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Is unemployment harmful to health? Evidence from Britain.

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Abstract

This paper investigates the effects of unemployment on health in Britain. It examines the effects of socio-economic variables on the duration of spells of good health by using an accelerated failure time model. Two different measures of health are used, self-assessed health and mobility problems (an objective health index based on a modified 'activities of daily living' index). Furthermore, the paper analyses whether socio-economic effects on good health duration vary between males and females and between the older and younger workforce. The analysis takes into account the role of lifestyle factors. It is found that employment status, education and income have significant effects on the duration of spells of good health. Importantly, unemployment adversely affects the duration of spells of good health, and income exerts a significant positive effect.

JEL Classification Code: C23, C33, I12, J100, J69

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1. Introduction

There has been a substantial interest in the economics literature examining the relationship between socioeconomic status, unemployment and health. The research has shown that there is a close relationship between aspects of the socio-economic status (SES) of individuals and general health. It is a common finding that individuals of lower SES are more disadvantaged in terms of health status compared to individuals who are "better-off".

The complexity of the unemployment-health relationship arises from the existence of endogeneity and selection mechanisms that are operating and make the relationship of interest difficult to be investigated. In particular, not only does unemployment or low income deteriorate health but also, it may be the case that poor health status can become a barrier to obtaining higher income or gaining re-employment, thus can cause increased periods of being out of the labour market. Yet, few studies have investigated the pathways through which the relationship operates.

This study investigates how differences in employment status, income, occupation and deprivation influence the length of time an individual remains in good health, after controlling for a number of individual characteristics. An accelerated failure time model is used, which takes into account unobserved individual heterogeneity. Two measures of health are utilised: self-assessed health and an objective measure of health, namely mobility problems encountered by the individual based on a modified 'activities of daily living' index. The latter measure is considered to be superior to the former measure, which is a subjective assessment.

In addition, this study attempts to tackle the issue of endogeneity in the income / unemployment – health relationship. Since the probability of exit from a spell of good health is estimated for a healthy individual and the labour market status or income is determined at the time of exit from a spell of good health, one should expect that lower health status cannot cause the labour market or income status. This methodology, namely to restrict the sample to those individuals who exhibit good health at the initial point of the survey is often used in applied research in order to circumvent the endogeneity problem, (Lynch *et al.*, 1997; Buckley *et al.*, 2004).

Furthermore, an individual who is healthy for long periods may adopt a lifestyle that may be more detrimental towards health than otherwise which, in turn, may cause loss of health capital, thus adversely affecting the duration of health spell. If prospects of deteriorating health increase as the good health spell continue, Heckman and Borjas (1990) and Lancaster (1979) have shown that there is a positive duration or state dependence. In addition, failure to account for the effects of unobserved personal characteristics[4] which decrease (increase) the probabilities of exiting a spell of good health may also bias the results in favour of a negative (positive) duration dependence. This study attempts to control for unobserved heterogeneity and circumvents the above issues.

The remainder of the paper is set out as follows. Section 2 reviews the literature on the nature of the relationship between employment status, income (and other measures of socio-economic status) and health. Section 3 details the data used for the empirical investigation. Section 4 describes in detail the hazard function methodology employed in the paper. The results are discussed in section 5 and conclusions are presented in section 6.

2. Brief Literature Review

Much has been written on the relationship between health and socioeconomic status (SES), and a thorough review of the literature is beyond the scope of this paper. However, to give a flavour of the research conducted in this area, recent research topics include investigations of race and the health-SES relationship (Navarro 1990 and Smith and Kington, 1997), physical health and labour force status (Martikainen and Valkonen, 1996, and Ruhm, 2000), psychological health and labour force status (Clark and Oswald, 1994, Gerlach and Gesine, 1996, Theodossiou, 1998, and Winkelmann and Winkelmann, 1998), age and the health-SES relationship (Morrell *et al*, 1999 and Grundy and Holt, 2000), and direct and indirect effects of SES on health (Duleep, 1986, and Gerdtham and Johannesson, 2001). Given the focus of this paper on extending the literature along the dimensions of SES effects on the duration of health spells, a brief summary of recent studies that examine the relationship with similar focus is given below.

[4] This may include not only personal or family characteristics but also unobserved factors such as the duration of the good health spell prior to the entrance of the individual in the observation period.

Evidence by Mackenbach *et al* (1990) suggests that variation in mortality rates and health is related more to individuals' socio-economic circumstances than to the level of medical provision and that the contribution of medical care is overshadowed by the impact of factors which affect the initial incidence of diseases and infections among the population. Smith and Kington (1997) find that social class is a key factor in accounting for racial and ethnic differences in health.

One aspect of SES, the "labour force status" of individuals, has been found to have significant effects on health. Moser *et al* (1984), Dahl (1993), and Bartley (1994), explored a number of aspects of the health-labour force status relationship and showed that unemployment is detrimental to an individual's health. Moreover, Gerdtham *et al*, 2003 showed that unemployment has been found to be a health hazard in itself. Rantakeisu *et al* (1999) tested the assumption that differences in health among the unemployed could be a function of financial hardship and experiences of shame using a sample of young unemployed people in Sweden. They found that the unemployed who experienced the greatest financial hardship and shaming experiences reported the worst health outcomes, their lifestyles had deteriorated, their social life was reduced, their self-confidence had diminished and they enjoyed fewer leisure activities such as going to the cinema or taking exercise. Some studies have also found that in old age inactivity can lead to rapid health deterioration. This was not limited to physical activity but also linked to social or productive activity of any kind (Glass *et al*, 1999). Moreover, Moser *et al* (1986) show that not only unemployed men but also their wives have higher mortality rates.

The most compelling research on the effects of unemployment of individuals on health examines the effects of unemployment risk. Ferrie *et al* (1995) examined the effect of anticipating job loss on self-reported health status. They observed that "job insecurity" has negative effects on individual health status for both genders. Men in anticipation of a job change, exhibit deterioration in their self-reported health compared with men that are not in the "anticipation phase". Women also exhibit similar deterioration, but only in a specific number of symptoms.

Ervasti (2002) surveys the findings of research into the deleterious effects of the duration of unemployment spells on mental health. Many of these findings support the existence of a non-linear effect, where psychological distress reaches its peak at the start of the

unemployment period and declines as the unemployment continues. Winefield *et al* (1990) examined the effect of the duration of unemployment spells on psychological distress on a sample of individuals aged 19-24 years. Their evidence supports the nonlinear hypothesis; specifically, distress peaks at about 9 months of unemployment, for the age group studied.

Grobe and Schwartz (2003) used data from the German Health Examination Survey showed that the length of the duration of unemployment acts negatively on self-reported health status, especially among unemployed men. In the case of men, one or more years of unemployment were found to exhibit a four times larger incidence of reporting poor or bad health status, in comparison to permanently employed men. In addition, employed men were found to spend less than half the amount of time in hospital than those unemployed, and unemployed women to spend about 1.7 times longer in hospital in comparison to employed women. They also report that death rates are not only higher among the unemployed in comparison to their employed counterparts, but they increase as the duration of unemployment increases.

There is strong evidence that the employment status effects on individual health status differ substantially according to gender. In fact, Theodossiou (1998) showed that men are more sensitive to unemployment than women. Grundy and Holt (2000) used a sample of individuals aged 55-69 years old, from the study of the Retirement and Retirement Plans Survey to examine the impact on health and disability status of the respondents' social class at different stages of their lives, the proportion of working life spent unemployed and other demographic and SES indicators. They found first that the odds of fair/poor health and disability status increased with the percentage of adult life spent unemployed for men; and second that employment related factors were strongly related to variations in health and disability status for men, in the case of women the indicators with the strongest explanatory power were family related factors.

To the knowledge of the authors, however, the literature has not addressed the effects of socioeconomic status on the duration of spells of good health, and therefore this is the key contribution of the present paper to the literature.

