.190 | 0.969 | 0.304 |
| Craft and related l(0) | -0.942 | 0.510 | 0.390 | -0.998 | 0.521 | 0.369 |
| Personal services (0) | -1.270 | 0.679 | 0.281 | -1.132 | 0.686 | 0.322 |
| Sales (0) | -0.341 | 0.957 | 0.711 | -0.194 | 0.993 | 0.823 |
| Plant operative (0) | -0.532 | 0.587 | 0.587 | -0.539 | 0.590 | 0.583 |
| Other (0) | -0.572 | 0.888 | 0.564 | -0.358 | 0.876 | 0.699 |
| *Socio-demographics:* | | | | | | |
| Married or couple | -0.179 | 0.461 | 0.836 | -0.336 | 0.482 | 0.715 |
| Age 53 | 0.208 | 1.035 | 1.232 | 0.119 | 1.025 | 1.127 |
| Age 54 | 0.725 | 0.972 | 2.066 | 0.562 | 0.948 | 1.753 |
| Age 55 | -0.815 | 1.276 | 0.442 | -0.946 | 1.265 | 0.388 |
| Age 56 | 1.857* | 0.854 | 6.405 | 1.775* | 0.831 | 5.901 |
| Age 57 | 1.119 | 0.928 | 3.064 | 1.033 | 0.901 | 2.812 |
| Age 58 | 1.816* | 0.889 | 6.146 | 1.769* | 0.863 | 5.865 |
| Age 59 | 1.338 | 0.923 | 3.812 | 1.200 | 0.899 | 3.321 |
| Age 60 | 2.821* | 0.914 | 16.786 | 2.657* | 0.879 | 14.254 |
| Age 61 | 2.603* | 0.933 | 13.511 | 2.483* | 0.913 | 11.981 |
| Age 62 | 2.311* | 0.976 | 10.084 | 2.217* | 0.942 | 9.180 |
| Age 63 | 3.578* | 0.973 | 35.780 | 3.456* | 0.949 | 31.699 |
| Age 64 | 3.338* | 1.035 | 28.164 | 3.203* | 1.013 | 24.603 |
| Log likelihood | -353.884 | | | -357.665 | | |
| LR test of gamma variation (p-value) | 7.854 (0.003) | | | 7.540 (0.003) | | |

* statistically significant at 5% level., (0) denotes initial (wave 1) values. Regional dummies included but not reported here.

