To Continue Working or not: The Case of Older Workers in Great Britain[☆]

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Abstract

This paper examines the behaviour of older workers, aged 50 or over, in the labour market. Especially, we analyze the pattern of older workers when they approach the retirement age. Do they remain employed? Are they encouraged to take early retirement? Are they more likely to lose job because of their age? This article attempts to answer these questions using a panel data for Great Britain (BHPS). A discrete-time competing risks model is used to analyse the patterns of elderly workers'labour market transitions from employment to three destination states: unemployment, retirement or other states of inactivity including disability leave. We find that workers with lower educational attainment, poor labour market experience and working in private sector have higher risk of becoming unemployed late in their career. The decision to take early retirement is strongly influenced by educational level, sector and size of firms, while the risk of becoming inactive for sickness or family care is increased by precarious employment contracts and by occupying a low skilled position. We also show that decisions to leave employment are not always a voluntary choice, but could also be involuntary. We find that non-employment transitions are strongly and significantly related to involuntary exits, and this could explain the low employment rate of the older workers.

Keywords: Older workers, Employment, Retirement, Panel data, Duration model
JEL: J3, J14, J24

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In developed countries, employment of older workers, aged 50 or over, has attracted attention of policymakers over the past years. The difficulties encountered on the labour market and their consequences on the economy have pushed the authorities to reform the labour market. Although the position of elderly workers in the labour force in the UK is better than the rest of OECD countries, the participation rate of workers over 55 has dropped since the 1950s. For instance, employment rates decline sharply from over 80% of 50 year olds being in work, to around 60% of 60 year-olds and 30% of 65 year-olds (Figure 1). While over 90% of men aged 60 to 64 were working in the 1950s, the employment rate is now around 50% (Figure 2). At the same time, the situation for those in their fifties is getting worse with an increasing unemployment rate since the last economic crisis of 2008. Although older people are less exposed to unemployment than those of prime-age, older jobseekers experience difficulties to reintegrate the labour force after a certain age. To report the situation of the elderly on the labour market, we focus on workers aged 50 or higher, whom we refer as older workers. The main objective of this study is to examine the employment duration of the older workers and the labour market decisions taken near retirement.

Encouraging seniors to stay into the labour force is a common aim of most of advanced economies. Many countries have already increased the state retirement age and continue reforming to increase the labour market participation of older workers. However how can older individuals be justifiably encouraged to remain in the labour force if they cannot find employment? At the same time, it is also important to understand the pattern of the individual's employment decisions approaching retirement age especially in an aging society context with the questions related to the financing retirement systems. Why an individual decides not to work and to retire definitively from the labour market? For this reason, understanding the employment behaviour of older individuals is important for both economic and politicy reasons. To understand what may affect labour force participation decisions, one needs to examine the choices facing an worker approaching age of retirement. For example, as retirement draws nearer, a worker can continue to work until the age of retirement, or he can stop working before that standard state pension age and enjoy pleasures of retirement. Early retirement can be considered as a voluntary choice. On the other side, early retirement transitions could not be voluntary. Older workers can be pushed out of employment by employers after negotiating financial deal or early retirement packages. Retirement is in this case not voluntary and can be used as an alternative of redundancy. In economic recessions, firms can promote early retirement to reduce their staff, or they could dismiss them. When job loss occurs late in life, the probability to find a new job become more difficult with age, increasing the length of time spent in unemployment. For example, in 2014, 48.9% of unemployed individuals aged 55 and over where

in long-term unemployment, compared to 14.4% in the USA[1]. Unemployment can be used to leave the labour force before being eligible to full pension entitlement.

In this paper, we explore the pathways facing seniors near retirement to answer the following questions: Why are certain older workers more likely to retire? Are they exposed to long-term unemployment when they loss or quit their jobs? One way to analyze these issues is to use a competing risks approach to model different types of events. One contribution of this paper is the use a discrete-time duration model not extensively applied in retirement studies. Additionally, previous studies on labour market decisions of seniors have been particularly concerned by early retirement issues (Oswald (1999), Schils (2008)). In the current paper the approach is extended to unemployment. Our paper is in the same spirit of Oswald (1999) paper but differs by the methodology (she uses a multinomial logit model without including unobserved heterogeneity), the sample (we do not include self-employed in our sample) and the period analysis (1991-1997). Finally, the present paper analyse the determinants of labour market transitions with a particular focus on whether the decisions to continue employment or not are voluntary choices or decisions induced by employers. Despite the fact that the factors influencing the labour market for older workers have extensively been studied, few attention has been given to the role of involuntary decisions We estimate the labour market transitions of older workers on British data, with a particular focus on voluntary and involuntary non-employment transitions which occur in later life.

The neoclassical theory of labour supply gives reply and explains that an individual's decisions are based on trade off between consumption (work) and leisure. An individual will decide to retire when the utility level associated to leisure is greater or equal to that of consumption. Obviously other factors influence labour force participation such as age discrimination. The US literature suggests a significant impact of age discrimination on employment. These studies find that older workers have problems in finding jobs and are subject to negative stereotypes that include that older workers are less productive, overpaid, less motivated, or in bad health which result in a disadvantageous position on labour market compared to their younger counterparts. Using US data, Neumark and Stock (1999) show that anti-age discrimination legislation, the Age Discrimination in Employment Act adopted in 1968 which purports to protect employees aged 40 and over against age discrimination in firms with 20 or more employees, have a positive effects on employment and participation rates of older workers. To identify the pure effects of anti-age discrimination laws from aggregate changes on employment, Neumark and Stock (1999) use the fact that some states had implemented anti-age discrimination laws before the passage of the federal law. They find that employment rates of protected workers, aged 60

[1] Source: OECD

and over, have significantly increased by 6 percentage points and less for workers under 60 years of age (0.8 percentage points). Using a similar approach with data from the Current Population Survey between 1964 to 1967, Adams (2004) confirms Neumark and Stock's (1999) findings. Anti-age discrimination legislation has boosted employment of older individuals by 5.6 percentage points in the US. He also finds that the laws reduce the probability of retirement among older workers. There is evidence that anti-age discrimination legislation succeeds to increase employment rates of protected workers at cost of a decrease of those ones of unprotected workers.