3. The Data

The data used in this study are from the British Household Panel Survey (BHPS), a nationally representative survey of the UK population commencing in 1991.[5] In this study the variable to be explained is the duration of a spell of good health for an individual. This variable is defined as follows. Individuals in good health are identified when they enter the survey. Then the length of the good health is measured (in years). The spell of good health can end in one of three ways. (a) The individual may enter a spell of bad health, (b) leave the panel before the end of the panel (wave 10) whilst still in good health, or (c) still be in good health by the end of the panel (wave 10). In the latter two cases, the period of good health is considered to be a censored observation. Thus, individuals who are observed as having good health from the beginning of the survey are recorded and are followed until the time that they report worsened health status. An individual who does not report deterioration of health by the end of the survey is a censored observation.

The independent variables comprise employment status, and a number of individual characteristics[6] recorded at the point at which the individual exits good health. By recording all the variables at the time of exit it eliminates the possibility of health deterioration causing the independent variables to change. Up to the time of exit the individual has been in good health and therefore the change in health is expected to be attributed to the change in the independent variables.

In this study two measures of physical health outcomes are used:

1. Mobility problems: This health measure is a modified 'Activities of Daily Living' index (Katz *et al*, 1963). In the survey there are a variety of questions regarding ease of mobility. Specifically, there are four questions asking respondents whether their health hinders them (i) doing their housework, (ii) climbing the stairs, (iii) getting dressed, and (iv) walking for more than ten minutes. The responses were coded in four levels, but since there were relatively few individuals in the BHPS who responded by reporting any limitations, this variable was collapsed into an indicator variable taking a value of one if there were any difficulties along

[5] The registered disabled are excluded since they typically have severe health limitations and differential employment experiences compared to the rest of the workforce.

[6] The independent variables included are detailed in Table 5.

any of these dimensions, and zero otherwise. Unfortunately, in wave 9, the set of questions on this issue was changed by the designers of the survey. However, four questions were identified which corresponded to those in the earlier waves, and these were used for wave 9. Respectively these questions were asking the respondents to reveal whether their health limits (i) moderate activities (moving a table, pushing a vacuum cleaner, bowls, golf), (ii) climbing one flight of stairs, (iii) bathing or dressing, and (iv) walking half a mile.

2. Self Assessed Health: This health variable is constructed from the individuals' responses to the question: "Please think back over the last 12 months about how your health has been. Compared to people of your own age, would you say that your health has on the whole been excellent, good, fair, poor, or very poor?" These categories are collapsed to a dummy variable where excellent and good states of health take the value one, and zero otherwise. An adjustment was again required for wave 9. In wave 9 the SF36 questionnaire was introduced and therefore the question enquiring about an individual's general health was not exactly the same as in the earlier waves or wave 10. In wave 9, the question is, "in general would you say your health is excellent, very good, good, fair or poor?" That is, in wave 9 a "very good" category has been inserted between the "good" and "excellent" categories of other waves, and the "very poor" category has been deleted. Thus it is not possible to combine wave 9 with the other waves. To deal with this problem, the responses for the wave 9 question were replaced by using the methodology explained in Appendix 1. The definitions of the variables and their means may be found in Table 5 in Appendix 2.

In order to assess the robustness of the results, the models were also replicated using the UK part of the European Community Household Panel Survey (ECHP). The ECHP is also a longitudinal panel survey covering fifteen European Union countries. The first interviews were carried out in 1994, with an initial sample size of approximately 9,800 households and 19,500 individuals in the first wave for the UK.

The spell of good health is defined in exactly the same manner as in the case of the BHPS data. Furthermore, as was the case for the BHPS, two measures of health are used.

1. Physical and Mental Health Problems, Illnesses and Disabilities (PMID). This variable is constructed based on the responses to the questions "Do you have any chronic physical or mental health problem, illness or disability?" The possible responses to this question are

either "yes" or "no". This variable is then renamed and takes the value one if there are no PMID problems and zero if the individual has developed a PMID problem.

2. Self-Assessed Health: This variable is constructed based on the responses to the question: "How is your health in general?" There are five possible responses to the question: "very good, good, fair, bad, and very bad". Individuals originally report their health as being in one of these five categories. These categories are collapsed to form a dummy variable, where "very good" and "good" take the value one, indicating good health, while "fair", "bad" and "very bad" take the value zero, indicating poor health.

The definitions of the variables and their means may be found in Table 6 in Appendix 2. Importantly, all the regressors which explain

4. Methodology

The Accelerated Failure Time Model

The natural logarithm of the survival time $\ln t$ (namely, the duration of a spell of good health) is expressed as a linear function of the covariates:

$$\ln t_j = x_j \beta + \sigma z_j$$

$$t_j = \exp(X\beta) t_0^{\sigma} \qquad (t_0 = \exp(z))$$

where x_j is a vector of covariates, β is a vector of regression coefficients, σ is a scale parameter, and z_j is the error. Depending on the assumed density for z_j the following models can be derived: for normal density, the lognormal model; for logistic density, the log-logistic model; and for extreme value density, the exponential and Weibull models

Since there are a number of possible distributions that could be encompassed within the above, the Akaike Information Criterion (AIC) can be used in order to identify the density

which best describes the data at hand. The AIC is based on the log likelihood function and takes into account the number of parameters that have to be estimated. It is defined as:

$$AIC = \text{-2 (log likelihood)} + 2(c + p + 1)$$

where c is the number of variables in the model, and p is the number of model-specific ancillary parameters. The best density is the one with the lowest AIC.

Table 7.1 in Appendix 3 shows the AIC test for choosing the most appropriate survival distribution for the BHPS data used in this study. Panel (a) reports the AIC tests for the whole sample, while the remaining panels report the AIC tests for all disaggregations in this paper, namely by gender (panels b and c) and age (panels d and e). Four distributions are considered: exponential, Weibull, lognormal and log-logistic. Table 3.2 reports the respective AIC tests for the ECHP data. The AIC criterion favours the lognormal distribution for all disaggregations.

For the lognormal distribution the error probability distribution function is:

$$(2\pi)^{-\frac{1}{2}} \exp\left(-\frac{1}{2z^2}\right)$$

If it is assumed that the censoring is independent of failure the right censored observations are included, then the log-likelihood function to be maximized is:

$$L = \sum_{i=1}^{n} \delta_i [\ln f(z_i; x) - \ln \sigma] + \sum_{i=1}^{n} (1 - \delta_i) \ln F(z_i; x)$$

where $z_i = \frac{1}{\sigma}(\ln t - X\beta)$, $f(z_i; x)$ is defined above, $\delta_i = 0$ indicates an observation is censored and $F(z; x)$ is given by:

$$\int_z^{\infty} (2\pi)^{-\frac{1}{2}} \exp\left(-\frac{1}{2u^2}\right) du$$

The effect of the accelerated failure time (AFT) model is to change the time scale by a factor of $\exp(-x_j\beta)$. The effect of the covariates is to accelerate or decelerate the duration and thus influence the time of failure. From the above expression for the natural logarithm of the survival time, the hazard function for the failure time t, in terms of the base-line hazard λ_0 can be defined as:

$$\lambda(t;x) = \lambda_0(t\exp(-x\beta)\exp(-x\beta))$$

The survivor function becomes:

$$F(t;x) = \exp\left[-\int_0^{t\exp(-x\beta)}\lambda_0(u)du\right]$$

The lognormal distribution non-monotonic hazard rates initially increase and then decrease. Lognormal distributions tend to produce similar results to the log-logistic distribution.

In the lognormal distribution, the natural log of time has a normal distribution. Therefore the survival and density functions for the lognormal distribution are:

$$S(t) = 1 - \Phi\left(\frac{\ln t - \mu}{\sigma}\right) \quad \Phi \text{ is the standard normal c.d.f.}$$

$$f(t) = \frac{1}{t\sigma\sqrt{2\pi}}\exp\left(-\frac{1}{2\sigma^2}(\ln(t)-\mu)^2\right)$$

where σ is estimated from the data and set $\mu_j = x_j\beta$. In an AFT model a positive coefficient indicates that a unit increase in the relevant covariate delays failure (namely, the end of a spell of good health) and therefore increases the length of the spell of good health.

