Extremely preliminary and woefully incomplete

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Health and retirement in England: New evidence from the English Longitudinal Study of Ageing

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1. Introduction

It is well known that recent increases in life expectancy (particularly at older ages), coupled with reductions in fertility rates, have resulted in demographic projections for EU populations that show rapidly rising proportions of older individuals over the next forty years. These in turn present some of the key policy issues currently facing European governments. Most notable is the extensive and ongoing debate about the financing of pension systems and the need for reform, but probably more important are a set of issues surrounding the future labour market outcomes of older workers.

The labour market participation of older workers will be the key issue driving the economic impacts of ageing populations around Europe. After all, it is not the demographic dependency ratio but the economic dependency ratio – the ratio of productive to unproductive individuals - that will underpin the pressures that future economies will face. And the extent to which increasing longevity is associated with a 'compression of morbidity', i.e. increasing health life expectancy as opposed to an increase in the fraction of later life spent with illness or disability, will therefore also play an important role.

On the labour supply side, more needs to be known about the degree to which older workers in the future will be willing to work to older ages. There are two key aspects to this that need to be integrated - firstly the effect of changing state and private pension provision on labour supply decisions and second the effect of late life health and disability on individuals ability (and willingness) to work. On the demand side, the issue of firms' demand for older workers, and the degree of substitutability of older workers, younger workers and capital, will also be key to understanding the wage offers which are available to those who want to work to later ages, which will in turn be key to understanding labour market outcomes for future cohorts of older workers.

The relationship between health and work at later life is an important research question for at least three reasons. Firstly, the dynamics of health 'shocks' and their effect on labour supply is a key issue for economic models of retirement and their associated policy implications, as indicated in the discussion above. Armed with such a model, economists could take epidemiological predictions of the compression of morbidity (the fraction of (increases in) late life life-expectancy that can be expected to be healthy, or disability free) and begin to better understand the true implications of population aging for labour supply. Second, and as we shall discuss below albeit briefly, the issue of social support and disability benefits for individuals unable to work due to health problems is an extremely important policy issue in it's own right. Finally, the pathway from health to employment (at all ages) is one of the key mechanisms by which health may affect socio-economic status (and more particularly income and wealth). The nature and intensity of such a relationship is a crucial element in understanding and decomposing the frequently observed correlation between SES and health (see Smith (2005) for example).

It is only relatively recently that detailed empirical research into these issues has become feasible, with the advent of large longitudinal population level datasets collecting detailed information on the key drivers of labour supply and individual productivity at older ages – health and (work) disability, pension arrangements, family and social factors. This paper uses a relatively new data source - the English Longitudinal Study of Ageing - to investigate the second of the topics delineated above, namely the effect of health on late life labour market outcomes. In particular, the ELSA data provide new research opportunities in this domain since they admit the possibility not only of distinguishing between an individual's subjective assessment of their overall health condition and more objective measures such as self-reported doctor diagnoses of specific conditions, but also separating each of these dimensions from direct biomedical or functional measurements of individual's health. In addition to providing an English counterpart to similar research carried out in the US using data from the Health and Retirement Study (HRS), the contribution of this paper will be to address the question of the value added of collecting and analysing detailed biological data on health, over and above the self-reported measures traditionally collected in social surveys.

This paper really only represents the first stage of a longer term project that will ultimately put together a complete model of health, pension arrangements and employment transitions at older ages. The longer term project will exploit the second and third waves of ELSA data as they become available, and will also involve much more detailed modelling of pension and retirement incentives, in order to investigate the relative importance of pensions and health in driving retirement outcomes.[1] Nevertheless, it still represents an attempt to provide a more detailed study of the links between health and employment transitions in England than has been available previously.

In what follows, Section 2 gives some background to recent employment trends for older workers in the UK, and Section 3 describes the data used in some detail. In Section 4 we look at cross-sectional evidence on the correlation between health (using various measures), employment and employment expectations. Finally in Section 5 we look at the association between health transitions and employment transitions. Section 6 draws some very tentative conclusions but, given the early stages of this work, focuses mainly on unresolved questions and topics for future investigation.

2. Labour force participation of older workers in the UK

After falling quite rapidly in the late 1970's and early eighties, the labour market participation of older men continued to decline steadily through to the mid 1990's and was an issue for some concern in policy circles. Figure 1 uses data from the Quarterly Labour Force Survey to show that this trend was apparent for all ages of older men, and across both high and low education groups, although the declines were certainly more marked for the older groups. Subsequent to 1996, however, there has been some pick up in employment rates of these groups, but the level remains low and the issue of the labour market participation of older men remains an important one.

In contrast Figure 2, which shows the same data for women below the State Pension Age,[2] tells a very different story. Although the levels of participation are lower for women than for men, as one might expect, there are contrasting time trends for women of all age and education groups. As has been argued previously however (see Banks et al (2003) for a brief discussion and summary) cohort effects in lifetime

[1] Indeed there are similar issues for pensions as there are for health – many surveys have crude self-reported data and a number of studies (including HRS and ELSA) are now including much more detailed pension measures (often based on official contributions histories from administrative data) in order to get a better understanding of the details of the association of pensions and labour market transitions.

[2] The State Pension Age in the UK is currently 60 for women and 65 for men, although this will be equalising to 65 for both over the period 2010-2020.

participation for women, however, will obscure true time trends for any individual cohort.

At the same time as participation has been declining there have been sharp increases in the number of individuals on disability benefits. Figure 3 shows the trends in disability caseloads over the corresponding period for men and women, decomposed by broad age group. An eligibility reform in 1995 meant that the numbers claiming these benefits that were older than the State Pension Age declined to zero over the subsequent five years. But for the other age groups the rolls have risen substantially and, for women at least, the numbers have continued to rise rapidly over the whole period. This rise in invalidity benefit caseloads for women suggests that individual cohorts are moving out of work over time, hence cohort effects in participation must be more than enough to offsetting such time series changes for individual cohorts

As in many countries around the world, the policy concern with rising invalidity benefit caseloads is that invalidity benefits may be providing a route to early retirement and hence many reforms options have suggested tightening the health criteria on the basis of which benefits will be paid. This is particularly the case in the UK, where there is no early retirement option in the public pension system.[3] Such empirical evidence in Britain as there is suggests that the prevalence of the key health problems (predominantly back pain and depression) has remained relatively stable over time, but that those with such conditions simply no longer work whereas they used to in the past (see Faggio and Nickell (2003) for example).

A similar story emerges if one looks at disability roles and health conditions across countries. Banks, Kapteyn, Smith and van Soest (2005) present comparative evidence on self-reported work disability (using multiple micro data sources including ELSA and the British Household Panel Study for the UK) where levels of work disability are compared to US and the Netherlands, and where the correlation between work disability and various measures of health is also compared across countries. Once again,

[3] Broadly speaking, the conclusion of the Gruber Wise (2002) study into international comparisons of social security and retirement, was that labour market participation of older workers was comparable around the world but that the non-participants were on different programmes according to the specific institutional framework, varying from early retirement pensions, to disability benefits, to unemployment insurance.

the broad message is that the prevalence of physical health conditions is comparable across countries, yet the numbers reporting themselves work disabled differs according to the institutional environment. Banks et al (2005) show that the exception to this rule of thumb is the prevalence of pain (either general, or of specific types) that also differs across countries in the same way as the work disability differences. The issue of pain as a key driver of work behaviour is an important one, although it is also one that is understandably complicated by measurement issues since (reported) pain is subjective and may well be correlated with heterogeneity over preferences for work.

With regard to other evidence on the correlation between health events and labour market exits in Britain, Disney, Emmerson and Wakefield (2003) provide evidence on changes in health and changes in employment status using the British Household Panel Study, and in particular, they follow Bound (1991, 1999) and estimate a model of health and labour market exit where self-reported health conditions are instrumented by self-reported specific conditions. However their analysis is limited by the BHPS health information being relatively crude. In addition, small numbers at each age means ability to control for time effects relatively limited. This last factor maybe important in the light of the time trends highlighted above.