Human capital theory emphasises the role played by educational attainment on labour market participation. Human capital increases workers' productivity, implying higher earnings. Individuals who invest in human capital (education, training,etc) are supposed to stay longer on the labour force (Becker (1964), Lemieux (2006)). Moreover, studies have shown that workers well educated are less prone to unemployment risks, that is to say the probability of becoming unemployed at a specific time. The pioneering studies of Nickell (1979) for Great Britain or Mincer (1991a), Mincer (1991b) for the United-States have found that higher education level reduces unemployment incidence and unemployment duration. Nickell (1979) uses a hazard rate framework to model how education affects the incidence and duration of unemployment. He finds that educational level plays an important role by reducing unemployment incidence for British workers. Mincer (1991a), Mincer (1991b) decomposes the unemployment rate into different parts (i.e. the probability of having separated from the previous job, the probability of experiencing unemployment when separated, the duration of unemployment for job separators, the labour force rate and the labour force participation rate) and demonstrates that school attainment lowers unemployment incidence and unemployment duration in United States.

Among the other determinants that can explain older workers' participation in labour market is the effect of employment policies through the influence of financial pension incentives. The literature has studied the impact of these economic factors on retirement behaviour of workers in a wide range of countries and shows evidence of their influence on retirement age. A common result indicates that social assistance increases the probability of exiting labour market. For example, in their study on Spanish employed and unemployed workers, García-Pérez, Jiménez-Martín and Sánchez-Martín (2013) explore the influence of financial incentives on labour transitions of older workers using an administrative data from the Spanish Social Security. They examine the determinants of both unemployed and employed workers on job search and retirement decisions. A multi-spell multi-state competing risk model with an inclusion of unobserved heterogeneity is applied to study the labour supply patterns of workers. They find a significant influence of financial incentives, the amount

of disposable income and the amount of pension rights (pension and unemployment benefits), on individual's decisions. Pension benefits are important predictors in the transition from employment to unemployment while unemployment benefits affect the timing between unemployment and retirement. In addition, they point out the role of unobserved heterogeneity in the estimation of financial incentives.

The literature on UK data reports similar results. Meghir and Whitehouse (1997) estimate the effects of economic variables, the earnings of employed workers and the Social Security benefits, on the transition in and out of employment of older male individuals without occupational plans. Using a single competing risk model, they find that only earnings affect significantly the probability of early retiring. Higher earnings delay the retirement age, while social security pensions delay the return to work (but the effects are not significant). In Germany and the United Kingdom, Oswald (1999) finds an impact of pension benefits on the exit into retirement, while labour demand factors mainly explain the exit into unemployment for both countries. Estimations are based on longitudinal panel data, the British Household Panel Study for the United Kingdom for the 1991-1997 period and the German Socio-Economic Panel for Germany for the 1984-1997 period for persons from age of 50, working at the time of the first appearance in the sample. She uses a multinomial logit model for discrete hazard rate models with three exit states for the British case (i.e. "retired" or "unemployment" or "other") and two exit states for the German case ("unemployed" and "retired or out of the labour force"). The time dependence of the hazard rate is specified with age dummies in order to introduce more flexibility. The model used in her paper is equivalent to a piecewise constant exponential hazard model. Another paper comparing labour market transition of older workers in different countries is Schils (2008) which focuses on the role of institutional differences on older workers' early retirement behaviour by comparing the employment exit path in Germany, Great Britain and the Netherlands, three countries with different early retirement systems. The German Socio-Economic Panel for Germany, the British Household Panel Study for the Great Britain and the Socio-Economics Panel for the Netherlands and discrete proportional time competing-risks models are used for the empirical analysis. Differences in social security systems are reflected in retirement decisions of workers. While in Germany and the Netherlands social security scheme is more used as an early retirement exit, this is less the case in Great Britain. The retirement hazard strongly increases with age in both Germany and the Netherlands than in Great Britain. The results also suggest a higher exit rate into unemployment and disability for the Netherlands. Overall, the exit rates are lower in Great Britain than in other two countries.

Our paper examines the *employment duration* of older workers in Great Britain using a discrete-time competing risk models. We examine the sensitivity of duration dependence estimated with different specifications: the

log of employment duration and a flexible functional form. We also assess the effects of covariates on older workers' employment duration with alternative models: a logit and multinomial logit model. We find that the expected employment duration is affected differently by covariates depending on exit destination. The results indicate that the risk of entering unemployment decreases with education level, while it increases the exit of early retirement. We also find that job related characteristics affect significantly and differently state exits. For example, the risk of becoming inactive for sickness or family care is increased by having a precarious employment contract and occupying a low skilled position, while it has no impact on early retirement process. We also find a strong role played by occupation pension plans on the labour force behaviour. The effect is positive on early retirement exit rate, but negative for unemployment or disability exit rate.

The paper proceeds as follows. We begin the paper by first presenting an overview of the pension system in Great Britain which can influence the labour market of older workers. The second section describes the data set and the empirical approach used to address these issues. The following section presents the estimation results of the discrete-time competing risks models. The last section presents robustness checks before concluding.

1. Institutional Pension Schemes

One of the major factors influencing the labour market for older workers is the process of leaving the labour force to retire. The low participation of older persons in employment depends on labour market policies implemented in the country. This section provides some institutional background on the social security system in Great Britain.

The British social insurance system, one of the lowest pension payments among European countries, is qualified as "liberal". The principle is to ensure a minimum state pension and encourage taking out to private pension provision. The state retirement age is fixed at 65 years for men and at 60 for women until 2010[2], and pension benefits are not available before this age. The state pension replacement rate is so low, 35% (before the 2007 policy change), workers have an incentive to take out. Measures such as early retirement are not possible through the public pension system[3]. The British pension system is organized into three pillars. The first tier, the Basic State Pension is a public mandatory flat-rate based on pay-as-you-go basic state pension. The Basic State Pension is available once the state retirement age is reached, the amount depends on the number of contributions that is at least 44 years for men and 39 for women prior to 2010. From April 2010 onwards

[2]The retirement age was raised by six months every year from 2010 to reach 65 years in 2020

[3]You will find more details on UK pension system in Blake (2003)

(implementation of the Pension Act 2007), the number of contributions years required to full rate basic pension decreased and individuals need 30 qualifying years to receive the full Basic State Pension. To encourage activity beyond the legal retirement age, the amount of Basic State Pension can be increased if retirement is deferred and a pro-rata approach is applied if the number of contributions required are not satisfied. The low level of flat-rate income[4](Basic State Pension has always been below the poverty line) allows individuals who receive only the basic pension to be eligible for additional income-tested benefits. The State Second Pension is an earnings-related income and low earners, disabled people, and some individuals with caring responsibilities are eligible for this pension. In addition to these pension incomes, individuals who have left the labour force before the state pension age are also eligible for this pension. Income Support benefits is one of them and is available for individuals who have been unemployed for at least one year and aged 60 and over. Older unemployed people are exempted from actively seeking employment but they are not considered as retired. Workers disabled or with a long-term sick are entitled to an incapacity benefit. They have to qualified to the basis of certificates.