The survival times are affected by unobservable factors. Thus, an individual who has enjoyed good health status over a long period may be engaging in certain lifestyle activities which affect the probability of improving or deteriorating his or her health status. Thus, for

example, if the individual's lifestyle activities involve investments in health, such as taking exercise, healthy eating, and preventative medical care, then this will lessen the probability of worsening health – as the good health spell continues, there is negative duration dependence. In addition, failure to account for effects of unobserved personal characteristics which decrease (increase) the probability of a good health spell ending may bias the results in favour of a negative (positive) duration dependence (Lancaster, 1979). The above are described as unobservable heterogeneity or frailty[7].

In this study individual heterogeneity is introduced as a multiplicative effect on the hazard function:

$$h(t/\alpha) = \alpha\, h(t)$$

where $h(t)$ is a hazard function. It is assumed that the heterogeneity is a random positive quantity with mean 1 and variance θ. By using the relationship between the cumulative hazard function and the heterogeneity, the hazard function conditional on the heterogeneity is:

$$S(t/\alpha) = \exp\left[-\int_0^t h(u/\alpha)\,du\right]$$

$$= \exp\left[-\alpha\int_0^t \frac{f(u)}{S(u)}du\right]$$

$$= [S(t)]^{\alpha}$$

where $S(t)$ is the survival function that corresponds to $h(t)$. It is not possible to observe α, so one should integrate it out of $S(t/\alpha)$ in order to obtain the unconditional survival function. Since $g(\alpha)$ is a p.d.f. of α, from this an estimable form of the heterogeneity model is achieved as:

$$S_\theta(t) = \int_0^\infty S(t/\alpha)g(\alpha)d\alpha = \int_0^\infty \{S(t)\}^{\alpha} g(\alpha)d\alpha$$

[7] In addition it is hoped that this correction for unobserved heterogeneity will also capture the circumstances of the individual before they enter the survey which are also unobserved.

If the unconditional survival function is available, the unconditional hazard and density functions are found in the usual way:

$$f_\theta(t) = -\frac{d}{dt}(S_\theta(t)) \qquad h_\theta(t) = \frac{f_\theta(t)}{S_\theta(t)}$$

The frailty distribution can be any continuous distribution of positive numbers with expectation 1 and finite variance θ. In this study it is assumed that frailty is distributed as a Gamma distribution with parameters $\left(\frac{1}{\theta}, \theta\right)$. The Gamma distribution with parameters a and b has pdf

$$g(x) = \frac{x^{a-1}e^{-x/b}}{\Gamma(a)b^a}$$

By carrying out the above integrations, using the Gamma distribution as the heterogeneity distribution, the following heterogeneity survival model is obtained:

$$S_\theta(t) = \left[1 - \theta \ln\{S(t)\}\right]^{-\frac{1}{\theta}}$$

Regardless of what distribution it is chosen to represent the heterogeneity,

$$\lim_{\theta \to 0} S_\theta(t) = S(t)$$

and thus the heterogeneity model reduces to $S(t)$ if there is no heterogeneity. Sigma is obtained by 1/p where p is the shape parameter. When p is greater than 1 (and consequently sigma is less than 1) the hazard of failure is increasing with time. If p is considerably greater than 1, this corresponds to a dramatic increase.

5. Results and Discussion

5.1 The socioeconomic determinants of good health: evidence from the BHPS

This section begins by examining the Kaplan-Meier survival functions, which are shown in Figure 1. Figure 1(a) plots the survival function for mobility problems by employment status. Although the figure does not immediately suggest a difference between the survival functions for the unemployed (showed by a solid line) compared with other employment statuses (shown by a broken line), the log rank test shown in Table 8 indicates that the difference is significant at the 7% level (the figure suggesting that the unemployed have a lower chance of remaining in good health). Figure 1(b) shows the corresponding survival function for self assessed health by employment status. It is clear from the figure that the unemployed (again shown by a solid line) have lower survival rates in good health than individuals in other employment statuses, and the log-rank test in Table 8 again confirms this.

The socioeconomic determinants of the duration of a spell of good health are investigated using first the whole sample from the BHPS dataset. The results are presented in Table 1(a). The literature reviewed in section 2 suggested that the key socioeconomic determinants of health status are employment status, income and education, and the results of this paper show that these factors are also key determinants of health duration.

Unemployment appears to have a detrimental effect on the duration of good health (though for the mobility measure of health only at the 12% significance level) compared with individuals in paid employment. Thus, this study shows that unemployment also has a negative effect on the *duration* of good health. This complements the findings of Moser *et al* (1984), Dahl (1993) and Bartley (1994) on the negative effects of unemployment on health; the findings of Gerdtham *et al* (2003) and Rantakeisu *et al* (1999) on the negative effect on health of various bad experiences associated with unemployment; the results of Ferrie *et al* (1995) on the adverse effect of the risk of unemployment on health; and the results from Ervasti (2002), Winefield *et al* (1990) and Grobe and Schwartz (2003) on the negative effect of unemployment duration on health.

Furthermore, households with higher incomes enjoy longer spells of good health, but only for the self-assessed measure of health. This result on the positive effect of household equivalised income on health duration again complements the results in the literature on the effects of income or wealth on health itself, *inter alia*, Goldman *et al* (1995), Ecob and Davey

Smith (1999), Duncan *et al* (2002), Attanasio and Hoynes (2000), Blakely *et al* (2002), Grundy and Holt (2000), Ruhm (2000), van Rossum *et al* (2000), Crossley and Kennedy (2002), Meer *et al* (2003) and Wagstaff *et al* (2001).

Finally, this study also shows that better educated individuals (those with 'A' levels or degrees) have significantly longer spells of good health than those without the benefit of such a standard of education (for the self-assessed measure of health). These findings support the results from Muller (2002) and Sturm and Gresenz (2002) who identified education as being closely related to health. In particular Muller (2002) showed that education is a powerful predictor of mortality. Moreover, better-educated individuals tend to adopt healthier lifestyles (Duncan *et al*, 2002) and increase the ability to take control of their behaviour, and make decisions over a longer time horizon (Fuchs, 2004).

Additionally, a number of interesting results may also be reported regarding the other socioeconomic determinants included in the present study. Individuals who are married or living as married appear to have shorter spells of good health. This result contradicts Grundy and Holt (2000) who state that marriage is usually associated with better health, though, in line with the results of this study, they do point out that marrying when young is associated with poor health. Unsurprisingly, respondents who smoke have shorter spells of good health. There is weak evidence that the oldest individuals were observed to have shorter spells of good health, as far as mobility problems are concerned, a finding that supports the results from Blaxter (1990). Age does not appear to be a significant determinant of health duration, but Table 1(a) shows that one of the four age variables is significant at the 10% level for the self assessed health and all four age dummy variables are significant at the 10% or 5% level for the mobility measure[8]. There are no consistently significant regional effects, in contrast to Grundy and Holt (2000) who identify individuals living outside South East England as more likely to be in poor health.

The likelihood ratio test for heterogeneity, shown by the parameter theta in Table 1(a), confirms that there is heterogeneity present for both health measures. Moreover, it can be

[8] The fact that age does not seem to be significant for the self assessed measure though it does for the mobility measure may reflect the framing of the question regarding the self-assessed health prior to wave 9 (see p.7).

seen, from the parameter "log sigma" in Table 1(a), that there is negative duration dependence for both measures of health[9].