**Table 2b: Hazard model for retirement transition in the UK - Women**

| | Health limitations N = 1,018 | | | (Latent) General Health N = 1000 | | |
|---|---|---|---|---|---|---|
| | Coef | S.E. | Hazard ratio | Coef | S.E. | Hazard ratio |
| *Own Health:* | | | | | | |
| Health limitations (t-1) | 1.411* | 0.435 | 4.103 | -- | -- | -- |
| Health limitations (0) | -1.863* | 0.815 | 0.155 | -- | -- | -- |
| Latent health (t-1) | -- | -- | -- | -0.834* | 0.409 | 0.434 |
| Latent health (0) | -- | -- | -- | 0.113 | 0.517 | 1.120 |
| *Spouse:* | | | | | | |
| Health limitations (t-1) | 0.493 | 0.526 | 1.636 | -- | -- | -- |
| Latent health (t-1) | -- | -- | -- | -0.347 | 0.441 | 0.706 |
| Has job (t-1) | -0.378 | 0.469 | 0.685 | -0.261 | 0.538 | 0.770 |
| *Education* | | | | | | |
| Degree or higher degree | -0.561 | 0.995 | 0.571 | -0.855 | 1.298 | 0.425 |
| HND or A levels | -1.098 | 0.714 | 0.334 | -1.066 | 0.896 | 0.344 |
| O levels or CSEs | -0.148 | 0.415 | 0.862 | -0.171 | 0.511 | 0.843 |
| *Income & Wealth :* | | | | | | |
| Own house with mortgage (t-1) | -0.373 | 0.382 | 0.688 | -0.706 | 0.535 | 0.494 |
| Local authority or housing association (t-1) | -0.019 | 0.624 | 0.980 | -0.570 | 0.931 | 0.565 |
| Private rented housing (t-1) | -0.932 | 1.064 | 0.394 | -1.265 | 1.222 | 0.282 |
| Log household income | 0.810* | 0.195 | 2.248 | 1.129 | 0.635 | 3.093 |
| *Pensions :* | | | | | | |
| Private pension | -1.132* | 0.506 | 0.267 | -1.382 | 0.737 | 0.251 |
| Employer pension | 0.537 | 0.405 | 1.711 | 0.707 | 0.674 | 2.028 |
| Private sector (0) | -1.484* | 0.583 | 0.227 | -1.364 | 0.882 | 0.256 |
| Civil service/Local Government (0) | -2.061* | 0.719 | 0.127 | -2.026 | 1.138 | 0.132 |
| Other sector (0) | -1.646* | 0.765 | 0.193 | -1.186 | 0.966 | 0.305 |
| *Occupational dummies* | | | | | | |
| Professional (0) | -0.662 | 0.899 | 0.516 | -0.719 | 1.171 | 0.487 |
| Management and administration (0) | -0.169 | 0.640 | 0.845 | -0.069 | 0.829 | 0.932 |
| Clerical and secretarial (0) | -0.818 | 0.674 | 0.441 | -1.132 | 0.964 | 0.323 |
| Craft and related l(0) | -1.177 | 1.149 | 0.308 | -1.428 | 1.419 | 0.239 |
| Personal services (0) | -0.789 | 0.632 | 0.454 | -0.891 | 0.917 | 0.410 |
| Sales (0) | 0.232 | 0.731 | 1.261 | 0.318 | 0.999 | 1.373 |
| Other (0) | -0.591 | 0.838 | 0.554 | -0.887 | 1.082 | 0.412 |
| *Socio-demographics:* | | | | | | |
| Married or couple | -0.019 | 0.542 | 0.981 | -0.515 | 0.848 | 0.597 |
| Age 53 | 0.726 | 1.198 | 2.067 | -- | -- | -- |
| Age 54 | 1.357 | 1.066 | 3.888 | 1.225 | 0.801 | 3.406 |
| Age 55/56 | 0.710 | 1.045 | 2.034 | 0.542 | 0.856 | 1.719 |
| Age 57 | 1.253 | 1.047 | 3.503 | 1.160 | 0.988 | 3.189 |
| Age 58 | 1.774 | 1.019 | 5.895 | 1.834 | 1.118 | 6.262 |
| Age 59 | 1.775 | 1.019 | 5.897 | 2.142 | 1.324 | 8.517 |
| Log likelihood | | -141.117 | | | -143.685 | |
| LR test of gamma variation (p-value) | | 0.000 (0.5) | | | 0.575 (0.224) | |

* statistically significant at 5% level., (0) denotes initial (wave 1) values. Regional dummies included but not reported here.