Additional to the State schemes, occupational schemes; personal or stakeholder plans both provided by financial companies constituted the second and third pillars. Workers are encouraged to contract-out to the private sector and personal savings by tax relief and subsidies. Occupational schemes are the most important private pension plans which cover more than two third of employees. These provide pensions by employers and two categories of occupational schemes exist, Defined Benefit and Defined Contribution pension schemes. The amount of pension provided by Defined Benefit schemes, which cover 80 % of employees, at retirement age depends on length of working life and on the wage level at the end of the career. The amount of pension provided by Defined Contribution schemes on the other hand depends on contributions made and on the return on the investment. A worker may also make contributions under an arrangement concluded with a provider such as with an insurance company. Contributions are invested during an individual's professional career, and then they are used to buy a pension at retirement. Tax advantages, similar to those existing for occupational schemes, are applied.

Concerning the job patterns, 1,327 (65.0%) individuals have a censored-spell, 184 (9.0%) individuals leave employment to unemployment, 447 (16.2%) retire from labour market and 202 (9.8%) for other states of inactivity (see Table 4). As shown in Table 3 transition out of employment is strongly related to age. Only 30% from 50-54 are retired, while the share increases with age: to 56% for 55-59 and to 64% of observations over 60. Transitions between job states depend to gender. Most men leave employment to retirement (more

[4]The full basis state pension for a single person is 90.70 per week in 2008 which is equivalent of 14% of the average earnings

than 50%) while the trend is less obvious for the women. Women tend to move to retirement and other states of inactivity (disability or family care) to similar extent. Again age is important to consider in job transition analysis. While a majority of males from 50-54 leave employment for unemployment, 43% of females from 50-54 leave employment for disease or maternity care. Over 55, most of job pattern is an employment followed by retirement regardless of gender even if the shares are more pronounced for males. The mean employment duration is 5.5 years; 5.9 years for the males and 5.2 years for the females. Individuals spend, on average, 3.7 years in employment before going to unemployment, 6 years before being retired and 4.3 years before leaving to other states of inactivity.

2. Data

We concentrate on the duration in employment (in paid employment) of older workers, aged 50 or over, and the transition out of the employment state over the period 1991-2007. The age of 50 is chosen as a lower bound because the participation rate start to decline from that age (see Figures 1 and 2). The age of 60 for females or 65 for males is chosen as upper bound due to the state retirement age. The data come from the British Household Panel Survey (BHPS), a longitudinal data of private British households. The BHPS was launched in 1991 and individuals are interviewed each year on a large number of socioeconomics topics. The longitudinal aspect of the survey provides information on whether there is a transition out of employment. Individuals are asked information about their current labour market status at the time of interview. They are also asked to indicate the start and end dates of labour market spells and the reason they left their last job. This information allows us to construct employment duration for respondents who report these dates.

Employment decisions are affected by individual and job characteristics and the institutional setting. Variables included in the model are individual characteristics (age, race, marital status, working status of the spouse), human capital indicators (education level, tenure before the age of 50 to control labour market experience before 50), regional unemployment rate to take into account effect of business cycle, job characteristics (occupations, hours worked, sector of industry, public or private sector, size of firm, etcetera) and institutional characteristics (occupational pension plan). We also include in the model calendar year at which individuals are interviewed for the first time. Three indicators are used to characterize the voluntary/non-voluntary type of the non-employment transition. The BHPS asked to respondents who retired early the reasons of early retirement and whether the decision was a choice or forced. In the same way, the BHPS includes questions about the reasons of leaving the last employment. Although these measures can suffer from measurement error due to subjective self-assessment of non-employment reasons, we decide to include in our analysis the variables due to their importance in explaining employment decisions at older ages.

Our sample is an unbalanced panel of male employed, aged between 50 and 64 years old and female employed, aged between 50 and 59 years old who are interviewed for the first time in 1991 or who enter the survey after 1991. The sample includes individuals who were working at the beginning of the interview. Individuals with missing data on any of the relevant labour market or personal characteristics are excluded. Our final sample contains 11,291 observations over seventeen years (1991 to 2007), from 2,043 individuals, a little over half of whom are women.

Tables 1 and 2 display descriptive statistics of the sample. Proportions and means are presented for sample by gender, and by destination exits which are employment, unemployment, retirement and other states of inactivity. The economic status are self-reported by respondents. We consider the impact of education level on the probability of leaving employment after the age of 50. High education level includes includes individuals with advanced level, as well as university entrance-level qualification or higher degree. Low education level refers to those with a gcse, o level, technical degree or without qualification. We are also interested by a series of qualitative information on occupation of individuals in employment or on employment occupied before the transition from employment. Occupational pension right is equal one if employers provide private pension plans. For job tenure, we compute the labour market spell with the current employer before the age of 50. The quality of employment is captured by part time job dummy which is equal one if the individual works less than thirty hours per weeks. Finally, sector and size of the firm are each proxied by three dummy variables: primary, commercial and non commercial services and small, medium and large firm respectively.

Table 1 shows differences between destination exit and gender. The sample is characterized by a high education level. Men have in majority a higher education levels than women. We note that a large proportion of workers who retire, as well men and women, have a higher educational level. They are also more likely to be in management and professional occupations and to have occupational plans than those who move to unemployment or other labour market status. Concerning the size of the firm, unemployed workers tend to come from small firms contrary to retired workers who were employed in large company. If we compare characteristics between gender, as shown in Table 2, differences are more evident between both gender. Men have higher educational attainment than women. Male workers are more often in professional and managerial positions while females are in skilled manual positions. Women are more often in part-time jobs: more than 83 percent of part-time jobs are held by women.

Nonparametric duration analysis give a first overview of survival functions and univariate descriptive statistics.