5.2 The effect of gender on the socioeconomic determinants of good health: evidence from the BHPS

The effect of key demographic factors (principally gender, age and ethnicity) on health status is well established in the literature (*inter alia* Theodossiou, 1998; Ruhm, 2000; Blakely *et al*, 2002; Meer *et a*l, 2003; Wu, 2003). Given the cultural and physiological differences between the genders, this section of the paper investigates whether gender has a similar effect on the relationship between socioeconomic status and health duration. Before proceeding directly to the econometric results, it is once again instructive to first look at the survival functions, this time disaggregated by gender. Figure 1(c) plots the survival function for mobility problems by gender, which highlights a clear difference between the survival rates of males (shown by the higher, broken line) and females (shown by the lower, solid line). The higher male survival rate is confirmed by the log-rank test reported in Table 8 (with males having a higher chance of remaining in good health than females). Finally Figure 1(d) shows the corresponding survival function for self assessed health by gender, and also shows that females have lower survival rates than males, and this is confirmed to be significant by the log-rank test detailed in Table 8.

The effects of gender on the socioeconomic determinants of the duration of a spell of good health are presented in Table 1(b). Looking first at the key socioeconomic determinants of health, namely, employment status, income and education, it can be seen that all have strong effects on health duration. Importantly, the unemployed have shorter spells of good health than those in paid employment - a significant result for both genders. Household equivalised income has a strong and significantly beneficial effect on the health of both genders for both health measures. It is worth noting that, although income was not significant for the mobility problems measure considering all individuals together, it turns out to be very significant for

[9] Duration dependence is captured by the parameter p, a shape parameter estimated from the data, where $p > 1$ may be interpreted as the hazard of failure increasing with time. Letting $\sigma = 1/p$ and hence that $\log \sigma = -\log p$, and noting that a larger value of $-\log p$ therefore represents increasing failure over time, i.e. duration dependence.

both men and women when the genders are considered separately. Education is also identified as a strong determinant of health duration. Those with a degree have an increased likelihood of enjoying longer spells of good health. Additionally, women with A-levels also enjoy the likelihood of longer spells of good health. The results therefore reinforce those found in the existing literature looking at the relationship between socioeconomic status and health, including Duncan *et al* (2002), Ecob and Davey Smith (1999), Sacker *et al* (2000) and van Rossum *et al* (2000), but additionally identify these factors also as the principal determinants of health *duration*, when gender differences are taken into account.

The results also identify some other interesting facets of the relationship between socioeconomic status and health duration when disaggregated by gender. The negative effects of smoking on good health duration are significantly greater for women than men. While older males are more likely to have shorter spells of good health, the results show a more complex age effect for women. Women appear to have a lower probability of enjoying long spells of good health at all ages compared to men, and seem to suffer this effect earlier in life than men. These results may go some way to support those of Duncan et al (2002), Wildman (2003), Björksten and Tälback (2001) and Griffin *et al* (2002), which identify females as being more susceptible to the effects of economic deprivation, family size, the workload at home and feeling of lack of control in the household. Moreover, in contrast to the conventional wisdom that females are more resilient to the effect of socioeconomic status on physical health (van Rossum *et al*, 2000), the results in this paper seem to confirm those of Theodossiou (1998) and Flatau et al (2000) which appear to reveal a greater vulnerability among females to the effect of socioeconomic status on psychological health. In line with the results of the previous section, individuals who are married or living as married are found to have a significantly increased risk of shorter duration of good health. Again, there appear to be no consistent regional effects.

The null hypothesis of no heterogeneity ($\theta = 0$) is rejected in all cases, as can be seen in Table 1(b), except for men with mobility problems. It is also clear by looking at the parameter "log sigma" in Table 1(b), that there is negative duration dependence, except again for men with mobility problems.

Whether unemployment had a significant effect on the survival function when the sample was split by gender was also investigated, and the findings are reported in Table 9 in

Appendix 4. For the self-assessed measure of health, the effect of unemployment is significant for both women and men[10]. Nevertheless, although the difference in the survival rate in a good spell of health is not significant for unemployment women or those out of the labour market.

5.3 The effect of age on the socioeconomic determinants of good health: evidence from the BHPS

An area of increasing concern in health policy in the light of the evidence of an ageing workforce is the effect on the socioeconomic status on health for the different age groups. The results showing the socioeconomic effects on the duration of good health by age are presented in Table 1(c). The sample is disaggregated into two groups: those aged 18-45; and those aged 46-65. The latter category represents what is termed "the older workforce" – people who are working but approaching retirement, and whose health has important implications for labour force participation and retirement policies.

It is well established in the literature that the effect on health of low socioeconomic status varies with age. The received wisdom is that health disparities arising from socioeconomic factors increase with age until after retirement (House *et al*, 1994; Van Ourti, 2003) and then weaken thereafter (Martelin, 1994; Ecob and Davey Smith, 1999; O'Reilly, 2002 and Theodossiou, 1998). The findings in the present study, however, yield a number of different conclusions. Unemployment is found to have a negative effect on the duration of a good health spell for the younger workforce, for both measures of health. Yet, for the older workforce, the effect is at best only marginally significant for mobility problems, and insignificant for self assessed health. This may lend some weight to the claim by Ervasti (2002) that, although unemployment has less severe mental health effects on young people (as they are more willing to adapt and place less value on social position), older workers embody a certain degree of experience that puts them in a better position to cope with the effects of unemployment. Retirement and being out of the labour market also have negative effects on the duration of good health for the older age group. This finding explains the lack of the unemployment effect on health duration for the older age group, as individuals who experience unemployment at relatively old age may decide to retire early or drop out of the

[10] However, it should be noted that, when using the mobility problems measure of health there is the problem with the low failure count.

labour market and thus the effect of unemployment on the duration of good health is masked as a retirement and being out of the labour market effect. Together, these results imply that labour force participation decisions are greatly affected by health deterioration and highlight the importance of policies aimed at reducing the negative effects of unemployment on health for this age group.

The effect of household equivalised income on health duration is similar for both age groups. Low income, it appears, has detrimental effects on health duration irrespective of age. Thus, in contrast to the studies cited above which suggest a weakening of the effect of socioeconomic factors on health, this study suggests that, income is an important determinant of health duration which persists strongly throughout working life. On the other hand, education effects are in line follow the results found in the literature in diminishing as age progresses: education is found to have a particularly positive effect on health duration for the younger workforce.

The other individual characteristics included in this study exhibit a number of important age related effects. The negative effect of being married (or living as married) turns out to be strong and significant for the 18-45 age group. This may be partly consistent with Grundy and Holt (2000) who claim that marriage is usually beneficial to health but at an early age it may be associated with poor health. In the 18-45 age group women are shown to have shorter spells of good health. This may support the literature cited in the previous section which suggests that female frailty with respect to health manifests itself at an earlier age than for males. Smoking appears to have a deleterious effect on health only for the younger age group (18-45 years). This may reflect the fact that natural selection at an earlier age has reduced the effect of smoking on the older workforce. No significant regional effects are found in this study.

The null hypothesis of no heterogeneity is also rejected in these disaggregations, as shown by the parameter theta in Table 1(c). The hazard of losing good health exhibits negative duration dependence, captured by the parameter "log sigma" in Table 1(c), in all cases apart from mobility problems for the 18-45 age group. For this group the probability of an individual in the 18-45 age group encountering mobility problems is actually decreasing with time in good health until they enter the 46-65 age group.

5.4 The socioeconomic determinants of good health: evidence from the ECHP

This section investigates the robustness of the results by examining their validity for a different dataset. The models presented in the earlier sections are replicated using the ECHP dataset for the UK. In the ECHP there is also a self-assessed measure of health, allowing direct comparison. Although there is not a direct comparator for the "mobility problems" health indicator of the BHPS, the ECHP offers a health measure which is based on "physical and mental health problems, illnesses and disabilities", which will be used to provide a comparison. The unemployment effect on health duration from the ECHP data is very similar to that revealed by the BHPS data - individuals who are unemployed again enjoying shorter spells of good health. In the ECHP dataset, household income is divided into quartiles, and, as can be seen from Table 2, individuals in the highest quartile have significantly longer spells of good health. The results from the ECHP data also are in line with the findings regarding education. As Table 2 confirms, individuals with higher (second and third levels[11]) levels of education are likely to have longer spells of good health (than those with only the first level of education or less) for both measures of health used in the ECHP.