To date, studies that have investigated the links between health and work, such as the Bound et al (1991, 1999), Disney et al (2003) and Smith (2005), have used self-reported health information entirely. Even if we confine ourselves to specific disease prevalence as opposed to general health status, self-reports may have several potential problems. Perhaps due to limited contact with the medical system, individuals may not be aware they have a particular disease or they may think they have been cured when at best the disease is only under control. If those within lower SES groups are less likely to report a health problem they actually have, these reporting problems may have a SES gradient of their own which may well correlate with the probability of working, or of exiting work. To give another not entirely fanciful example, the manner and language by which physicians communicate health problems to their patients may be quite different. In some situations doctors may tell their patients that they have problems with blood sugar, which may not be understood by their patients to imply diabetes.

In both these scenarios, biological data can provide supplementary health information on individuals that will help to identify true physical health processes. In addition, and importantly for us, the addition of biomedical information over and above the self reports offers us the chance to control for risk factors for future health events that, at the time of the original observation were unknown to the respondent themselves. Using the informational content in these markers over and above the self-reports will provide us with our understanding of the effects of health shocks on labour market exits.

3. Data

The English Longitudinal Study of Ageing (ELSA) is a panel study of around 12,000 respondents aged 50 and over on Feb 29 2002. The core interview, which is conducted face to face and takes place every two years, covers full details of economic position (including assets and pensions), health, demographic and social factors (see Marmot et al (2003) for a full description of the survey and an descriptive analysis of the cross-sectional findings from the first wave). The first ELSA interview was in 2002, and the 2004 interview included a follow up nurse visit for specific health and biomedical measurements and the collection of blood samples and saliva. This design (of a supplementary nurse visit every other interview) will continue into the foreseeable future.

Some further details of the ELSA sample design are relevant here since at this relatively early stage in the study they will govern what longitudinal information is available to us. The ELSA sample was recruited from respondents to three separate years of the Health Survey for England (HSE) survey in such a way as to provide a representative sample of the English population over 50. In particular, sample was taken from respondents to the 1998, 1998 and 2001 surveys. Importantly, ELSA individuals can be linked back to their HSE data so that the HSE effectively provides the first 'baseline' observation on each ELSA respondent. All HSE surveys contain information on health and labour market position but information on detailed economic position (and in particular income and assets) is weak. In addition, different years of HSE focus on different themes - detailed modules of self-reports on health and/or biomedical samples are collected to allow research on the theme in that particular year. The 2001 HSE was a general survey with shorter modules on nutrition, accidents, disability and respiratory illness whilst the 1999 HSE focused on the health of ethnic groups and the 1998 HSE focused on cardiovascular disease. Of the 12,100 ELSA respondents, 5,053 (41.76%) were previously interviewed in the 1998 HSE, 2,227 (18.4%) came from the 1999 HSE and 4,549 (37.6%) came from the 2001 survey.

The linking of HSE and ELSA data means that the initial health data has now been supplemented by collection of baseline social and economic data in the first wave of ELSA and will continue to be so on an ongoing basis. ELSA is also especially rich in the health domain so the analysis of health transitions can be very detailed. Its health module collects data on self-reported general health, specific diagnoses of disease (hypertension, heart disease, diabetes, stroke, chronic lung diseases, asthma, arthritis and osteoporosis, cancer, and emotional and mental illness including depression, memory and cognitive assessment, disability and functioning status (e.g., ADLs and IADLs), difficulty with pain, health behaviors (smoking, alcohol consumption, and physical activity), and on symptoms of heart disease.

Overall, health measurement in ELSA is arguably superior to that available in the American counterpart to ELSA – the Health and Retirement Study. These advantages include the prior physical measurement and respondent health measurement available in the Health Survey for England from which the ELSA sample was drawn. In addition to blood samples which were collected from 1998 and 2001 HSE respondents, waist, height, hip and blood pressure measurements are taken in all HSE years. Moreover, the ELSA wave 2 nurse visit, which went into the field in mid 2004, will repeat the HSE measurement of biological markers and collect additional biological samples (fasting bloods, cortisol) and a further battery of physical functioning tests (grip strength, balance test, chair stand, lung function test). Further nurse visits will occur every second wave and the walking speed test collected in the main ELSA interview will be repeated as part of the core ELSA interview every two years. Since the use of this data in economic models is relatively novel, the next brief subsection describes the data in more detail.

3.1 Biomedical data on health

In this paper we will predominantly use the subsample of ELSA respondents that were previously interviewed in the 1998 HSE. For these respondents we have a five year time delay between the two interviews, and a very detailed set of biological samples and self-reported health questions that arise from the focus of the1998 HSE on cardio-vascular disease. A number of known risk factors for future health events (and in particular cardio-vascular disease) are therefore available to us at baseline.

Hypertension (or high blood pressure), a major risk factor for cardiovascular disease (CVD), is a relatively common condition with a prevalence that grows rapidly with age. Before the introduction of new effective drugs, the recommended treatment consisted of some combination of exercise and diet, particularly to reduce excessive weight and salt. In HSE the clinical definition of high blood pressure is given by systolic blood pressure equal to or greater than 140 mm Hg and/or diastolic blood pressure equal to or greater than 90 mm Hg and/or taking medication. Of course, some individuals may have high blood pressure by this measured definition but not by the self-reported doctor diagnosis, since they may not have consulted their GP, or indeed their GP may have used a different threshold to that used to calculate the HSE measure.

The HSE nurses measurement of height and weight also allows us to compute Body Mass Index (BMI) and categorise individuals as overweight (BMI > 25) or obese (BMI > 30). As is well known, obesity is a risk factor for a number of diseases including heart disease and diabetes.

Finally, the biological measures available from the blood samples are of interest for several reasons. They include markers such as fibrinogen (which controls blood clotting and is a risk factor for CVD), C- reactive protein (CRP - measuring the concentration of a protein in serum that indicates acute inflammation and possible arthritis), cholesterol and HBa1c (an indication of diabetes). Such measures can be used as supplementary information to respondents' self-reports and to gauge overall health, but they can also inform us about pre-clinical levels of disease of which the respondents may not have been aware and therefore to which they have not yet able to react behaviorally. The pre-clinical gradient in disease is a largely explored area of research in large population based samples.

We have two sub-clinical markers of disease available in the 1998 HSE, C-reactive protein and fibrinogen. In these cases, there is no matching respondent self-reports so the primary issue becomes whether the nature of the relationships between these measures and labour market exits convey additional information over and above the self-reports on diseases for which these clinical measurements are well-established risk factors. This will include in particular cardiovascular disease and to a lesser extent arthritis.

C-reactive protein (CRP) is an acute phase reactant released in response to acute injury, infection, or other inflammatory stimuli. In the context of cardiovascular disease, raised CRP levels are thought to be a marker for atherosclerosis by reflecting the inflammatory condition of the vascular wall. Several studies have shown a positive association between C- reactive protein and coronary artery disease and that it serves as a good marker for future cardiovascular events (Mendall et al 1996). C- reactive protein measures the concentration of a protein in serum that indicates acute inflammation and possible arthritis. Tests for C-reactive protein were conducted on respondents in the 1998 HSE. In our analysis we will be following medical convention by categorizing measurement into three groups - 3 mg/L or higher indicates high risk, between 1 and 3 is moderate risk, and less than 1 is low risk.

Fibrinogen is a protein produced by the liver that circulates in the blood and helps stop bleeding by assisting blood clots to form. High fibrinogen has been identified as an important risk factor for cardiovascular disease. Fibrinogen and C-reactive protein levels appear to rise in response to stress stimuli and to take longer to return to normal levels among those in lower SES groups. (Steptoe and Marmot, 2004). The normal range is 200-400 mg/dl (mg/dl = milligrams per deciliter and above 400 is considered a high risk for heart disease.

For each of these markers, the epidemiological evidence suggests that they can be predictive of subsequent heart disease with greater than 10 years of follow up (Danesh et al., 2004) and hence they are seen as markers of the early processes that occur in the aetiology of such conditions. As individuals age the markers also predict other diseases, such as arthritis in particular.