Nonparametric analysis estimates the probability of leaving employment conditional on being employed until the beginning of the interval, without assuming any functional form for the hazard rate. Survivor and hazard functions (Figures 5 to 8) are derived from the Life-table methods, a generalization of the Kaplan-Meier estimator adapted for data grouped into intervals. Figure 5 describes survival functions of staying employed, i.e. the evolution of workers' survival in employment over time, t, conditional on having been employed until $t-1$. The vertical lines represent 95 % confidence intervals for the estimates. The figure shows that half of the sample has left employment at 11th year spell corresponding to age 60-61. In other words, 80% of workers are still in work after 5 years, 50% of them are employed after 11 years and this figure decreases at 30% after14 years. However proportions are different when destination exits are considered (Figure 6). Unemployed and other states of inactivity have higher survival rates than retired individuals, and their survivor functions drop more sharply than curve for retirement exit. Unemployed workers leave employment, on average 3.7 years, before those who leave employment for inactivity, on average 4.3, and retired workers, who leave work on average 6 years after age of 50. Log-rank and Wilcoxon tests indicate that survivor functions across the groups are statistically different[5]. Figures 9 and 10 depict the graphs of the hazard rates aggregated and disaggregated by exits. They represent the evolution of failure over survival time, that is the probability of leaving employment in a specific interval t conditional on having been employed until interval $t-1$. The graphs increase non-monotonically over years. The aggregate hazard rate (combining all exits) declines during the first years around the 4th year, increases gradually until 13 years and declines thereafter prior becoming flat after survival year 14 (i.e the state retirement age). The function suggests that workers are more likely to leave employment after 10 years. If we look at the results for different exits, hazard rates show the same pattern. Hazard rates are especially high after 10 years spent in employment. Looking at the cumulative distribution functions, 50 percent of workers have moved from employment status within 11 years. As for survival functions, the cumulative distribution function for retired sample is lower than the two others, which is not surprising given that the cumulative distribution function equals one minus the survivor function. This nonparametric analysis show that workers leave the labour force before their 60. Unemployed workers are the first who exit employment in large extent, followed by those who moved to other labour market states. Retired workers leave labour force before the state retirement age, but well behind unemployed workers. A nonparametric duration analysis show that employment hazard rate are different across exits. Unemployed workers and those who leave labour force for sickness or family care reasons are the first to withdraw employment, followed by retired workers who do not wait to reach retirement age to withdraw from the labour force. However, these estimates are 'naive' in the sense that other characteristics can explain the transition out of employment near retirement. For instance,

[5]The statistics are 34.22 for the Log-rank test and 48.11 for the Wilcoxon test

occupational pension schemes seem to have impact on retirement decisions given the large proportion of British workers covered by occupational plans (see Table 1). To assess the effects of covariates as occupational pension rights on retirement behaviour, in the next section we estimate semi-parametric models.

3. Model

A discrete-time competing risks model is adopted to model the transition from employment to different labour market states: A worker can remain employed, become unemployed, retired or other including disability, sick and family care. We assume that retirement decision is an absorbing state: the worker cannot reintegrate the labour force once retired. In the same way, we use a single-spell model. We only examine the employment spell length until the first exit out of employment is observed, re-entry is not modeled. Competing risks models analyze the time until an event occurs, and compare this time with time until an other event is observed. This approach is preferred to single duration model because leaving employment may be the result of different reasons. Transition into a specific exit may be influenced by different factors, which may influence differently the exit to another state. By distinguishing exits, we can assess the impact of covariates on different exits whilst avoiding potential aggregation bias, and enhances understanding of seniors'employment. However, the independent competing risks model assumes that the distinct destination exits are independent and mutually exclusive from each other.

Independent Competing Risks Model

The empirical model used in this study is a discrete-time competing risks model. As data are collected on a yearly basis, a discrete-time model is more appropriate even though the underlying process out of employment is assumed to be continuous. "The data are not intrinsically discrete, but they are grouped into intervals of unit length" (Jenkins, 2005, p.97). The idea is to divide the time spent in employment into time interval and to study whether individuals have left or not employment state in each time interval. The unit of the time intervals in our analysis is a year. This is the basic idea of the hazard rate models: analyze whether there is a transition at each time interval rather than the duration spent in a state.

A discrete-time competing risks model is used to study employment duration T_{ij}^s which is the time spent in employment for the individual i, for $i = 1, ..., N$, in the s^{th} spell (i.e. unit of spell is a year), for $s = 1, 2, 3, ..., S_i$ of state j before that an event occurs or i remains in employment. j is the initial labour force status of the individual, that is being employed by construction. T_{ij}^s is a discrete random variable divided into time-intervals I_t, with $t \in \{1, ..., T_{ij}^s\}$. $T_{ij}^s = t$ if an individual leaves employment state and $T_{ij}^s > t$ if an

individual remains employed at the end of interval I_t. A worker may leave his current employment either for unemployment, retirement or other sates of inactivity. The spell is complete in this case. A worker who does not experience an event during the sample period or who reaches the legal age of retirement is defined as right-censored.

The specific-destination discrete hazard rate $h^s_{ijk}(t)$ for the individual i is the probability of making transition from the j state (i.e. employment) to state k (unemployment, retirement or inactivity) at his s^{th} spell for $k \neq j$, conditional on being employed at the beginning of the interval I_t and on observed characteristics ($X_{ijk}(t)$) and unobserved characteristics (ϵ_{ij}).

$$h^s_{ijk}(t) = Prob(t \mid X_{ijk}(t), v_{ijk}) = Prob(T^s_{ij} = t, \lambda^s_{ij} = 1 \mid T^s_{ij} \geq t, X_{ijk}(t), \epsilon_{ij}) \tag{1}$$

which is given by:

$$h^s_{ijk}(t) = \frac{f^s_{ijk}(t)}{S(t-1)} \tag{2}$$

where $T^s_{ij} = min\{T^*_{ij}, C^*_{ij}\}$ with T^*_{ij} a latent failure time and C^*_{ij} a latent censoring time for the individual i. λ^s_{ijk} is dummy variable equals one if the event $k = 1, 2, 3$ (the destinations are unemployment, retirement or other states out of labour force) and 0 otherwise. $f^s_{ijk}(t)$ is the destination specific density function at time t and $S(t-1)$ is the survival function in employment until the beginning of the interval t.