Turning next to gender effects, the finding that the unemployed have shorter spells of good health is confirmed for both health measures in the ECHP dataset but only for men, as shown in Table 3. This suggests that unemployment has a greater effect on the health duration for men due to their traditional role as breadwinner of the household, whereas unemployment is not so critical for women who find an alternative to paid employment in household production (Theodossiou, 1998), and hence unemployment is not so stressful in terms of the impact on their health duration. This line of reasoning would also be supported by the finding shown in Table 3 with respect to household equivalised income where there is a significant difference for men and women with incomes in the highest quartile for the PMID measure and these are only significant effects for men with incomes in the highest quartile for the self assessed measure. Thus it appears that men's health duration is more sensitive to income than women's, perhaps reflecting the burden placed on males fulfilling their traditional role as breadwinner in the household. There are again strong education effects in the ECHP for both males and females.

[11] Third level education is taken to be equivalent to a degree or professional qualification and second level education to A-levels or equivalent higher school qualification.

The age effects are detailed in Table 4. Whereas in the BHPS, unemployment affected the health duration of the younger age group, evidence from the ECHP shows a less strong effect, and indeed, for the self-assessed measure of health, affects the older age group more. The effect of income is greatest for the older age group, consistent with the findings from the BHPS. The positive effect of education on health duration, particularly for the younger workforce, is also seen in the ECHP when using the PMID measure. Overall, the results from the ECHP support the results obtained by using the BHPS.

6. Conclusions

This paper investigates the effect of labour market status and income in the hazard of someone exhibiting deterioration in his or her health status. The key results show that individuals with higher incomes have longer spells of good health and that unemployment has a detrimental effect on health duration. This result is obtained by circumventing the problem of endogeneity in the duration of health – unemployment/income relationship since the individual is shown to have been in good health up to that point of becoming unemployed and only after that point does health deteriorate. Thus, in this framework it is unemployment that causes loss of health, not loss of health that is causing unemployment. Importantly, this study finds that unemployment, after controlling for income and education, appears to cause adverse health effects.

It is also shown that respondents with higher levels of qualifications have longer spells of good health. Age has the expected effect of older respondents being in poorer physical health. The negative effects of being married and smoking are particularly strong for women and the younger workforce. There are no discernable regional effects. Importantly, this study shows that individual heterogeneity is important in determining the probability of exit from a spell of good health and in particular this study shows negative duration dependence.

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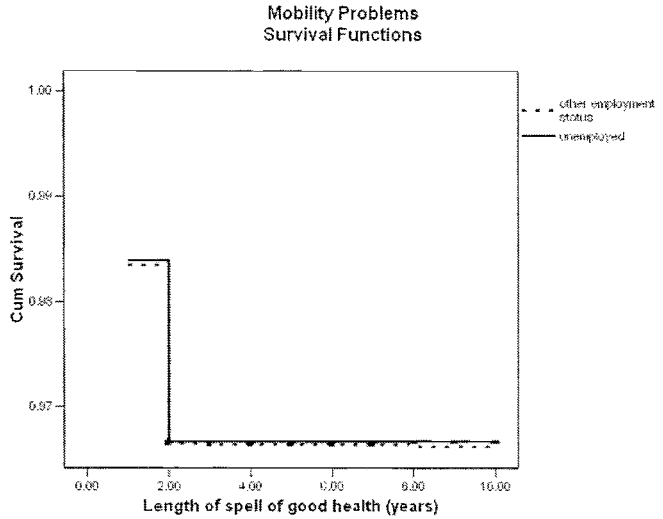
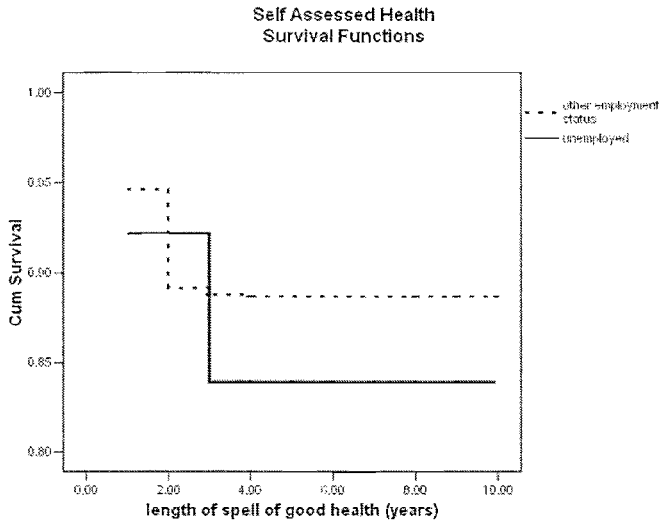
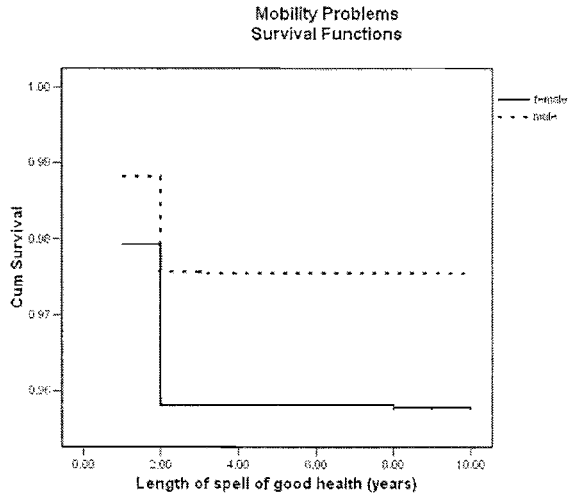
Figure 1 Survival Functions



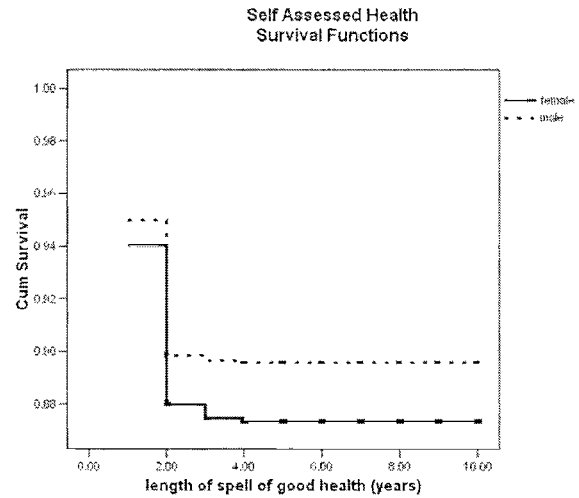
1(a)



1(b)



1(c)



1(d)

Table 1 The socioeconomic determinants of good health

Table 1(a) The socioeconomic determinants of good health (whole sample)

	Self-assessed health		Mobility problems	
Variable	**Coefficient**	**z-value**	**Coefficient**	**z-value**
Age 29 - 39	0.034	0.95	-0.292**	-2.34
Age 40 - 49	0.061	1.52	-0.284*	-1.85
Age 50 - 59	0.014	0.34	-0.800**	-2.11
Age 60 - 65	0.130**	2.06	-0.662*	-1.80
Gender	-0.029	-1.16	-0.401	-1.42
Degree	0.208***	5.45	0.434	1.11
A-levels	0.150***	3.61	0.393	1.10
O-levels	0.018	0.51	0.202	0.76
Other qualification	0.026	0.63	0.110	0.75
Equivalised Income	0.074***	5.00	0.197	1.32
Self Employed	-0.034	-0.73	0.024	0.16
Unemployed	-0.144***	-2.87	-0.521	-1.55
Retired	0.070	1.10	-0.246	-0.90
Non-employed	-0.070**	-2.10	-0.294	-0.88
Married	-0.148***	-4.24	-0.639**	-2.25
Was married	-0.043	-0.84	-0.317	-1.51
No. cigarettes smoked	-0.006***	-4.17	-0.019*	-1.84
Remote area	-0.002	-0.05	0.050	0.42
Accessible area	0.050	1.25	-0.047	-0.36
South England	0.085	1.47	0.341	1.35
East England	0.006	0.09	0.286	1.06
West England	0.173**	2.49	0.148	0.75
North England	0.054	0.98	0.369*	1.67
Wales	-0.178***	-3.04	-0.107	-0.36
Scotland	-0.122**	-2.29	0.109	0.49
Constant	-0.059	-0.81	1.312	0.83
Log sigma	-1.101***	-19.91	-0.788	-0.76
Log theta	6.477***	67.00	8.659***	3.03
Number of obs	12748		15332	
No. of failures	1493		438	
Time at risk	45918		67839	
Wald chi2(25)	115.47		55.31	
Log pseudo-likelihood	-5460.7548		-2230.302	
Prob > chi2	0.0000		0.0004	