4. The relationship between health and work

We begin by looking in cross section at the relationship between employment behaviour (and expectations of future employment behaviour) and health using the full sample from the ELSA 2002 data. As has been observed in other studies, when one looks in cross-section, labour market participation follows an inverse U shape with respect to wealth – it is those in the middle of the wealth distribution that are most likely to be working at older ages. But the (self-reported) reason for the non-participation is different for different groups. Figure 4 shows that, broadly speaking, those at the bottom of the wealth distribution exit through inactivity whereas those at the top exit into retirement, presumably with private pension income since there is no early retirement option for the state pension in the UK. It is the group at the bottom who primarily exit onto disability benefits (and/or income support).

This strong cross sectional relationship between health and employment status is confirmed if we look at employment differences across categories of the self-reported general health measure, presented in Figure 5. Employment rates are substantially lower for all age-gender groups for those who report their health to be fair or poor in comparison to those reporting their health as excellent, very good or good.

Studies based on the HRS have shown that there are significant feedbacks from health shocks to labor force exits and to lower household incomes (see Smith (2005) for an example). The new availability of ELSA allows us to take an initial look at whether similar feedbacks exist in England. Given the greater governmental support system in England compared to the US, we would have anticipated that labor force exits due to health shocks might even be larger in England than in the United States, but that the income losses associated with these exits might be smaller.

Table 1 provides an initial look at this issue. Panel a shows that fraction of those in poor or fair health at each age specific income quartile. Especially for those in their early fifties, a much larger fraction of those in the bottom income quartile report themselves in poor health than do their counterparts higher up the income distribution. The second panel in this table demonstrates that a large fraction of those in the bottom income quartile again in both countries are not working even for those ages 50-53. The third panel in these tables completes the thought by showing that a very large fraction of those who are not working in the lowest income quartile self-report themselves in poor health. These patterns are suggestive that there may well be important feedbacks from health to labor force exits to low incomes as there are in the US. It is important to note, however, that even if true this in no way implies that there are not simultaneously pathways from SES to health or about what the nature of those pathways might be.

Both Figure 5 and Table 1 use self-reported general health status as a measure of health. As argued elsewhere in the literature, individual responses to a subjective self-reported health question may exhibit justification bias, whereby an individual who is out of work is more likely (conditional on the same underlying physical health condition) to report themselves in bad health than an equivalent individual who is working, since this would provide the individual with a *post hoc* rationale or justification for their labour market inactivity.[4]

To investigate this, and as a preface to the analysis that follows, we begin by presenting some simple descriptive statistics for the detailed health measures that we will use and show the way in which they vary across our sample and in particular across workers and non-workers. Table 2 shows the proportion of the sample falling into groups defined by the C-reactive protein, fibrinogen, obesity and hypertension 'health risk' categories we defined earlier. The differences across groups that accord with what we would expect, given the epidemiological evidence. With the relatively coarse definition employed here, the education differences are only somewhat consistent with a social gradient in health but Banks, Marmot, Oldfield and Smith (2005) show that such social

[4] Given the data available in ELSA it would be possible to estimate a model for self-reported health conditional on a raft of self-reported conditions, which is essentially the approach taken by Bound (1991) and Disney et al (2003). Such a model could also be supplemented with the biological measures described above and future versions of this paper may include such a model. Two issues arise however. First, and most obviously, to interpret such a model as justification bias alone precludes feedbacks from work to health such as those postulated in the literature on socioeconomic determinants of health. Second and maybe more important, at least conceptually, such a model implicitly assumes that general health status and specific health conditions are two measures of the same underlying factor. More likely, general health (and in particular subjective general health) picks up dimensions of health other than the specific physical health dimension. If this is true of course, one must then exercise caution when using patterns observed in general health status as indicators of processes or gradients for specific health conditions or diseases.

gradients in specific conditions and biological markers is strongly present in the ELSA/HSE data when looking across other SES dimensions such as income or across education within income groups.

More important for our purposes is how these risk factors vary within groups which have common employment status and self reported health. This is presented in Tables 3 and Tables 4 for C-reactive Protein and Fibrinogen respectively. Taking Table 3 first, there are clear differences in the distribution of CRP risk categories by whether an individual is working or not working: 40.4% of those not working fall into the high risk category, as opposed to only 24.6% of those who are working. This is a correlation between health and work that is certainly not affected by justification bias. There are also strong correlations between self-reported health and the underlying risk factors within groups defined by workers and non workers – within those not working, for example, 53.6% of those reporting bad or very bad health are in the CRP high risk category, compared with only 25.4% of those reporting their health as very good.

A similar, possibly more striking, set of differences emerges for fibrinogen risk presented in Table 4 categories. In this case the differences between workers and non-workers, particularly for those with low self-reported health, is even more stark - Non workers are almost twice as likely to be in the high risk category as workers, and non-workers in the lowest self-reported health group are almost five times more likely.

On a slightly different tack, one final piece of cross-sectional evidence relating to labour market participation can be provided before we move on to look at employment transitions. This exploits the expectations data that are collected as part of the ELSA core interview and relates to how health differences may be related not to current employment status but to future employment expectations. Such a distinction is important if we are, for example, to interpret the proportion inactive in Figure 4 as ‘retirees’ for economic purposes (i.e. people who are not expecting to work again in the future) as opposed to just as unemployed.

As part of a module on measuring expectations of future events, all ELSA respondents under 65 are asked to report their subjective chances of working at later ages, using the now well established per cent chance methodology employed in the HRS and analysed by amongst others Hurd and McGarry (1995, 2002). Specifically, respondents are asked to report the chances of being in work at a future age on a scale between 0 and 100, where “0 means that you think there is absolutely no chance an event will happen, and 100 means that you think an event is certain to happen).

These data provide us a first opportunity to investigate how health is correlated with employment expectations, as opposed to employment outcomes. Figure 6 shows that, for those individuals no longer active in the labour market, the subjectively reported chances of returning to work are extremely low and markedly lower for those who report fair or poor health than those who report health as good or better

This analysis is developed further in Table 5 where individuals per cent chances of working five years prior to the State Pension Age (i.e. at age 60 for men, and 55 for women) are regressed on dummies for each self-reported health category and a full set of age dummies.[5] An interesting asymmetry emerges. For those in work, current health is not correlated with future subjective employment expectations and the age dummies are strongly significant. Conditional on being out of work, however, the situation is reversed. Although the analysis is not presented here, this result holds for other definitions of health, whether based on long standing illnesses or reports of specific conditions.

This analysis raises the important issue of what is a shock to the individual and what is not, and more particularly whether health changes (and employment changes) may be anticipated by individuals. This issue is at the heart of understanding the relationship between health and labour market exits, and in the next section we will attempt to use sub-clinical markers and other detailed measures of health that are available in ELSA to provide a more detailed, but still only somewhat partial, explanation.

5. The relationship between changes in health and work exits

A more formal test of the pathways from health shocks to labor force exits and income has of course to rely on longitudinal information rather than just cross-sectional correlations. In this section we will look at labour market transitions between 1998 and

[5] In order to be comparable to later sections we switch to use a classification of self-reported health, based on the HSE (rather than the HRS) five-point scale response categories, that takes the value 1 if health is reported as bad or very bad, 2 if health is reported as fair, 3 if good and 4 if very good. All ELSA respondents are given the question with both sets of wordings.

2002 for the sample of ELSA respondents who were observed in both the 1998 HSE and the 2002 ELSA wave 1. This gives us a sample of 5,053 respondents, who were aged 46 and over at the time of their first interview in 1998.[6] In total, 2,236 were working (defined as either and employee or self-employed) at that first interview and of these 2,236 individuals, 517 were observed to stopped work between the two waves. Of course biological samples cannot always be taken (and respondents sometimes refuse permission for either the nurse visit or for the blood sample and the subsequent analysis) so the workable subsamples for various model specifications may be smaller. Nevertheless, response rates to these elements of the HSE were high. For C-reactive protein, for example, there are a total of 3,837 cases, with 1,706 working at baseline and 378 retirements between waves.

To get an initial idea of whether the variation in biomedical risk factors may be correlated with subsequent exits, Figure 3 shows the non-parametric density of the CRP measure for the sample of workers in 1998, split by whether they are still in work in 2002 or whether they have stopped by the second interview. Also marked on the figure are the cut points for the two risk groups defined in the previous sections. Some correlation between health risk and subsequent labour market exit is apparent – the density in the low health risk category for those who continue working is certainly lower than for those who stop, and there are corresponding differences in the moderate and high risk groups.