The probability that the individual i does not leave employment at the s^{th} spell, conditional that he was employed at the beginning of interval I_t is given by the survivor function S_{ijk}.

$$S_{ijk} = Prob(T^s_{ij} > t) = \prod_{j=1}^{t}(1 - h^s_{ijk}) \tag{3}$$

The likelihood contribution of the individual i with a completed spell with a discrete-time density function (probability that an event is observed between t_{-1} and t) is :

$$\begin{aligned} f_{ijk} &= Prob(t-1 < T^s_{ij} \leq t) \\ &= S_{ijk}(t-1) - S_{ijk}(t) \\ &= \left[\frac{h^s_{ijk}}{1 - h^s_{ijk}} \prod_{j=1}^{t}(1 - h^s_{ijk})\right] \end{aligned} \tag{4}$$

The overall contribution to the likelihood L is the product of the individual likelihoods L_i for individual i=1,...,N

and given by :

$$L = \prod_{i=1}^{N} \left[Prob(t-1 < T_{ij}^{s} \leq t)\right]^{c_i} \left[Prob(T_{ij}^{s} > t)\right]^{1-c_i} \tag{5}$$

$$= \prod_{i=1}^{N} \left[\left(\frac{h_{ijk}^{s}}{1-h_{ijk}^{s}} \right)^{c_i} \prod_{j=1}^{t} (1-h_{ijk}^{s}) \right] \tag{6}$$

where c_i is defined as:

$$c_i = \begin{cases} 1 & \text{if} \quad \text{the spell is completed} \\ 0 & \text{si} \quad \text{the spell is censored} \end{cases} \tag{7}$$

The log likelihood $log\ L$ is :

$$logL = \sum_{i=1}^{N} c_i \log \left(\frac{h_{ijk}^{s}}{1-h_{ijk}^{s}} \right) + \sum_{i=1}^{N} \sum_{j=1}^{t} \log(1-h_{ijk}^{s}) \tag{8}$$

The log likelihood given in Equation (8) cannot be maximized directly, Allison (1992), Jenkins (1995) and Jenkins (2005) propose to rewrite Equation (8) as a function of binary dependent variable y_{ijk} for an easy estimation :

$$logL = \sum_{i=1}^{N} \sum_{j=1}^{t} y_{ijk} \log \left(\frac{h_{ijk}^{s}}{1-h_{ijk}^{s}} \right) + \sum_{i=1}^{N} \sum_{j=1}^{t} \log(1-h_{ijk}^{s}) \tag{9}$$

$$= \sum_{i=1}^{N} \sum_{j=1}^{t} \left[y_{ijk} log\ h_{ijk}^{s} + (1-y_{ijk}) log\ (1-h_{ijk}^{s}) \right] \tag{10}$$

where y_{ijk} is defined as:

$$y_{ijk} = \begin{cases} 1 & \text{if} \quad \text{the individual leaves employment state during the time interval [t-1,t]} \\ 0 & \text{if} \quad \text{the individual remains in employment during the time interval [t-1,t]} \end{cases} \tag{11}$$

With this trick, the log likelihood function (equation (10)) can be estimated by a binary models (such as a logit model), and the other exit destinations are considered as censored. This requires a re-organization of the data into individual-year format (see Appendix Section 7.2).

To estimate empirically the models, other assumptions about the state transitions between time intervals and the functional form for the destination-specific continuous hazard are required. Indeed, in a continuous model with

several exits, the log-likelihood is the sum of the log-likelihoods for each of the destination-specific models, and each sub-contribution depends only on the parameters specific to that destination. Estimating a competing risks model with multiple destinations in a continuous case is easy because it is equivalent to estimating a single-destination model separately, one for each destination. Contrary to the continuous case, the separability property does not hold for the discrete-time censored interval case because more than one latent event is observed in each time interval, and the observed exit corresponds to the minimum of the latent survival times. "Put another way, when constructing the likelihood and considering the probability of observing an exit to a specific destination in a given interval, we have to take account of the fact that, not only was there an exit to that destination, but also that exit occurred before an exit to the other potential destinations" (Jenkins, 2005, p. 97). One way to model discrete-time competing risks is to assume that the destination-specific density functions (or hazard rates) are constant within time interval and may vary between intervals. An alternative assumption is that the transition between states occurs at the boundaries of the time intervals. Following Narandranathan and Stewart (1995) and Jenkins (2005), we assume that the transition occurs at the end of the time interval. As a result, the log-likelihood for competing risks is the same that for continuous case and it can be estimated by a single-risk model. The destination specific hazards can be estimated separately with a logit model and the other destinations are considered as censored. One restriction is that the model assumes the independence between competing risks, so that correlation between unobserved explanatory variables does not affect each exit. In other words, an individual can leave employment to one state, independently of the others. As in Meyer (1990), the discrete-time hazard specification $h^s_{ijk}(t)$ is assumed to take the complementary log-log form (the underlying continuous time hazard rate is a proportional hazard model).

$$h^s_{ijk}(t) = 1 - exp\left[-exp\left(\gamma_{jk} + \beta'_{jk} x_{ijk}(t)\right)\right] \tag{12}$$

where $\gamma_{jk}(t)$ is the baseline hazard function, $x_{ijk}(t)$ is a vector of explanatory variables.

Another important point in hazard models concerns the unobserved heterogeneity, especially when the exit out of employment is analyzed (D'Addio and Rosholm (2002), Farber (1994)). Unobserved heterogeneity corresponds to unmeasured characteristics which are important to explain variability in the hazard rate between individuals, but which are not included in the model because they are not available in our dataset. Not accounting for unobserved heterogeneity when unmeasured characteristics are correlated with the explanatory variables included in our model can introduce bias in the duration dependence and in the regressors coefficient estimates. To illustrate how the baseline hazard rate can be affected by unobserved heterogeneity, suppose that the sample

is composed by two types of workers with hazards constant over time, but one of them has a higher hazard than the other. If we cannot distinguish these two types of workers, the estimated hazard will be a mixture of these two hazard rates. As time goes by, workers with higher hazards will leave the sample at faster rate, leading to a sample composed of workers with a low ϵ_{ij}. The aggregated hazard rate will be decreasing over time. Accounting for unobserved heterogeneity when unmeasured characteristics such as ability, work effort or motivation can affect the decision of worker of leaving his current work position is important. On the other hand, literature explains that accounting for unobserved heterogeneity is not necessary. Meyer (1990) shows that unobserved heterogeneity will not introduce bias in the estimates when a flexible specification for duration dependence is used. Moreover, Narandranathan and Stewart (1995) point out that a misspecification of unobserved heterogeneity may bias the estimates. The standard approach to deal with unobserved heterogeneity is to include a random variable, specific to the individual and fixed over time and with a given distribution. The hazard rate can be rewritten as:

$$h^s_{ijk}(t) = 1 - exp\left[-exp\left(\gamma_{jk} + \beta'_{jk}x_{ijk}(t) + \epsilon_{ij}\right)\right] \tag{13}$$

where ϵ_{ij} are the unobserved characteristics distributed according to a Gamma or a Normal distribution. The presence of unobserved heterogeneity is tested under the null hypothesis that the variance equals zero. Under the null hypothesis, the unobserved heterogeneity is not important and the model can be estimated without including heterogeneity. Unobserved heterogeneity can also be treated in a nonparametric way. Heckman and Singer (1984) assume that there are a number of different individuals or mass points, and each mass point can be assigned to a probability. ϵ_{ij} is assumed to follow a discrete distribution, ϵ_{ij} is divided into M mass points, $m = 1, ..., M$ with a probability $Pr(\epsilon_{mj})$. Unobserved heterogeneity is incorporated in the hazard function by the intercepts, m_{type}, which are different for the different type of individuals.

$$h^s_{ijk,type}(t) = 1 - exp\left[-exp\left(\gamma_{jk} + \beta'_{jk}x_{ijk}(t) + m_{type}\right)\right] \tag{14}$$

The likelihood function will be a mixture of contributions of different types of individuals, weighted by the probabilities associated to the mass points. We choose to not include a nonparametric unobserved heterogeneity due to the difficulties encountered in the estimation. Meyer (1990) presents that the computation difficulties encountered are the result of the parametric assumption of the baseline hazard form imposed in the Heckman and Singer (1984) approach. Additionally, Narandranathan and Stewart (1995) add that bias in the Heckman and Singer (1984) paper are due to parametric form of the duration dependence. Several specification for individual unobserved heterogeneity distribution can be considered without a substantial on the estimates

parameters. Meyer (1990) shows that the choice of distribution assumed for unobserved heterogeneity is non important when a flexible specification for duration dependence is used. "When the baseline hazard is nonparametrically estimated, the choice of heterogeneity distribution may be unimportant" (Meyer, 1990, p.771). In their paper Jenkins and Garcia-Serrano (2004) justify the fact of not including unobserved heterogeneity due to the long estimation routines of mixture models needed to converge[6].

$\gamma_{jk}(t)$ in equation 13 is the baseline hazard function. It represents the duration dependence of the hazard rate, that is how hazard rate evolves over time elapsed in the employment state given that all explanatory variables are held constant. We consider alternative specifications for the functional form for the baseline hazard function, a parametric specification, the logarithm of the baseline hazard, and a nonparametric specification. The parametric specification of baseline hazard function imposes strong restrictions on the form of the hazard rate, while the nonparametric specification has the advantage to introduce more flexibility for the duration dependence path and avoid misspecification. The baseline function is modeled using duration dummies. The duration dependence is assumed to be constant within time intervals, but can vary between intervals. We create for that 14 interval-specific dummy variables, one for each year at risk (no exits occur after t=13, the following dummies are not included because the hazard cannot be estimated if there is no events). The advantage to treat duration dependence with a flexible functional form is to reduce the effects of unobserved heterogeneity on duration dependence and covariates estimates. Estimates are more robust with flexible duration dependence specification (Dolton and Van der Klaauw (1995), Narandranathan and Stewart (1995)).

4. Results from the Discrete-Time Hazard Model

In this section, we discuss the results from a hazard rate model with a complementary log-log specification. We study here the time spent in employment or, in other words, the hazard of leaving employment after the age of 50 whatever the exit destination. The estimates presented result from the estimation of models with unobserved heterogeneity. Both parametric, represented by the logarithm of baseline hazard, and nonparametric specification, approximated by duration dummy variables, have been used but only the nonparametric results are presented. The presence of unobserved heterogeneity among workers has been tested by the inclusion of a random variable. The unobserved heterogeneity distribution is assumed to be a mixture of Normal distribution. This additional variable summarizes the impact of omitted variables on employment exit rate, and represents

[6]For example, it takes more than three weeks to have a converge of the maximum likelihood estimator. Moreover, we encounter convergence issues with a Gamma distribution caused by the value of the log of variance, $Log\ \sigma_\epsilon^2$, around -10. Jenkins (2005) claims that the convergence problems result from the value of variance close to zero, while the model is programmed with a gamma variance constrained to be positive

also the impact of measurement error. A Likelihood Ratio test of the model with unobserved heterogeneity against the model without unobserved heterogeneity indicates whether unobserved heterogeneity is important. The results from the Likelihood test show that the null hypothesis cannot be accepted in ours estimations excepted in two cases where heterogeneity of variance is statistically significant.

Table 5 reports the estimated results of the baseline dependence with a nonparametric specification. The effects of covariates on the hazard rate, which are multiplicative on the duration dependence, are similar across the two models estimated, although more covariates are significant in the nonparametric specification. Starting with individual characteristics, the results indicate that male workers have a higher hazard rate to leave employment relative to their female counterparts but the coefficient is not significant. As regards the human capital characteristics, higher education has a positive effect on the probability of leaving employment, but the coefficients are not significant[7]. Turning to job-related characteristics, we find that occupation affects the exit hazard rate. A professional or a manager has a higher probability to leave employment than an unskilled workers, while the probability is lower for a manual worker. Turning to firm characteristics, we find that the industry branch affects the employment hazard rate. Working in non commercial services reduces the probability to leave employment by 40% than in primary sector. In the same way, working in a small (less than 25 employees) or in a medium (between 25 and 499 employees) company has a negative effect on the transition out of employment relative to working in a large company (more than 500 employees). An alternative way of looking at this is to examine the effect of voluntary/involuntary decisions to leave employment late in life. The decisions to stop working are not always voluntary, and this could constitute an explanation for the decline in employment rate at older ages. We define an involuntary exit as any transition from employment due to redundancy, dismissal or sacking, and we want to estimate the effects of involuntary exit on employment duration age the age of 50. We use the information of past employment spells to construct this involuntary decision to leave employment. We find that there is a strong and significant effect of involuntary exit on the probability to leave employment. Being pushed out of employment after the age of 50 appears to be an important determinant of the employment of the seniors. Decisions to leave employment before the state pension age is not always a choice made by the worker, but due to restriction on continuing employment.