Stars are used to indicate level of significance: *** significant at 1% level, ** significant at 5% level, * significant at 10% level

Table 1 (b) The socioeconomic determinants of health (split by gender)

	Self assessed health	Male	Self assessed health	Female	Mobility problems	Male	Mobility problems	Female
Variable	**Coefficient**	**z-value**	**Coefficient**	**z-value**	**Coefficient**	**z-value**	**Coefficient**	**z-value**
Age 29 – 39	-0.001	-0.02	0.128**	2.37	-0.222	-0.47	-0.306**	-2.19
Age 40 – 49	0.038	0.59	0.157***	2.61	-0.636	-1.37	-0.323**	-2.33
Age 50 – 59	-0.062	-0.95	0.137**	2.11	-1.682***	-3.78	-0.417***	-2.71
Age 60 – 65	-0.029	-0.34	0.422***	3.75	-1.668***	-3.25	-0.226	-1.17
Degree	0.233***	4.15	0.252***	4.27	0.982***	3.27	0.472***	3.20
A-levels	0.098	1.56	0.265***	4.03	0.649	1.60	0.532***	2.80
O-levels	0.021	0.36	0.027	0.52	0.604*	1.83	0.267**	2.07
Other qualification	-0.013	-0.19	0.035	0.53	-0.168	-0.49	0.263*	1.76
Equivalised Income	0.068***	3.73	0.114***	5.36	0.626***	3.06	0.169***	2.69
Self Employed	-0.001	-0.00	-0.158	-1.49	-0.001	-0.00	-0.040	-0.22
Unemployed	-0.123*	-1.86	-0.175**	-2.03	-0.956**	-2.48	-0.692***	-3.36
Retired	0.180*	1.88	-0.052	-0.50	-0.059	-0.13	-0.711***	-3.38
Non-employed	-0.062	-0.92	-0.086**	-1.98	-1.673***	-3.45	-0.264**	-2.36
Married	-0.131**	-2.53	-0.239***	-4.41	-1.071**	-2.34	-0.701***	-5.13
Was married	-0.077	-0.80	-0.107	-1.44	-0.663	-1.16	-0.416***	-2.67
No. cigarettes smoked	-0.004*	-1.91	-0.009***	-4.22	-0.015	-1.38	-0.024***	-4.33
Remote area	0.058	0.87	-0.057	-0.89	0.418	1.10	-0.030	-0.21
Accessible area	0.015	0.26	0.115*	1.84	-0.068	-0.21	0.012	0.08
South England	0.233***	2.69	-0.024	-0.28	0.162	0.29	0.173	0.77
East England	0.078	0.86	-0.037	-0.41	0.625	0.10	0.173	0.67
West England	0.378***	3.48	0.035	0.35	0.026	0.04	-0.099	-0.46
North England	0.089	1.12	0.081	1.00	0.134	0.24	0.193	0.95
Wales	-0.023	-0.26	-0.368***	-4.29	-1.227**	-2.24	-0.097	-0.44
Scotland	-0.012	-0.16	-0.264***	-3.33	-0.739	-1.38	0.102	0.51
Constant	-0.301***	-3.21	-0.070	-0.72	7.645***	6.06	0.659**	2.42
log sigma	-1.080***	-21.20	-1.042***	-16.65	1.018***	9.25	-0.805***	-4.35
log theta	6.747***	110.61	6.008***	48.74	0.584	0.22	8.417***	17.19
Number of obs	6222		6526		7416		7916	
No. of failures	659		834		148		290	
Time at risk	22676		23242		32521		35318	
Wald chi2(25)	79.22		87.17		284.27		80.45	
Log pseudo-likelihood	-2500.38		-2981.84		-783.29		-1422.71	
Prob > chi2	0.0000		0.0000		0.0000		0.0000	

Stars are used to indicate level of significance: *** significant at 1% level, ** significant at 5% level, * significant at 10% level

Table 1 (c) The socioeconomic determinants of health (split by age)

	Self assessed health	18-45	Self assessed health	46-65	Mobility problems	18-45	Mobility problems	46-65
Variable	**Coefficient**	**z-value**	**Coefficient**	**z-value**	**Coefficient**	**z-value**	**Coefficient**	**z-value**
Age at time of exit	0.005**	2.23	0.015**	2.27	-0.013	-1.16	-0.010	-0.92
Gender	-0.052*	-1.71	-0.029	-0.52	-0.835***	-4.45	-0.101	-0.96
Degree	0.236***	4.81	0.215**	2.34	0.905***	3.46	0.193	1.38
A-levels	0.167***	3.33	0.163	1.31	0.495*	1.87	0.7765***	2.65
O-levels	0.033	0.73	-0.004	-0.05	0.260	1.09	0.404**	2.19
Other qualification	0.134**	2.33	-0.137*	-1.65	0.044	0.17	0.177	1.00
Equivalised Income	0.058***	3.71	0.162***	3.82	0.414**	2.36	0.154***	2.90
Self Employed	0.016	0.25	-0.177*	-1.88	0.178	0.52	-0.197	-1.13
Unemployed	-0.189***	-3.44	0.085	0.67	-0.792***	-2.85	-0.356*	-1.66
Retired			0.086	0.97	-2.133	-1.34	-0.366**	-2.06
Non-employed	-0.045	-1.18	-0.207**	-2.25	-0.338*	-1.64	-0.715***	-3.27
Married	-0.195***	-4.85	-0.152	-1.18	-1.003***	-4.30	-0.168	-1.00
Was married	-0.153**	-2.22	0.091	0.65	-0.708**	-2.09	0.103	0.54
No. cigarettes smoked	-0.008***	-4.52	-0.005	-1.50	-0.034***	-4.33	-0.010*	-1.78
remote area	0.134**	2.39	-0.146*	-1.72	0.023	0.09	0.156	0.99
accessible area	0.099**	2.01	-0.038	-0.43	0.020	0.08	0.084	0.52
South England	0.066	0.98	0.004	0.03	0.248	0.69	0.574*	1.94
East England	-0.043	-0.59	-0.030	-0.22	0.633	1.56	0.158	0.54
West England	0.156*	1.90	0.139	0.88	0.011	0.03	0.099	0.31
North England	0.056	0.86	-0.116	-0.92	0.749**	2.17	0.208	0.79
Wales	-0.098	-1.44	-0.579***	-3.16	-0.432	-1.20	0.001	0.00
Scotland	-0.083	-1.33	-0.459***	-2.81	-0.129	-0.38	0.126	0.50
Constant	-0.098	-0.93	-0.742*	-1.91	5.679***	4.24	0.513	0.65
log sigma	-1.066***	-17.64	-0.980***	-4.70	0.524*	1.93	-0.870***	-3.37
log theta	6.280***	58.43	6.376***	13.89	4.479***	3.51	8.181***	12.75
Number of obs	8771		3977		10659		4673	
No. of failures	1004		489		204		234	
Time at risk	28365		17553		44189		23650	
Wald chi2(25)	89.18		19.16		125.42		20.79	
Log pseudo-likelihood	-3627.16		-1831.34		-1109.27		-1098.20	
Prob > chi2	0.0000		0.6356		0.0000		0.5340	