Figure 7 presents the same figure for Fibrinogen. In this case the fraction in the high risk category across the two groups is more comparable, although it is certainly true that the distribution of baseline Fibrinogen for those who subsequently stop work is shifted to the right.

In order to look at the effects of biological markers and other health factors on labour market exits we need to establish that, in the relatively small and also heterogeneous sample that we have, they do indeed predict subsequent health events as would be expected from the (very) recent epidemiological literature on sub-clinical markers and the aetiology of disease. For analysis purposes we consider two aggregated measures of risk categories as well as the full set of risk categories identified in Table 2.

[6] Note about attrition – obviously a big deal here and need to discriminate between attrition and death, which will be done in future draft when we link into the government mortality database. This version just uses the 'balanced panel' of responders to both waves.

Namely, one specification in all the tables uses a dummy variable that assigns an individual into a group if they have either a CRP risk of moderate or high or a high Fibrinogen risk. Similarly, an aggregator dummy variable assigns individuals who are either overweight or obese into the same group.

Table 6 reports the marginal effects from a Probit model of the incidence of cardiovascular disease (defined as the onset of either Heart Attack, Angina, Stroke, Diabetes or Hypertension) and shows that CVD is indeed predicted by the biological markers in our sample population, over and above gender, age, education, interactions of age and education, and self-reported general health status.[7] Looking at specification (3), where the individual risk categories are entered separately, it is apparent that it is CRP risk and Measured Hypertension that are most statistically significant in this model.[8] Table 7 and Table 8 report similar specifications for models that use as dependent variables the onset of poor self-reported health and the onset of any long-standing illness respectively. As anticipated from a reading of the epidemiological evidence, the markers are not as predictive of the more global health events as they are of CVD. Partly this is expected since because our population is restricted to those of less than the State Pension Age and it is only at later ages when the markers begin to predict a wider set of conditions (Kritchevsky et al., 2005). But the set of biomedical markers in general are still jointly significant in each model.

In Table 9 we briefly repeat the cross-sectional analysis of the previous section on this sample, and using a multivariate approach, to investigate the issue of health selection into the baseline sample of employees. Whilst there are strong predictors of employment status in this equation the significance of the biomedical markers over and above the self-reported health measures is relatively weak, with only the highest CRP risk group being statistically significantly less likely to be working at baseline.

[7] Here would be where we would write about whether the marker is a sufficient statistic for all this (i.e. we don't need anything else in the model at all because it's all in the marker) or whether we need to keep these variables in as indicators of residual predictive variance.

[8] Since the regression sample only contains those with no CVD conditions at baseline (and since one of the CVD conditions is diagnosed hypertension) the marginal effects for measured high blood pressure at baseline are large since this baseline variation is entirely capturing *undiagnosed* hypertension, which is therefore very likely to have been diagnosed five years later.

Finally, we turn to looking at labour market exits and these health changes and health risks. Table 10 reports the marginal effects from a Probit model for remaining in employment until 2002 for the sample of those initially in employment at the 1998 baseline. Somewhat surprisingly the biomedical markers, despite being shown to predict subsequent health events, do not predict labour market exits over and above the socioeconomic and self-reported health measures that are entered as conditioning variables. Part of this may be an issue of statistical power. On the one hand there might be thought to be relatively few severe health events occurring in this sample (which is both relatively young and relatively healthy at baseline since we are conditioning on their being employed). It is such severe events that are more likely to lead to total labour market exit than less severe conditions. On the other hand it is only that fraction of health events that are predictable from the biological markers that will enter here, and it may instead be in this dimension that there is a lack of explanatory power.

In Table 11 we address this by estimating the probability of a labor force exit with a specification where, in addition to controls for education, age, gender, marital status, and baseline health (self-reported health status), we include measures of the health shocks themselves, as opposed to the baseline risk of the shocks. The first two represent the onset of a mild or serious CVD shock (where mild is defined as hypertension or diabetes and severe is defined as heart attack, angina or stroke) while the third measure simply records the onset of any other (self-reported) long standing illness. Specification (1) shows that severe CVD shocks and the onset of longstanding illness are indeed strong predictors of subsequent exits and specification (3) shows that a self-reported general health 'shock' (which is significant in specification (2) when entered on it's own in the absence of the changes in specific conditions) is not statistically significant when specific condition shocks are controlled for. This labor force model mimics findings from the HRS. In particular, serious health onsets are strong predictors of labor market exits.

6. Conclusions and further plans

to be added

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Table 1

a. Fraction in Poor Health

	Income Quartile within Age				Bottom Education Group Only Income Quartile within Age			
Age	1	2	3	4	1	2	3	4
50-53	0.313	0.164	0.127	0.060	0.419	0.161	0.161	0.161
54-57	0.360	0.258	0.098	0.117	0.413	0.422	0.378	0.156
58-61	0.331	0.270	0.162	0.099	0.462	0.346	0.346	0.216
62-65	0.354	0.380	0.233	0.140	0.417	0.458	0.375	0.170
66-69	0.339	0.382	0.274	0.130	0.340	0.520	0.480	0.286

b. Fraction Not Working

	Income Quartile within Age				Bottom Education Group Only Bottom Education Group			
Age	1	2	3	4	1	2	3	4
50-53	0.336	0.075	0.037	0.030	0.323	0.129	0.065	0.097
54-57	0.409	0.209	0.079	0.067	0.435	0.244	0.200	0.000
58-61	0.697	0.426	0.211	0.184	0.808	0.577	0.269	0.176
62-65	0.838	0.729	0.434	0.442	0.854	0.792	0.500	0.340
66-69	0.952	0.878	0.879	0.642	0.960	0.960	0.940	0.714

c. Percent in Poor Health by Work Status—Low Education Group—Bottom Income Quartile

	Work Status	
Age	Working	Not Working
50-53	0.238	0.800
54-57	0.077	0.850
58-61	0.000	0.571
62-65	0.143	0.463
66-69	0.000	0.354

Table 2: Proportions falling into different risk groups

	CRP mod	CRP high	Fib high	HBP	Over-weight	Obese
Female	34.29	32.37	15.05	20.19	37.22	27.02
Male	36.74	27.31	11.6	25.64	50.97	23.80
< 50	35.86	24.07	10.16	11.85	38.88	24.11
50-54	34.35	28.39	11.94	19.88	43.20	25.85
55-59	34.10	34.10	14.77	26.16	45.69	25.29
60-64	37.52	34.60	18.14	32.11	44.92	27.03
Educ low	34.55	37.97	16.90	24.96	41.98	30.79
Middle	36.55	27.28	11.71	22.52	43.67	24.28
High	35.26	23.80	11.51	20.18	44.12	21.65
Not Working	33.60	40.44	19.27	28.21	40.86	29.68
Working	36.37	24.55	10.71	19.34	44.55	23.39
All	35.41	30.06	13.50	22.55	43.25	25.60
N	2,488		2,200	4,981	6,819	

Sample: ELSA respondents aged 65 and under in 2002 (data from HSE baseline surveys)

Table 3. CRP risk categories by self-reported health and employment status

	Not working				**Working**			
Health	Low	Moderate	High	N	Low	Moderate	High	N
Bad/v bad	16.3	30.1	53.6	153	18.9	45.9	35.1	37
Fair	20.8	29.0	50.2	221	33.5	36.3	30.3	251
Good	27.4	36.5	36.1	296	38.1	37.1	24.9	712
Very good	37.3	37.3	25.4	193	43.7	35.0	21.3	625
All	26.0	33.6	40.4	863	39.1	36.4	24.6	1,625

Sample: ELSA respondents aged 65 and under in 2002 (data from 1998 HSE baseline)

Table 4. Fibrinogen risk categories by self-reported health and employment status

	Not working			Working		
Health	Normal	High	N	Normal	High	N
Bad/very bad	69.2	30.8	107	93.3	6.7	30
Fair	79.5	20.5	190	89.1	10.9	211
Good	81.4	18.6	242	89.8	10.2	650
Very good	88.1	11.9	177	88.5	11.5	593
All	80.7	19.3	716	89.3	10.7	1484

Sample: ELSA respondents aged 65 and under in 2002 (data from 1998 HSE baseline)

Table 5: Self-reported health and subjective chances of working five years before State Pension Age

	Men		Women	
Variable	Active	Inactive	Active	Inactive
Constant	57.928	7.257	82.206	6.435
s.e	*7.012*	*2.723*	*11.159*	*3.955*
SRH = fair	6.090	5.068	-0.131	9.430
s.e	*7.371*	*3.676*	*11.394*	*4.899*
SRH = good	8.144	11.511	-0.165	15.142
s.e	*7.124*	*3.730*	*11.229*	*4.851*
SRH = very good	11.336	14.246	0.747	14.540
s.e	*7.139*	*4.011*	*11.245*	*5.401*
F test on age dummies	5.41	0.31	1.87	1.42
df	9, 1460	9, 406	4, 839	4, 287
p value	0.000	0.971	0.114	0.228

Note: Due to gender differences in State Pension Age, dependent variable is percent chance of working at age 60 for males, and percent chance of working at age 55 for females. Samples are those aged 50-59 for males and those aged 50-54 for females.