**Table 3a: Hazard model for retirement transition in Germany - Men**

| | Self Assessed Health N = 5,306 | | | (Latent) General Health N = 5,212 | | |
|---|---|---|---|---|---|---|
| | Coef | S.E. | Hazard ratio | Coef | S.E. | Hazard ratio |
| *Own Health:* | | | | | | |
| Fair SAH (t-1) | -0.427* | 0.117 | 0.652 | -- | -- | -- |
| Good SAH (t-1) | -0.561* | 0.136 | 0.571 | -- | -- | -- |
| Excellent SAH (t-1) | -0.709* | 0.325 | 0.492 | -- | -- | -- |
| Fair SAH (0) | -0.146 | 0.140 | 0.864 | -- | -- | -- |
| Good SAH (0) | -0.208 | 0.147 | 0.812 | -- | -- | -- |
| Excellent SAH (0) | -0.225 | 0.233 | 0.798 | -- | -- | -- |
| Latent health (t-1) | -- | -- | -- | -0.225* | 0.043 | 0.798 |
| Latent health (0) | -- | -- | -- | -0.071 | 0.042 | 0.932 |
| *Spouse:* | | | | | | |
| Fair SAH (t-1) | 0.062 | 0.116 | 1.064 | -- | -- | -- |
| Good SAH (t-1) | 0.055 | 0.129 | 1.057 | -- | -- | -- |
| Excellent SAH (t-1) | -0.066 | 0.357 | 0.936 | -- | -- | -- |
| Latent health (t-1) | -- | -- | -- | 0.064 | 0.039 | 1.066 |
| Has job (t-1) | -0.032 | 0.098 | 0.968 | -0.060 | 0.097 | 0.941 |
| *Higher education* | 0.056 | 0.145 | 1.057 | 0.089 | 0.145 | 1.094 |
| *Income & wealth:* | | | | | | |
| Log household income | -0.651* | 0.130 | 0.521 | -0.661* | 0.131 | 0.516 |
| Owner occupier | -0.133 | 0.102 | 0.876 | -0.102 | 0.103 | 0.903 |
| Subsidised housing | -0.216 | 0.188 | 0.806 | -0.192 | 0.187 | 0.826 |
| *Pensions* | | | | | | |
| Civil service (0) | 0.196 | 0.207 | 1.216 | 0.196 | 0.206 | 1.216 |
| *Industry Sector:* | | | | | | |
| Agriculture (0) | -0.567 | 0.348 | 0.567 | -0.506 | 0.349 | 0.603 |
| Energy (0) | -0.054 | 0.417 | 0.947 | 0.037 | 0.418 | 1.038 |
| Manufacturing (0) | -0.196 | 0.273 | 0.822 | -0.160 | 0.274 | 0.852 |
| Construction (0) | -0.456 | 0.291 | 0.634 | -0.419 | 0.294 | 0.658 |
| Trade (0) | -0.790* | 0.325 | 0.454 | -0.722* | 0.326 | 0.485 |
| Transport (0) | 0.320 | 0.322 | 1.377 | 0.375 | 0.322 | 1.455 |
| Banking (0) | -0.560 | 0.419 | 0.571 | -0.471 | 0.419 | 0.624 |
| Services (0) | -0.723* | 0.287 | 0.485 | -0.641* | 0.289 | 0.527 |
| *Origin:* | | | | | | |
| East German | -0.057 | 0.270 | 0.944 | -0.103 | 0.284 | 0.902 |
| Foreigner | -0.458* | 0.160 | 0.632 | -0.394* | 0.161 | 0.674 |
| *Socio-demographics:* | | | | | | |
| Married or couple | 0.448* | 0.180 | 1.565 | 0.148 | 0.265 | 1.160 |
| Age 54 | 0.861 | 0.450 | 2.364 | 0.864 | 0.449 | 2.374 |
| Age 55 | 0.173 | 0.501 | 1.189 | 0.199 | 0.500 | 1.220 |
| Age 56 | 0.966* | 0.416 | 2.626 | 0.893* | 0.419 | 2.443 |
| Age 57 | 1.707* | 0.384 | 5.512 | 1.673* | 0.384 | 5.328 |
| Age 58 | 1.617* | 0.388 | 5.036 | 1.607* | 0.388 | 4.992 |
| Age 59 | 1.520* | 0.393 | 4.575 | 1.523* | 0.393 | 4.586 |
| Age 60 | 1.882* | 0.384 | 6.565 | 1.869* | 0.383 | 6.487 |
| Age 61 | 3.068* | 0.367 | 21.493 | 3.051* | 0.366 | 21.131 |
| Age 62 | 3.050* | 0.373 | 21.112 | 3.019* | 0.373 | 20.462 |
| Age 63 | 2.614* | 0.392 | 13.654 | 2.558* | 0.393 | 12.906 |
| Age 64 | 3.716* | 0.378 | 41.113 | 3.721* | 0.377 | 41.298 |
| Log likelihood | -1433.223 | | | -1403.089 | | |