Stars are used to indicate level of significance: *** significant at 1% level, ** significant at 5% level, * significant at 10% level

Table 2 All individuals grouped together (ECHP)

	Self-Assessed Health		Physical and Mental Health Problems Illnesses and Disabilities	
Variable	Co-efficient	Z-value	Co-efficient	Z-value
Self-employed	0.0953*	1.85	0.0265	0.54
Unemployed	-0.1572***	-2.84	-0.1220**	-1.96
Full-Time education or training	0.1139	1.37	0.0333	0.37
Retired	-0.0326	-0.44	0.0001	0.00
Out of labour market	-0.0372	-0.98	0.0132	0.32
Second level education	0.2307***	6.39	0.2284***	6.04
Third level education	0.1737***	5.93	0.1230***	4.04
Income Group 2	-0.0410	-1.11	0.0249	0.62
Income Group 3	-0.0184	-0.48	0.0093	0.23
Income Group 4	0.0717*	1.81	0.1294***	3.08

Table 3 Individuals split by age and gender (Self Assessed Health) (ECHP)

	20 - 40		41 - 65		Males		Females	
Variable	Co-efficient	Z-value	Co-efficient	Z-value	Co-efficient	Z-value	Co-efficient	Z-value
Self-employed	0.0159	0.12	0.2399***	2.64	0.1062*	1.72	0.1025	1.05
Unemployed	-0.1179	-0.11	-0.2821**	-2.30	-0.2053***	-3.04	-0.0907	-0.86
Full-Time education or training	0.1189	0.25	-0.0518	-0.20	0.1588	1.22	0.0639	0.61
Retired	0.8133	0.15	-0.0337	-0.36	0.0526	0.40	-0.0830	-0.94
Out of labour market	-0.0117	-0.18	-0.0870	-1.32	0.1295	1.16	-0.0729*	-1.72
Second level education	0.2350	0.14	0.2571***	3.14	0.2204***	3.99	0.2507***	5.28
Third level education	0.1395	0.11	0.2774***	4.95	0.1724***	3.98	0.1707***	4.24
Income Group 2	-0.0329	-0.19	-0.0051	-0.06	-0.0695	-1.22	-0.0178	-0.36
Income Group 3	0.0053	0.04	0.0065	0.09	-0.0342	-0.60	-0.0067	-0.13
Income Group 4	0.0637	0.11	0.1770**	2.39	0.0980*	1.66	0.0472	0.92

Table 4 Individuals split by age and gender (Physical and Mental Health Problems Illnesses and Disabilities) (ECHP)

	20 - 40		41 - 65		Males		Females	
Variable	Co-efficient	Z-value	Co-efficient	Z-value	Co-efficient	Z-value	Co-efficient	Z-value
Self-employed	0.106	1.05	0.020	0.33	-0.001	-0.02	0.128	1.24
Unemployed	-0.113	-0.99	-0.170	-1.50	-0.138**	-1.98	-0.053	-0.40
Full-Time education or training	0.002	0.02	-0.019	-0.08	-0.025	-0.19	0.122	1.01
Retired	1.953***	10.09	0.003	0.04	-0.102	-0.90	0.096	0.97
Out of labour market	-0.009	-0.12	0.060	0.98	0.106	0.88	0.005	0.12
Second level education	0.382***	4.83	0.196**	2.51	0.206***	3.70	0.266***	5.05
Third level education	0.191***	3.51	0.144*	1.66	0.118***	2.66	0.134***	3.21
Income Group 2	0.037	0.52	0.080	1.22	-0.012	-0.21	0.074	1.40
Income Group 3	-0.006	-0.08	0.089	1.50	-0.043	-0.76	0.067	1.21
Income Group 4	0.129*	1.73	0.251***	2.89	0.140**	2.33	0.110**	1.96

Stars are used to indicate level of significance: *** significant at 1% level, ** significant at 5% level, * significant at 10% level

Appendix 1

Recoding methodology for wave 9

In wave 9 the question and possible responses are changed. The SF36 health questionnaire was implemented in wave 9 and therefore some of the health questions are slightly different. In wave 9 the closest question to, "*Please think back over the last 12 months about how your health has been. Compared to people of your own age, would you say that your health has on the whole been excellent, good, fair, poor, or very poor?*" is, "*In general would you say your health is excellent, very good, good, fair or poor?*" Though at first glance the question is almost identical there is a problem with the possible responses. Although there are 5 possible responses for both questions, they cannot be split into good health and poor health in the same way. The question used in the other waves has two responses ("excellent" and "good") that indicate good health and three responses ("fair", "poor" and "very poor"), which indicate poor health. The question in wave 9 has three responses ("excellent", "very good" and "good") indicating good health and only two responses ("fair" and "poor") indicating poor health. Therefore it is not possible to simply re-label the groups for wave 9 and combine this wave with the other nine waves. Thus, the responses for wave 9 were recoded, based on the response to the question, "*Compared to one year ago, how would you rate your health in general now?*" The possible responses are: "much better than a year ago", "better than a year ago", "about the same", "worse than a year ago", "much worse than a year ago". The recoding process combined the three good health categories ("excellent", "very good" and "good") into two ("excellent" and "good") and expanded the two poor health categories ("fair" and "poor") into three ("fair", "poor" and "very poor"). To collapse the three categories into two, all the individuals in the very good category were recoded into either the "excellent" or "good" categories. The first step involved recoding all individuals in the "very good" category who say their health is "better or much better than a year ago" into the "excellent" category. This leaves the remainder who say their health is "about the same or worse" in the "good" category. The recoding must also expand the "fair" and "poor" categories to the "fair", "poor" and "very poor" categories. In doing so, the "fair" category remained unaltered. However, some of the individuals in the "poor" category were moved into the new "very poor" category if their health is reported as being "worse than a year ago." Individuals who were originally in the "poor" category and who said their health is "either

the same or better" were also classed as being in "poor" health. The following table explains the re-classification.

Wave 9 variables		Waves 1-8, 10 category
Health in general	**Health in general, compared to one year ago**	
very good	much better or better	excellent
very good	about the same or worse	good
poor	much better, better or about the same	poor
poor	worse	very poor

The independent variables which are used to explain the duration of a good health spell are a set of individual labour market status, lifestyle and regional characteristics at the time of the individual's exit from the spell of good health. Table 5 and Table 6 in Appendix 2 report the variables used in this study, their definitions and their means, from the BHPS and ECHP respectively.

Appendix 2

Table 5 Definition of variables (BHPS)