Table 6

Incidence of self-reported CVD	(1)	(2)	(3)
Male	0.044	0.020	0.020
	(0.021)	(0.021)	(0.021)
Age in 1998	0.004	0.002	0.002
	(0.004)	(0.004)	(0.004)
Middle Educ	-0.046	0.004	0.002
	(0.250)	(0.267)	(0.266)
High Educ	0.383	0.455	0.439
	(0.359)	(0.372)	(0.375)
Middle Educ * Age in 1998	0.001	0.000	0.000
	(0.005)	(0.005)	(0.005)
High Educ * Age in 1998	-0.006	-0.007	-0.006
	(0.005)	(0.005)	(0.005)
Married	-0.025	-0.028	-0.031
	(0.026)	(0.026)	(0.026)
SRH = fair	-0.014	-0.004	-0.007
	(0.049)	(0.048)	(0.048)
SRH = good	-0.035	-0.030	-0.030
	(0.047)	(0.044)	(0.044)
SRH = very good	-0.086	-0.066	-0.064
	(0.045)	(0.043)	(0.043)
Measured BP > 140/90		0.493	0.491
		(0.053)	(0.054)
Any CRP or Fibrinogen risk		0.048	
		(0.020)	
BMI > 25		0.052	
		(0.021)	
CRP risk moderate			0.047
			(0.026)
CRP risk high			0.077
			(0.033)
Fibrinogen risk high			-0.048
			(0.026)
Overweight (BMI 25-30)			0.044
			(0.024)
Obese (BMI > 30)			0.091
			(0.038)
Observations	1,219	1,219	1,219

Standard errors in parentheses

Sample: Those under State Pension Age in 1998 and reporting no CVD conditions at baseline

Table 7

Incidence of SRH = bad/very bad	(1)	(2)	(3)
Male	0.003	0.002	0.005
	(0.019)	(0.019)	(0.019)
Age in 1998	0.005	0.004	0.004
	(0.003)	(0.003)	(0.003)
Middle Educ	0.186	0.233	0.196
	(0.302)	(0.314)	(0.306)
High Educ	0.120	0.135	0.095
	(0.273)	(0.275)	(0.265)
Middle Educ * Age in 1998	-0.004	-0.005	-0.004
	(0.005)	(0.005)	(0.004)
High Educ * Age in 1998	-0.004	-0.004	-0.003
	(0.004)	(0.004)	(0.004)
Married	-0.034	-0.039	-0.037
	(0.024)	(0.024)	(0.024)
Measured BP > 140/90		0.035	0.025
		(0.027)	(0.026)
Any CRP or Fibrinogen risk		0.060	
		(0.019)	
BMI > 25		0.019	
		(0.020)	
CRP risk moderate			0.029
			(0.023)
CRP risk high			0.093
			(0.030)
Fibrinogen risk high			0.009
			(0.029)
Overweight (BMI 25-30)			-0.007
			(0.022)
Obese (BMI > 30)			0.071
			(0.030)
Observations	1,539	1,539	1,539

Standard errors in parentheses

Sample: Those under State Pension Age in 1998 and reporting self-reported general health better than bad/very bad at baseline

Table 8

Incidence of long standing illness	(1)	(2)	(3)
Male	-0.022	-0.033	-0.033
	(0.031)	(0.031)	(0.031)
Age in 1998	0.002	0.001	0.000
	(0.005)	(0.005)	(0.005)
Middle Educ	-0.463	-0.410	-0.452
	(0.210)	(0.229)	(0.214)
High Educ	-0.306	-0.240	-0.271
	(0.284)	(0.310)	(0.298)
Middle Educ * Age in 1998	0.012	0.011	0.012
	(0.008)	(0.008)	(0.008)
High Educ * Age in 1998	0.007	0.006	0.006
	(0.007)	(0.007)	(0.007)
Married	0.024	0.019	0.016
	(0.036)	(0.036)	(0.036)
SRH = good	-0.152	-0.148	-0.141
	(0.049)	(0.049)	(0.050)
SRH = very good	-0.282	-0.273	-0.262
	(0.049)	(0.050)	(0.050)
Measured BP > 140/90		0.189	0.184
		(0.052)	(0.052)
Any CRP or Fibrinogen risk		0.035	
		(0.030)	
BMI > 25		-0.014	
		(0.032)	
CRP risk moderate			0.003
			(0.035)
CRP risk high			0.060
			(0.044)
Fibrinogen risk high			-0.024
			(0.047)
Overweight (BMI 25-30)			-0.031
			(0.034)
Obese (BMI > 30)			0.032
			(0.046)
Observations	887	887	887

Standard errors in parentheses

Sample: Those under State Pension Age in 1998 and reporting no longstanding illnesses at baseline

Table 9

Working in 1998	(1)	(2)	(3)
Male	0.198	0.189	0.187
	(0.024)	(0.026)	(0.026)
Age in 1998	-0.044	-0.042	-0.041
	(0.002)	(0.003)	(0.003)
Middle Educ	0.330	0.320	0.317
	(0.205)	(0.206)	(0.206)
High Educ	0.437	0.432	0.426
	(0.190)	(0.191)	(0.192)
Middle Educ * Age in 1998	-0.006	-0.005	-0.005
	(0.004)	(0.004)	(0.004)
High Educ * Age in 1998	-0.006	-0.006	-0.006
	(0.004)	(0.004)	(0.004)
Married	0.006	0.005	0.001
	(0.028)	(0.028)	(0.028)
SRH = fair	0.295	0.293	0.293
	(0.055)	(0.055)	(0.055)
SRH = good	0.461	0.458	0.454
	(0.047)	(0.047)	(0.048)
SRH = very good	0.502	0.496	0.492
	(0.045)	(0.046)	(0.046)
Reaches SPA between 98 and 02		-0.028	-0.026
		(0.041)	(0.041)
Measured BP > 140/90		-0.030	-0.029
		(0.030)	(0.030)
Any CRP or Fibrinogen risk		-0.040	
		(0.027)	
BMI > 25		0.031	
		(0.027)	
CRP risk moderate			-0.013
			(0.029)
CRP risk high			-0.065
			(0.033)
Fibrinogen risk high			-0.017
			(0.036)
Overweight (BMI 25-30)			0.033
			(0.028)
Obese (BMI > 30)			0.035
			(0.035)
Observations	2,767	2,767	2,767

Standard errors in parentheses

Table 10

Working in 2002, conditional on working in 1998	(1)	(2)	(3)
Male	0.072	0.043	0.042
	(0.023)	(0.025)	(0.025)
Age in 1998	-0.017	-0.011	-0.011
	(0.003)	(0.004)	(0.004)
Middle Educ	0.504	0.486	0.488
	(0.127)	(0.127)	(0.127)
High Educ	0.302	0.326	0.331
	(0.165)	(0.161)	(0.160)
Middle Educ * Age in 1998	-0.014	-0.013	-0.013
	(0.005)	(0.004)	(0.004)
High Educ * Age in 1998	-0.006	-0.006	-0.007
	(0.004)	(0.004)	(0.004)
Married	-0.038	-0.040	-0.040
	(0.025)	(0.025)	(0.025)
SRH = fair	0.146	0.141	0.141
	(0.039)	(0.041)	(0.041)
SRH = good	0.241	0.238	0.236
	(0.062)	(0.063)	(0.063)
SRH = very good	0.202	0.202	0.199
	(0.059)	(0.060)	(0.060)
Reaches SPA between 98 and 02		-0.118	-0.118
		(0.046)	(0.046)
Measured BP > 140/90		-0.007	-0.006
		(0.030)	(0.030)
Any CRP or Fibrinogen risk		-0.012	
		(0.023)	
BMI > 25		0.024	
		(0.025)	
CRP risk moderate			-0.013
			(0.026)
CRP risk high			-0.013
			(0.032)
Fibrinogen risk high			0.010
			(0.036)
Overweight (BMI 25-30)			0.029
			(0.026)
Obese (BMI > 30)			0.012
			(0.031)
Observations	1,312	1,312	1,312