* statistically significant at 5% level., (0) denotes initial (wave 1) values. Regional dummies included but not reported here. Models estimated without heterogeneity

## Table 3b: Hazard model for retirement transition in Germany - Women

| | Self Assessed Health N = 2,293 | | | (Latent) General Health N = 2,234 | | |
|---|---|---|---|---|---|---|
| | Coef | S.E. | Hazard ratio | Coef | S.E. | Hazard ratio |
| *Own Health:* | | | | | | |
| Fair SAH (t-1) | -1.257* | 0.400 | 0.285 | -- | -- | -- |
| Good SAH (t-1) | -2.011* | 0.542 | 0.134 | -- | -- | -- |
| Excellent SAH (t-1) | -2.154 | 1.325 | 0.116 | -- | -- | -- |
| Fair SAH (0) | -0.293 | 0.553 | 0.746 | -- | -- | -- |
| Good SAH (0) | -0.767 | 0.612 | 0.464 | -- | -- | -- |
| Excellent SAH (0) | -0.403 | 1.033 | 0.669 | -- | -- | -- |
| Latent health (t-1) | -- | -- | -- | -0.554* | 0.159 | 0.574 |
| Latent health (0) | -- | -- | -- | -0.365 | 0.201 | 0.694 |
| *Spouse:* | | | | | | |
| Fair SAH (t-1) | -0.416 | 0.484 | 0.660 | -- | -- | -- |
| Good SAH (t-1) | 0.238 | 0.505 | 1.268 | -- | -- | -- |
| Excellent SAH (t-1) | 0.427 | 1.367 | 1.532 | -- | -- | -- |
| Latent health (t-1) | -- | -- | -- | 0.219 | 0.158 | 1.244 |
| Has job (t-1) | -0.325 | 0.417 | 0.722 | -0.441 | 0.416 | 0.643 |
| *Higher education* | -0.477 | 0.511 | 0.621 | -0.415 | 0.518 | 0.661 |
| *Income & wealth:* | | | | | | |
| Log household income | -0.478 | 0.516 | 0.620 | -0.479 | 0.526 | 0.620 |
| Owner occupier | -0.487 | 0.442 | 0.615 | -0.586 | 0.453 | 0.556 |
| Subsidised housing | 0.575 | 0.697 | 1.777 | 0.345 | 0.746 | 1.412 |
| *Industry Sector:* | | | | | | |
| Manufacturing (0) | -0.821 | 0.636 | 0.440 | -0.864 | 0.652 | 0.852 |
| Trade (0) | -0.767 | 0.760 | 0.465 | -1.002 | 0.802 | 0.485 |
| Services (0) | -0.425 | 0.572 | 0.654 | -0.558 | 0.602 | 0.527 |
| *Origin:* | | | | | | |
| East German | 0.847 | 1.049 | 2.333 | 0.469 | 1.031 | 0.902 |
| Foreigner | -0.601 | 0.646 | 0.548 | -0.579 | 0.639 | 0.674 |
| *Socio-demographics:* | | | | | | |
| Married or couple | -1.206 | 0.584 | 0.299 | -2.229* | 0.877 | 0.108 |
| Age 55 | 1.978* | 0.740 | 7.227 | 1.826* | 0.708 | 6.213 |
| Age 56 | 2.535* | 0.730 | 12.622 | 2.458* | 0.693 | 11.692 |
| Age 57 | 3.075* | 0.857 | 21.649 | 3.023* | 0.779 | 20.573 |
| Age 58 | 3.129* | 0.977 | 22.857 | 2.874* | 0.862 | 17.717 |
| Age 59 | 3.912* | 1.091 | 49.986 | 3.712* | 0.931 | 40.970 |
| Log likelihood | | -299.811 | | | -289.959 | |
| LR test of gamma variation (p-value) | | 9.423 (0.001) | | | 10.301 (0.001) | |

* statistically significant at 5% level., (0) denotes initial (wave 1) values. Regional dummies included but not reported here.