Variable	Description	Means	
		Mobility Problems	Self-Assessed Health
pid	unique number to identify each individual	4.80E+07	4.78E+07
wave	wave number	4.338	4.568
hid	unique identifier for each household	4816565	5036625
gender	1 = "male" 2 = "female"	1.519	1.512
mastat	marital status	2.652	2.009
age	age in years at time of exit from good health	36.769	35.542
ncigsN	number of cigarettes smoked per day at time of exit	5.262	4.447
jbstat	employment status	2.988	2.658
region	area in UK	10.548	6.045
qfedhi	education status	7.010	2.670
equiv_income	household equivalised income £	17973.58	18505.88
gdspell	length of spell of good health (years)	4.324	3.501
C	0 = "censored" 1 = "failure observed"	0.028	0.113
marriedN	0 = "not married" 1 = "married"	0.665	0.632
wasmarriedN	0 = "married/never married" 1 = "was married i.e. separated, divorced, widowed"	0.088	0.080
ageN	age group at time of exit	2.324	2.423
age29N	at time of exit age is between 29 and 39	0.265	0.252
age40N	at time of exit age is between 40 and 49	0.192	0.182
age50N	at time of exit age is between 50 and 59	0.136	0.123
age60N	at time of exit age is between 60 and 65	0.067	0.061
ei_0000N	household equivalised income at time of exit (£0,000)	1.797	2.081
degreeN	0 = "other" 1 = "degree or equivalent at time of exit"	0.303	0.368
alevelsN	0 = "other" 1 = "A-levels or equivalent at time of exit"	0.160	0.165
olevelsN	0 = "other" 1 = "O-levels or equivalent at time of exit"	0.215	0.200
other_qualN	0 = "other" 1 = "other qualification or equivalent at time of exit"	0.098	0.087
self_empN	0 = "other" 1 = "self employed at time of exit"	0.081	0.082
unempN	0 = "other" 1 = "unemployed at time of exit"	0.072	0.054
nonempN	0 = "other" 1 = "out of labour market at time of exit"	0.195	0.173
retiredN	0 = "other" 1 = "retired at time of exit"	0.045	0.067
south	0 = "elsewhere" 1 = "lives in South England at time of exit"	0.204	0.205
eastN	0 = "elsewhere" 1 = "lives in East England at time of exit"	0.094	0.095
westN	0 = "elsewhere" 1 = "lives in West England at time of exit"	0.069	0.068
north	0 = "elsewhere" 1 = "lives in North England at time of exit"	0.195	0.190
ScotN	0 = "elsewhere" 1 = "lives in Scotland at time of exit"	0.206	0.208
WalesN	0 = "elsewhere" 1 = "lives in Wales at time of exit"	0.150	0.154
frural	index of remoteness	2.684	2.673
remoteN	0 = "other" 1 = "individual lives in a remote place"	0.084	0.088
accessN	0 = "other" 1 = "individual lives in a accessible place"	0.148	0.150

Table 6 Definition of variables (ECHP)

Variable	Description	Means Self-Assessed Health	PMID
self_emp	0 = "other" 1 = "self-employed at time of exit"	0.092	0.088
unemp	0 = "other" 1 = "unemployed at time of exit"	0.035	0.038
educate_training	0 = "other" 1 = "in full-time education or training at time of exit"	0.036	0.040
retired	0 = "other" 1 = "retired at time of exit"	0.046	0.033
out_of_labour_market	0 = "other" 1 = "out of labour market at time of exit"	0.128	0.136
second_ed	0 = "other" 1 = "individual has 2nd level education"	0.234	0.243
third_ed	0 = "other" 1 = "individual has 3rd level education"	0.441	0.428
inc_gp2	0 = "other" 1 = "income in 2nd lowest quartile at exit"	0.216	0.218
inc_gp3	0 = "other" 1 = "income in 2nd highest quartile at exit"	0.262	0.251
inc_gp4	0 = "other" 1 = "income in highest quartile at exit"	0.316	0.309
hlth_spell	length of spell of good health (years)	2.496	2.757
end_spell	0 = "censored" 1 = "failure observed"	0.106	0.112

Appendix 3

Table 7 Akaike Information Criterion for Selecting the Survival Distribution.

Table 7.1 (a) Whole sample (BHPS)
Self Assessed Health

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-6352.5685	-6395.4852	-6206.628	-6307.6566
c	25	25	25	25
p	1	0	1	1
AIC	12759.137	12842.9704	12467.256	12669.3132

Mobility Problems

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-2285.059	-2321.8422	-2263.5561	-2280.3058
c	25	25	25	25
p	1	0	1	1
AIC	4624.118	4695.6844	4581.1122	4614.6116

Table 7.1(b) Males (BHPS)
Self Assessed Health

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-2933.9478	-2957.4753	-2869.0037	-2915.9328
c	24	24	24	24
p	1	0	1	1
AIC	5919.8956	5964.9506	5790.0074	5883.8656

Mobility Problems

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-787.09819	-797.61231	-783.48046	-785.68098
c	24	24	24	24
p	1	0	1	1
AIC	1626.19638	1645.22462	1618.96092	1623.36196

Table 7.1(c) Females (BHPS)
Self Assessed Health

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-3393.7813	-3412.0543	-3314.102	-3367.0978
c	24	24	24	24
p	1	0	1	1
AIC	6839.5626	6874.1086	6680.204	6786.1956

Mobility Problems

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-1477.0675	-1503.3649	-1461.7064	-1474.0208
c	24	24	24	24
p	1	0	1	1
AIC	3006.135	3056.7298	2975.4128	3000.0416

Table 7.1(d) Age group - 18 to 45 (BHPS)
Self Assessed Health

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-2151.3218	-2183.3108	-2102.8674	-2133.9437
c	22	22	22	22
p	1	0	1	1
AIC	4350.6436	4412.6216	4253.7348	4315.8874

Mobility Problems

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-1127.2039	-1153.0539	-1116.1734	-1123.5974
c	22	22	22	22
p	1	0	1	1
AIC	2302.4078	2352.1078	2280.3468	2295.1948

Table 7.1(e) Age group - 46 to 65 (BHPS)
Self Assessed Health

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-4156.7038	-4169.0613	-4059.8909	-4128.5223
c	22	22	22	22
p	1	0	1	1
AIC	8361.4076	8384.1226	8167.7818	8305.0446

Mobility Problems

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-1126.0685	-1138.0902	-1116.0622	-1124.7102
c	22	22	22	22
p	1	0	1	1
AIC	2300.137	2322.1804	2280.1244	2297.4204

Table 7.2(a) Whole sample (ECHP)
Self-Assessed Health

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-3421.2701	-3495.404	-3332.3716	-3399.7304
c	17	17	17	17
p	1	0	1	1
AIC	6880.5402	7026.808	6702.7432	6837.4608

Physical and Mental Health Problems, Illnesses & Disabilities

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-10564.194	-10872.225	-10327.654	-10507.492
c	17	17	17	17
p	1	0	1	1
AIC	21166.388	21780.45	20693.308	21052.984

Table 7.2(b) Males (ECHP)
Self-Assessed Health

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-1521.8574	-1583.155	-1485.0097	-1512.2516
c	16	16	16	16
p	1	0	1	1
AIC	3079.7148	3200.31	3006.0194	3060.5032

Physical and Mental Health Problems, Illnesses & Disabilities

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-1621.7864	-1574.1151	-1537.9236	-1564.9651
c	16	16	16	16
p	1	0	1	1
AIC	3184.2302	3277.5728	3111.8472	3165.9302

Table 7.2(c) Females (ECHP)

Self-Assessed Health

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-1768.3259	-1829.7058	-1720.7053	-1755.6795
c	16	16	16	16
p	1	0	1	1
AIC	3572.6518	3693.4116	3477.4106	3547.359

Physical and Mental Health Problems, Illnesses & Disabilities

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-1820.0787	-1878.2712	-1780.7473	-1810.4147
c	16	16	16	16
p	1	0	1	1
AIC	3676.1574	3790.5424	3597.4946	3656.8294

Table 7.2(d) Age group - 20 to 40 (ECHP)

Self-Assessed Health

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-1820.6906	-1888.5713	-1777.098	-1809.6077
c	17	17	17	17
p	1	0	1	1
AIC	3679.3812	3813.1426	3592.196	3657.2154

Physical and Mental Health Problems, Illnesses & Disabilities

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-1754.8209	-1823.2582	-1726.0929	-1748.5812
c	17	17	17	17
p	1	0	1	1
AIC	3547.6418	3682.5164	3490.1858	3535.1624

Table 7.2(e) Age group - 41 to 65 (ECHP)

Self-Assessed Health

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-1464.09	-1518.6966	-1422.2098	-1452.1763
c	17	17	17	17
p	1	0	1	1
AIC	2966.18	3073.3932	2882.4196	2942.3526

Physical and Mental Health Problems, Illnesses & Disabilities

	Weibull	Exponential	Lognormal	Log-logistic
log likelihood	-1631.6072	-1671.585	-1589.0377	-1620.2757
c	17	17	17	17
p	1	0	1	1
AIC	3301.2144	3379.17	3216.0754	3278.5514