Standard errors in parentheses

Table 11

Working in 2002, conditional on working in 1998	(1)	(2)	(3)
Male	0.048	0.046	0.047
	(0.024)	(0.024)	(0.024)
Age in 1998	-0.010	-0.010	-0.010
	(0.004)	(0.004)	(0.004)
Middle Educ	0.485	0.486	0.485
	(0.127)	(0.127)	(0.127)
High Educ	0.340	0.332	0.342
	(0.159)	(0.160)	(0.159)
Middle Educ * Age in 1998	-0.013	-0.013	-0.013
	(0.004)	(0.004)	(0.004)
High Educ * Age in 1998	-0.007	-0.007	-0.007
	(0.004)	(0.004)	(0.004)
Married	-0.039	-0.039	-0.040
	(0.025)	(0.025)	(0.025)
SRH = fair	0.148	0.133	0.143
	(0.038)	(0.043)	(0.040)
SRH = good	0.249	0.211	0.231
	(0.062)	(0.066)	(0.065)
SRH = very good	0.207	0.172	0.187
	(0.058)	(0.063)	(0.062)
Reaches SPA between 98 and 02	-0.125	-0.121	-0.127
	(0.046)	(0.046)	(0.046)
Onset of mild CVD	-0.038		-0.034
	(0.038)		(0.038)
Onset of severe CVD	-0.181		-0.158
	(0.099)		(0.098)
Onset of other long standing illness	-0.099		-0.091
	(0.045)		(0.045)
Onset of bad self reported health		-0.070	-0.044
		(0.038)	(0.037)
Observations	1,312	1,312	1,312