**Table 4: Verbeek and Nijman (1992) test for attrition bias.**

| NEXT WAVE | *b* | S.E. | z-test | p-value |
|---|---|---|---|---|
| BHPS | | | | |
| Men | | | | |
| Health limitations | .843 | .461 | 1.83 | .068 |
| Latent self-assessed health | .631 | .424 | 1.49 | .136 |
| Women | | | | |
| Health limitations | .009 | .664 | .01 | .988 |
| Latent self-assessed health | .004 | .691 | .01 | .996 |
| GSOEP | | | | |
| Men | | | | |
| Self-assessed health | -.161 | .139 | 1.16 | .244 |
| Latent self-assessed health | -.198 | .138 | 1.44 | .151 |
| Women | | | | |
| Self-assessed health | -.596 | .596 | 1.00 | .317 |
| Latent self-assessed health | -.302 | .630 | .48 | .631 |

## *Appendix: Variable codes, definitions and data sources*

| Variable name | Description | Definition UK | Definition Germany |
|---|---|---|---|
| Retirement status | Self-reported retirement status | 1 - retired<br>0 - otherwise | 1 - retired<br>0 - otherwise |
| Latent health | | continuous | continuous |
| Self-assessed health | Excellent SAH | 1 – excellent, 0 - otherwise | 1 – very good, 0 - otherwise |
| | Good SAH | 1 – good, 0 - otherwise | 1 – good, 0 - otherwise |
| | Fair SAH | 1 – fair, 0 - otherwise | 1 – fair, 0 - otherwise |
| | Poor SAH | 1 - poor or v poor, 0 - otherwise | 1 - poor or bad, 0 - otherwise |
| Health limitations | "Does your health in any way limit your daily activities compared to most people of your age?" | 1 - yes, 0 - otherwise | -- |
| Specific health problems | Arms, legs, hands | 1 - yes, 0 - otherwise | -- |
| | Sight | 1 – yes, 0 - otherwise | -- |
| | hearing | 1 – yes, 0 - otherwise | -- |
| | Skin conditions or allergies | 1 – yes, 0 - otherwise | -- |
| | Chest/breathing | 1 – yes, 0 - otherwise | -- |
| | Heart/blood pressure | 1 – yes, 0 - otherwise | -- |
| | stomach or digestion | 1 – yes, 0 - otherwise | -- |
| | Anxiety or depression | 1 – yes, 0 - otherwise | -- |
| | Diabetes | 1 – yes, 0 - otherwise | -- |
| | alcohol or drugs | 1 – yes, 0 - otherwise | -- |
| | Epilepsy | 1 – yes, 0 - otherwise | -- |
| | Migraine | 1 – yes, 0 - otherwise | -- |
| | Other | 1 – yes, 0 - otherwise | |
| Formal disability rating | Degree of disability as per German Pension Office | -- | 0-100% |
| Health satisfaction | Person's satisfaction with own health | -- | 11 point scale:<br>0 - 'not at all satisfied'<br>10 - 'completely satisfied' |
| Education | Highest level of formal education obtained<br>O level or CSEs | 1 - CSE, O level<br>0 - otherwise | 1 – more than mandatory schooling<br>0 - otherwise |
| | HND or A level | 1 - A level, HND, HNC, Teaching<br>0 - otherwise | -- |
| | Degree or higher degree | 1 - degree, higher degree<br>0 - otherwise | -- |
| Pension entitlement | Private pension | 1 - private pension<br>0 - otherwise | 1 - Class 1 civil servant<br>0 - otherwise |
| | Employer pension | 1 - employer pension<br>0 - otherwise | -- |
| | Private sector | 1 - employed in private company<br>0 - otherwise | -- |
| | civil service or local government | 1 - employed in civil service or local government<br>0 - otherwise | -- |
| | Other sector | 1 - employed in other employment sector<br>0 - otherwise | -- |
| Income | Individual specific mean of log household income | continuous | -- |
| | Mean of log household post-government income | -- | continuous |
| Housing tenure | Own house with mortgage | 1 - own house with mortgage<br>0 - otherwise | 1 - owner occupier<br>0 - otherwise |
| | Private rented accommodation | 1 - live in private rented accommodation<br>0 - otherwise | 1 - live in subsidised housing<br>0 - otherwise |
| | Housing association of local authority rented housing | 1 - live in housing association or local authority rented accommodation<br>0 - otherwise | |