Finally, the estimated coefficient for duration dependence shows that the baseline hazard increases over time, suggesting that the likelihood of leaving employment becomes higher with duration in employment (Fig-

[7]Education level is aggregated into high and low education level to improve the significance level of the estimates of educational attainment in the competing risks models. We also estimate models by differencing education level into 4 groups, which are college/university, a level, o level or equivalent and no qualification, and the remaining estimated parameters are quite similar.

ure 11). The results from the nonparametric specification also show that baseline hazard function follows a pattern of positive duration dependence. Duration dummies rise significantly until the 10th year of the spell, with a substantial increase at the 9th year of the spell corresponding to age of 59-60, the age at which eligibility for early retirement and income support schemes becomes possible.

5. Results from the Competing Risks Model

Turning now to the results from the competing risks models where destination state is taken into account. Table 6 presents the estimated coefficients of the determinants of the employment hazard rate into unemployment, retirement and other states of inactivity respectively.

5.1. Leaving Employment to Unemployment

Starting with the exit to unemployment, personal characteristics exert a significant effect on the employment hazard. Relative to low educated workers, high educated workers have 40% lower rate of exit to unemployment. British studies find that education has a negative effect on the probability to go into unemployment (Meghir and Whitehouse (1997), Miniaci and Stancanelli (1998) and Oswald (1999)). Educational attainment seems to insure against unemployment. More the worker is educated, more the worker is productive and qualified to achieve performance in executing tasks. Education which approximates general human capital but also tenure which represents specific human capital are highly valued by firms and explain their negative effect on unemployment hazard. We also find that household composition plays a significant role for unemployment incidence. Being married lowers the probability of entering into unemployment by 40%. Senior workers could may be less encouraged to 'choose' unemployment when they are married or in a couple. Studies find evidence of voluntary unemployment as a choice done by individuals. Related to job characteristics, job tenure reduces probability of being unemployed. Labour market experience seems to protect worker against unemployment. Job tenure reflects specific human capital which is accumulated through work experience with the current employer. Workers are more experienced, more skilled. They have greater knowledge of the job tasks they perform than their younger co-workers. Abraham and Farber (1987) show that longer tenures signal high quality matches between employer and employee, producing rents that are shared in terms of earnings premia. In this model, the probability of leaving employment is lower for workers with higher tenure which is consistent with Abraham and Farber findings, and with Jovanovic's model which describes that an exit reflects a bad match between employer and employee. Coefficients associated with part time job dummy is significantly negative. Having a part time job decreases the probability of exiting to employment. Having an occupational plan is associated with a lower probability of becoming inactive in comparison to those without these benefits. Involuntary non-employment transitions which occur in later life are also important to explain the transition

into unemployment. Involuntary exit from employment to unemployment has a large and significant effect on the probability of being unemployed. The involuntary exit dummy positively affects the non-employment decision.

The nonparametric estimates indicate that the effects of the duration dependence on the probability to leave employment is non-monotonic over time. The duration dependence is decreasing over time, except between the 6 and the 7 year of spell where the duration dependence increases to reach a peak. The baseline hazard is highest for workers in their 56-57 age after which it decreases, to finally rises back from the 11 year of spell. The dashed line in Figure 12 depicts the trend of the baseline risk for the exit to unemployment. Finally, we check the presence of unobserved heterogeneity with the LR test. The LR test cannot reject the null hypothesis that unobserved heterogeneity is not important. Unobserved heterogeneity does not affect older workers' probability of leaving employment for unemployment.

5.2. Leaving Employment to Retirement

Starting with sociodemographic characteristics, males have almost 52% higher hazard rate of retirement relative to their female counterparts. Human capital is also important in explaining exit the process to retirement. Older workers with higher educational levels have a higher probability of moving into early retirement compared to less skilled workers. Higher educated workers may have access to early retirement schemes, with generous replacement incomes contrary to low educated workers who are in jobs without early retirement schemes (Oswald (1999), Schils (2008)). Oswald (1999) refers to dual labour market theory or segmented labour market to explain this effect. In this model, labour market is divided into two sectors: the primary sector characterized by skilled and experienced workers, with high earnings and with job security. The secondary one is the opposite with few career prospects and insecure jobs. The type of occupied before the transition into retirement also affects significantly the employment duration of seniors. Thus, skilled manual workers have a lower probability of early retiring than unskilled workers. We also test whether transitions out of labour force are taken jointly with the partner. Studies have found that retirement timing is a decision taken by the couple and not only by the individual. Partner's labour market status is an important determinant of labour market participation (Miniaci and Stancanelli (1998), Blau and Riphahn (1999)). Couples coordinate their retirement decisions. On other hand, certain studies have found that the joint retirement effect is only significant for women (Hospido and Zamarro (2014)). In our case, the effect is negative but not significant. The partner's labour market status seems not to affect the probability to retirement of workers. We find that occupation affects significantly the exit from employment to early retirement. A professional, a manager or a skilled worker has a higher probability to leave employment than an unskilled workers, while the probability to retire early is lower for a manual worker. Turning to firm characteristics, we find that the industry branch is an important determinant for early retirement process. Working in non commercial services seems to reduce the likelihood to retire early by 42%

than in primary sector. Similarly, working in small firms declines the probability of retirement exit compared to large and medium firms. Casey and Wood (1994)[8] show that in the Great Britain, early retirement has been used in large companies, in manufacturing and in the public sector. Larger firms have the financial means to pay redundancy payments and to negotiate early retirement packages. Having an occupational plan has positive effect on early retirement exit. British studies carried out by Blundell, Meghir and Smith (2002) and Banks and Smith (2006) confirm the role played by private pension plans on early retirement decisions. Blundell, Meghir and Smith (2002) find that occupational pensions encourage taking early retirement in the United Kingdom. Individuals with occupational schemes are more likely to stay in employment at younger ages, and they retire at age 60 once they have accumulated wealth in earlier years. Banks and Smith (2006) add that workers in the top of wealth distribution are more likely to withdraw early from the labour market. The effects of non-voluntary early retirement are also examined. The BHPS asked to respondents who retired early the reasons of early retirement and whether the decision was a choice or forced. As expected, non-voluntary early retirement has a positive effect on the probability to leave employment. Involuntary early retirement has a large and significant effect on the probability of ceasing employment.