Standard errors in parentheses

Figure 1: % of men employed or self-employed by age education and year

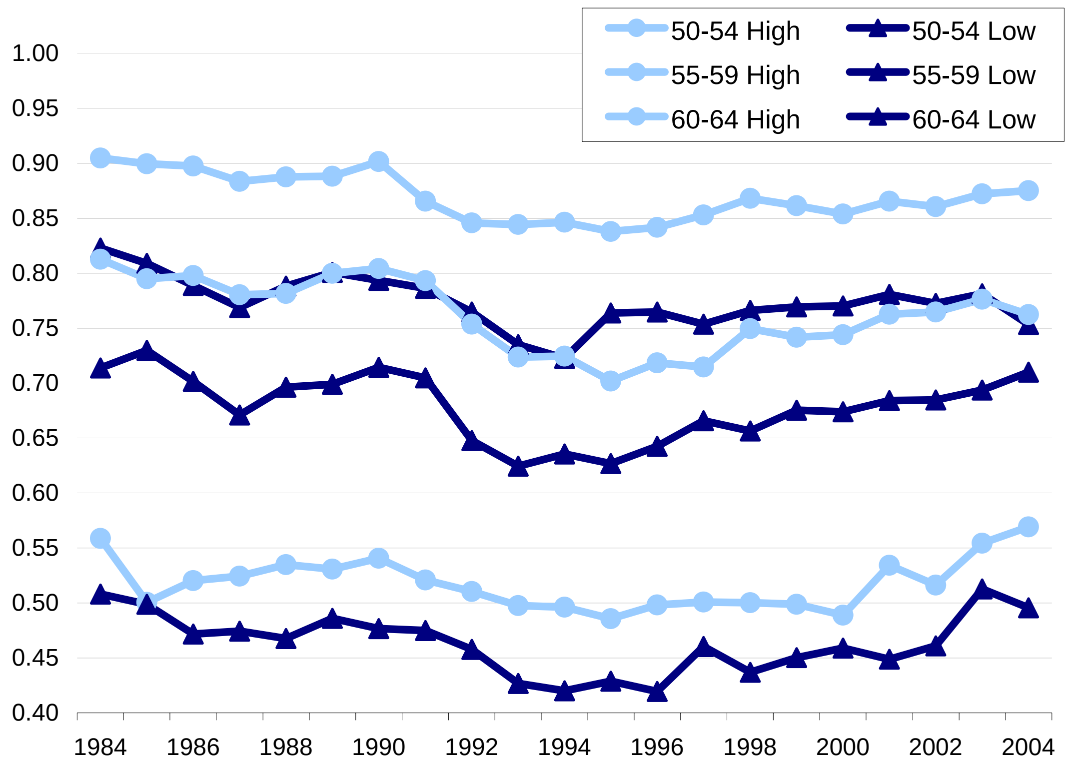


Figure 2: % of women employed or self-employed by education and year

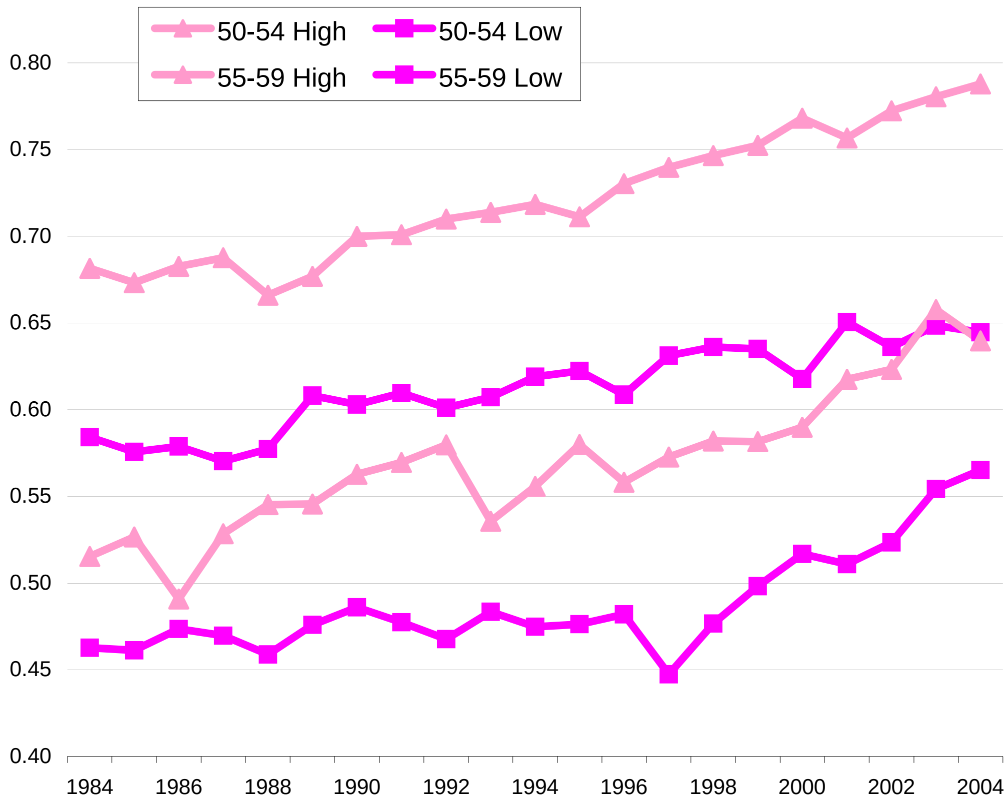


Figure 3: Disability benefit caseloads for older adults, 1980-2004/5

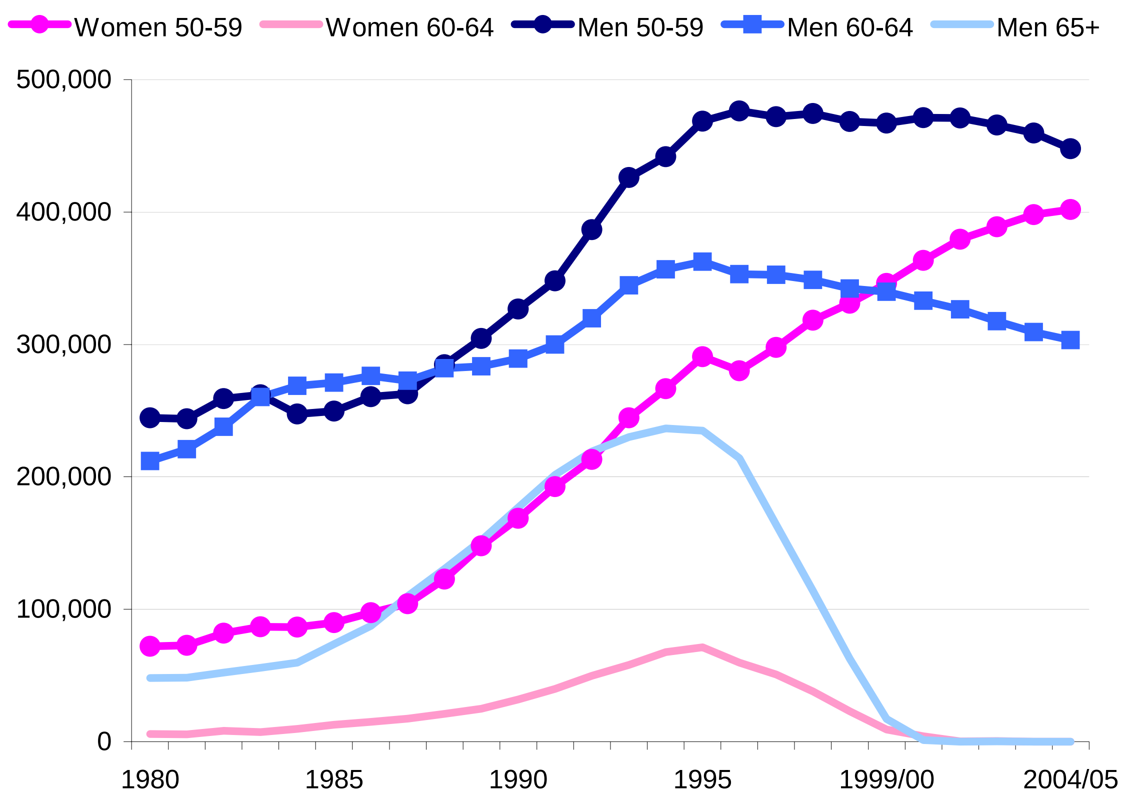
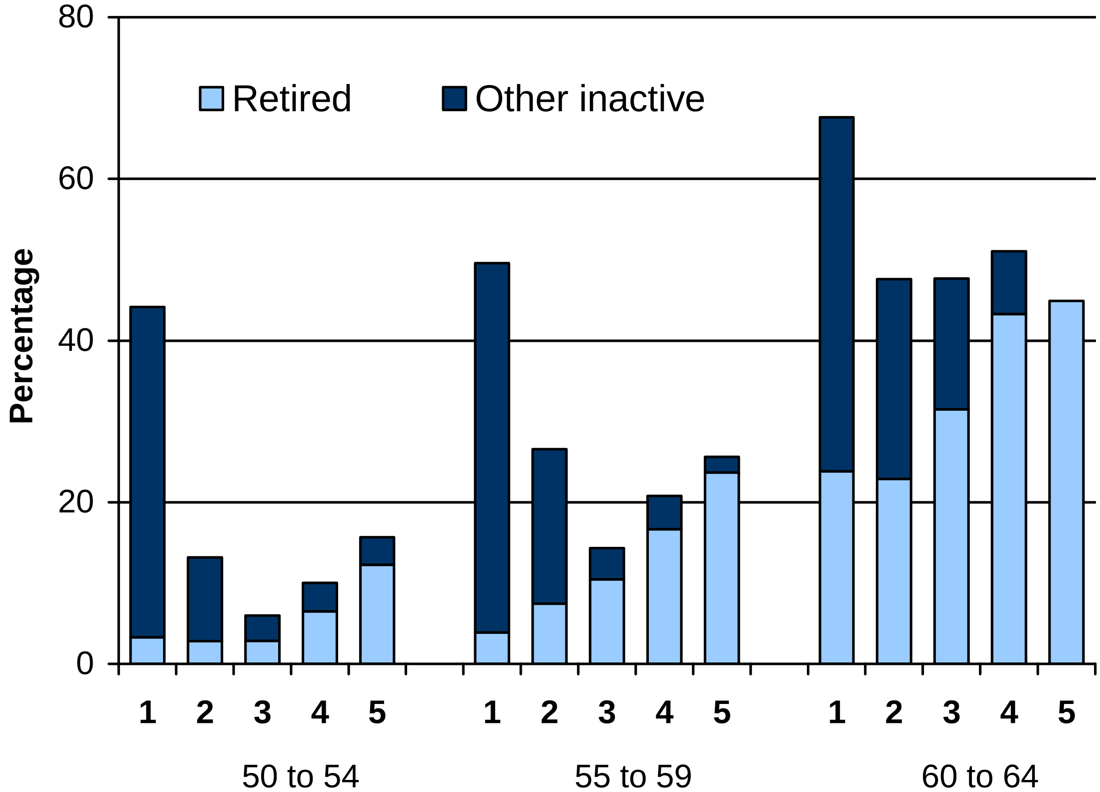
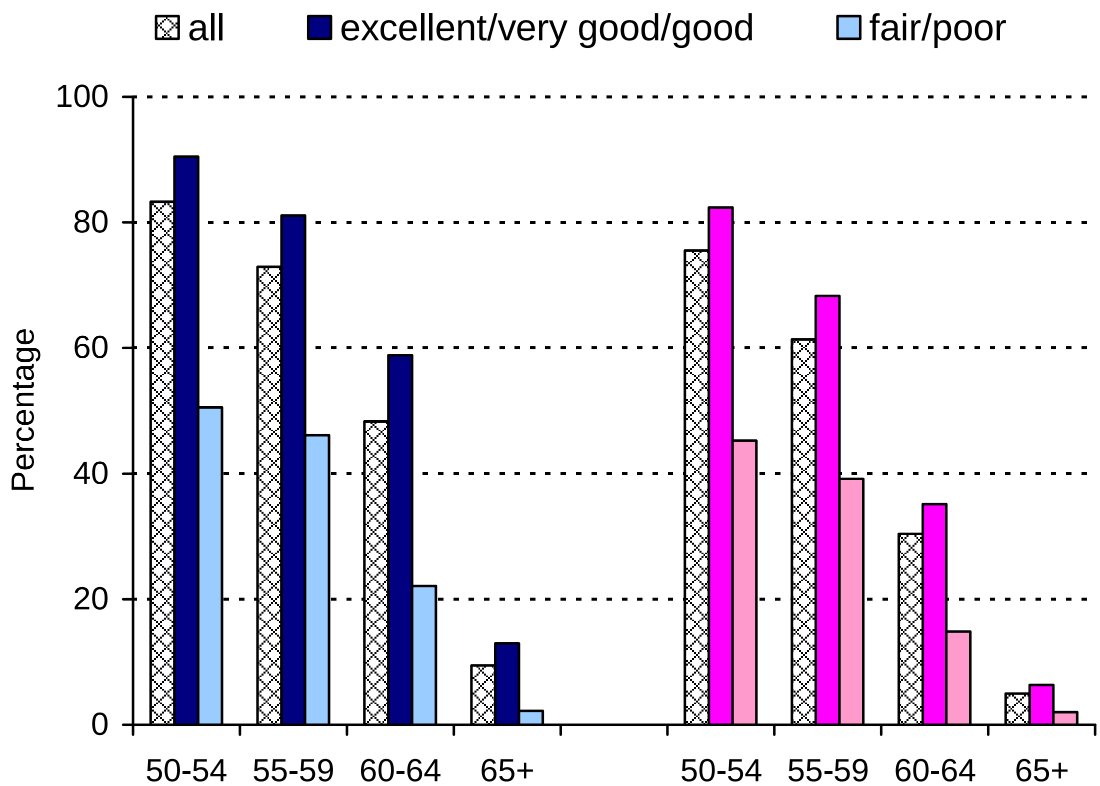