| Variable name | Description | Definition UK | Definition Germany |
|---|---|---|---|
| Demographic and other variables | Marital or couple | 1 - married or living as a couple<br>0 - otherwise | 1 – married or living as a couple<br>0 - otherwise |
| | Age 50-54 | 1 - aged 50 and 54 years<br>0 - otherwise | 1 - aged 50 and 54 years<br>0 - otherwise |
| | Age 55-99 | 1 - aged 55 and 59 years<br>0 - otherwise | 1 - aged 55 and 59 years<br>0 - otherwise |
| | Age 60-64 | 1 - aged 60 and 64 years<br>0 - otherwise | 1 - aged 60 and 64 years<br>0 - otherwise |
| | Age 65-69 | 1 - aged 65 and 69 years<br>0 - otherwise | -- |
| | Region/State of residence | 18 individual dummy variables | |
| | North | -- | 1 - lives in North<br>0 - otherwise |
| | South | -- | 1 - lives in Sorth<br>0 - otherwise |
| | East German | -- | 1 - born in East Germany<br>0 - otherwise |
| | Foreigner | -- | 1 - born outside Germany<br>0 - otherwise |
| Spouse variables | spouse latent health | continuous variables | continuous variable |
| | spouse SAH fair | -- | 1 - spouse SAH is fair<br>0 - otherwise |
| | spouse SAH good | -- | 1 - spouse SAH is good<br>0 - otherwise |
| | spouse SAH excellent | -- | 1 - spouse SAH is excellent<br>0 - otherwise |
| | spouse health limitations | 1 - spouse has health limitations<br>0 - otherwise | -- |
| | spouse has job | 1 - spouse is employed<br>0 - otherwise | 1 - spouse is employed<br>0 - otherwise |
| **Variable name** | **Description** | **Definition UK** | **Definition Germany** |
| | management or administration | 1 - management or administration<br>0 - otherwise | -- |
| Occupational class | professional | 1 - professional<br>0 - otherwise | -- |
| | clerical or secretarial | 1 - clerical or secretarial<br>0 - otherwise | -- |
| | craft or related | 1 - craft or related<br>0 - otherwise | -- |
| | personal or protective services | 1 - personal or protective services<br>0 - otherwise | -- |
| | sales | 1 - sales<br>0 - otherwise | -- |
| | plant operator | 1 - plant operator<br>0 - otherwise | -- |
| | other occupations | 1 - other occupations<br>0 - otherwise | -- |
| | Agriculture | -- | 1 - agriculture<br>0 - otherwise |
| Industrial sector | Energy | -- | 1 - energy<br>0 - otherwise |
| | Manufacturing | -- | 1 - manufacturing<br>0 - otherwise |
| | Construction | -- | 1 - construction<br>0 - otherwise |
| | Trade | -- | 1 - trade<br>0 - otherwise |
| | Transport | -- | 1 - transportation<br>0 - otherwise |
| | Banking | -- | 1 - banking or insurance<br>0 - otherwise |
| | Services | -- | 1 – services<br>0 - otherwise |