Figure 4: Labour market inactivity by wealth quintile and broad age group



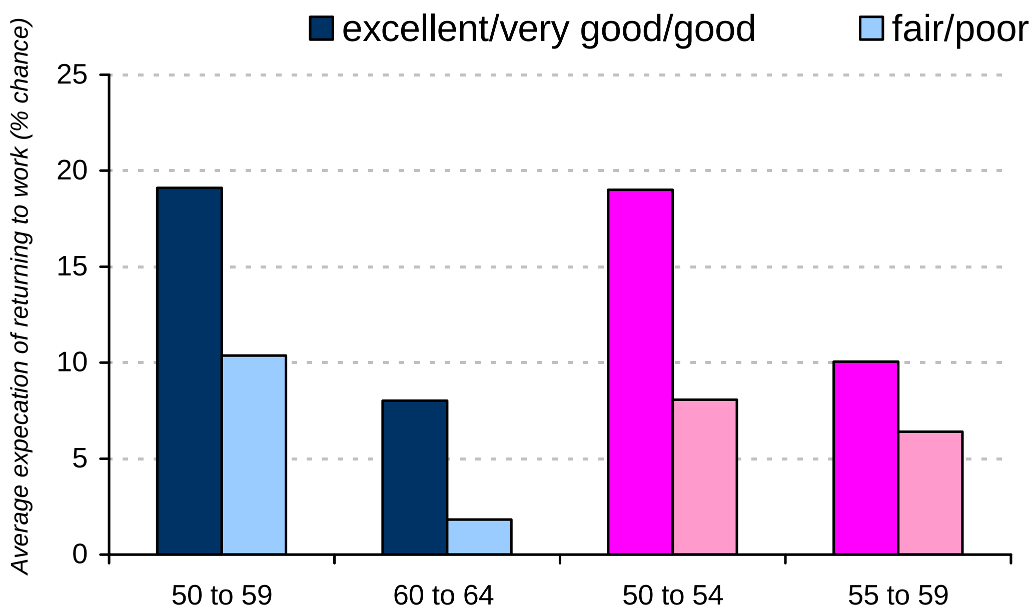
Source: Banks and Casanova (2003), data taken from ELSA 2002

Figure 5: Employment rates, by self-reported health, age and gender



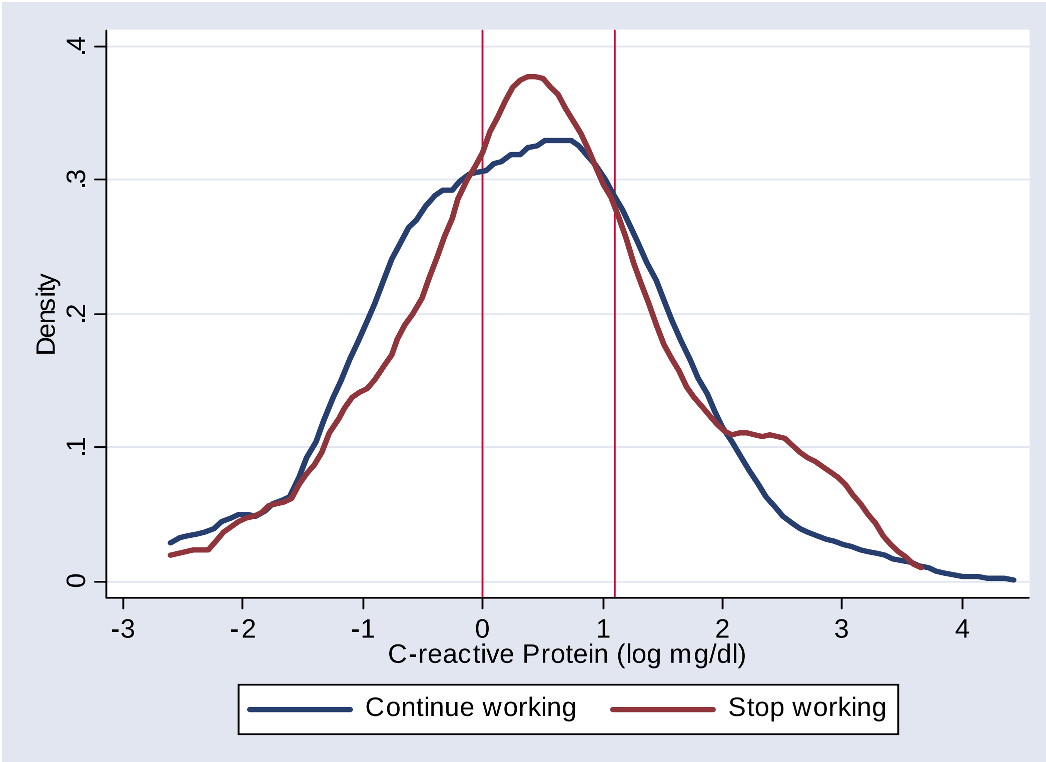
Source: Banks and Casanova (2003), data taken from ELSA 2002

Figure 6: Expectations of working by age, gender and health status, Inactive individuals



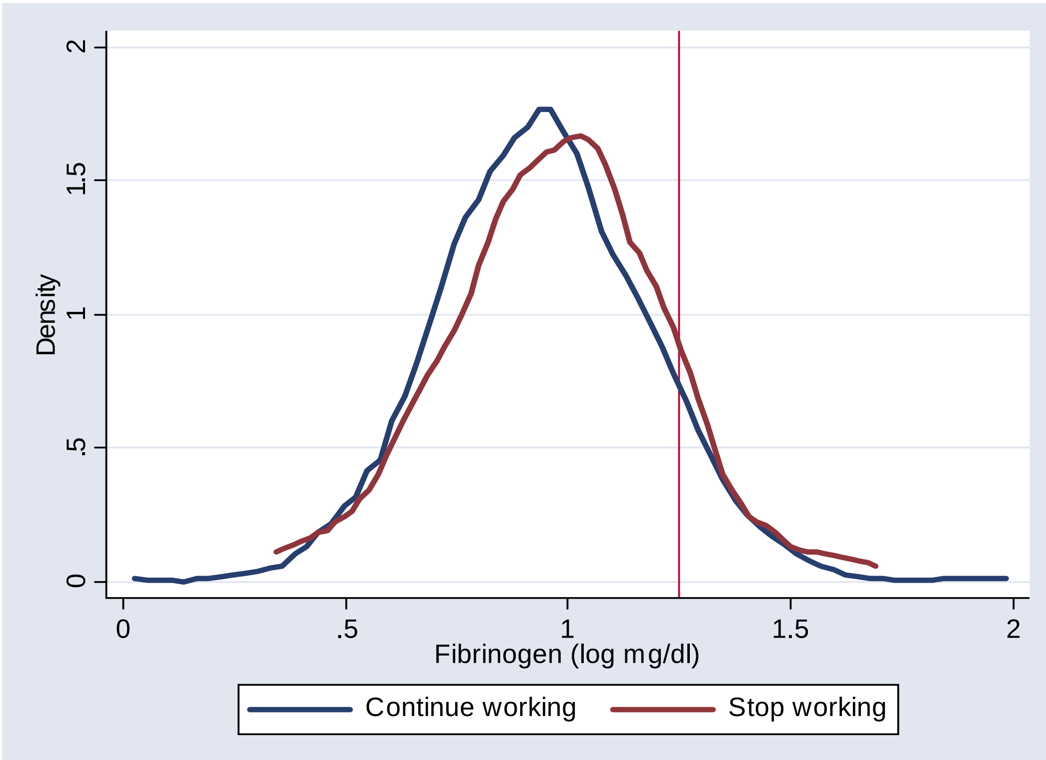
Source: ELSA wave 1 (2002) data.

Figure 6: C-reactive protein, by employment transitions 1998-2002



Sample: ELSA Sample members previously sampled in 1998 HSE, and who were in employment at the time of their HSE interview

Figure 7: Fibrinogen, by employment transitions 1998-2002



Sample: ELSA Sample members previously sampled in 1998 HSE, and who were in employment at the time of their HSE interview