With regards to the effects of duration dependence, the results from the nonparametric estimation indicate positive and significant duration dependence: workers are more likely to retire with age. Figure 12 plots the estimated hazard rate for the retirement route from the non parametric model (solid line). The duration dummies are positive and significant in almost case. The baseline hazard increases sharply after the 9 year of the spell, meaning around the age of 60. The exit to retirement continuously grows, which means that more workers leave employment to retirement with time spent in work. This finding is not surprising given that, as time proceeds, workers are more likely to have the required years of contributions to retire. These findings can be related to the distance to retirement, a concept widely used as an explanation for the decline of employment rate of the seniors observed before the state pension age (Hairault, Langot and Sopraseuth (2010)). Distance to retirement, which is the time remaining until the eligibility age for the state pension benefits, explains how the retirement age decision affects older workers' employment prior to retirement. Distance to retirement exerts negative feedbacks on both labour supply and demand because the expected returns of investments become less profitable as the employment horizon is shorter, older workers are discouraged to invest in human capital and in job search. Symmetrically, employers are reluctant to hire older workers because the cost of hiring and training older workers are higher than the expected returns.

In addition to the effects of observed characteristics on exit rate, other relevant unobserved characteristics also

[8] mentioned in Oswald (1999)

explain the retirement process. Unobserved factors such as motivation, attitude or labour market attachment affect the decisions of the older workers to leave employment for early retirement. The Likelihood Ratio test is significantly different from zero, which indicates presence of unobserved heterogeneity for the retirement exit.

5.3. Leaving Employment out of Labour Force

As shown in Table 6, there is less significant determinants to explain the exit into inactivity of elderly workers, which it could be explained by the few events observed in this case. Starting with individual characteristics, the results indicate that male workers have a 60% higher hazard rate to leave employment relative to their female counterparts. Tenure plays an important role on the exit process. Job tenure reduces probability of being inactive. Turning to job-related characteristics, we find that occupation does not affect the exit hazard rate, but individuals working in the private sector are more likely to exit into inactivity than those working in public sector. Having an occupational plan is associated with a lower probability of becoming inactive in comparison to those without these benefits but the results are not significantly different from zero. Finally, the transition to inactivity is strongly related to involuntary decisions of the workers. As for the exit to unemployment, the involuntary exit dummy is positively significant. Workers do not always chose to leave their job.
Concerning the baseline hazard function, the nonparametric function shows no particular trend of the duration dependence. The dotted line in Figure 12 reveals a decreasing pattern followed by increasing trend. We note a substitution effect, by parts, between the three exits. While the duration dependence for retirement is increasing over the all period considered, the baseline hazards into unemployment and into other states of inactivity are decreasing as from the age 56-57, then decrease before increase from the age 60 and this is true for the three exits. However duration dependence into other states of inactivity is non significant. The small number of exits to unemployment might explain the lack of precision of estimates (there are fewer exits into other states of inactivity than to retirement, see Table 3).The test for the presence of unobserved heterogeneity rejects it existence to explain the inactivity process.

To sum up, competing risks models provide important information about the duration dependence and the effects of covariates on the employment duration of workers near retirement. The discrete-time hazard model is not sufficient to characterize the impact of variables or the shape of the hazard for the distinct destination hazards.

5.4. The Role of Health on Non-Employment Decisions

Health state can also affect the employment decisions of older individuals. Health can be considered as a component of human capital, and investing in health increases the workers'productivity level (Grossman's model).

Hence, having a poor health is associated with a lower productivity, involving a lower labour income and decreases the likelihood of labour force participation. Many studies on aging have supported the idea that health is an important determinant of retirement decisions. Berkovec and Stern (1991) estimate both static and dynamic models of retirement on older men with a model of simulated moments on US data. For both models, they find that having a poor health, a lack of education and being aged increase the likelihood of leaving employment for retirement. Gannon and Roberts (2011) use the Living in Ireland Survey and the BHPS to estimate multinominal logit models on the probabilities of being employed full-time, part-time and retired. They find that for Ireland and UK, bad health state increases the probability of retirement.

In this section, we assess the effect of health on labour force participation. Particularly, we investigate the role of health state on the timing of taking early retirement. The BHPS collects information about health and diseases using several questions. Physical conditions of workers are captured by the presence of acute or chronic diseases. Variables which describe health limits daily activity and health limits type or amount are not used as alternative health measures because they are self-assessed health status and are not available in every wave of the survey. These variables can introduce bias because individuals are asked about how they perceive their health state and how it can affect their work (Questions are in the forms "Does your health in any way limit your daily activities compared to most people of your age?"; "Does your health limit the type of work or the amount of work you can do?"). Moreover, the fact of using "objective" health measure reduces the potential endogeneity related to the use of self-assessed health measures. However, our health measure is a self-reported measure and the issue of endogeneity is not addressed. Health measure enters the regressions as a dummy variable. It is coded one if the individual is in bad health and 0 if he is healthy.

Table 7 reports the results from models including health state and unemployment rate. We find that heath state affects inactivity decisions. Health state has a large and significant effect on the probability of both retiring and leaving employment for other reasons of inactivity, while it does not have effect on exit to unemployment. The health problems dummy positively affects the decision to participate. Individuals with health problems are more likely to leave employment to unemployment than those in better health. Similarly, being in bad health increase the hazard rate to inactivity.

5.5. Specification Tests

Table 8 provides the results of test specifications. In first step, we test whether alternative exits, unemployment and inactivity, might be distinguished from the pooled specification. We run a series of LR tests to check whether the states have to be separated or combined into a single category. The null hypothesis that the coefficients of the two candidates for pooling are identical is rejected for each alternative. Unemployment and

inactivity are significantly different destination states. The competing risks model seems to be appropriate given the rejection of tests. Another series of LR tests are used to determine whether the right functional form of the baseline hazard is a parametric or a nonparametric specification. The LR tests show that the null hypothesis cannot be accepted for any alternatives. The data support a nonparametric baseline hazard function. In addition, the $log\ likelihood$ is always higher in value for the nonparametric baseline hazard regressions which means that flexible specification fits the data better.

5.6. Other specifications for Hazard Rate

Estimates may depend on models used. In order to check the sensibility of our results, alternative specifications for the functional form of the hazard rate are considered to ensure that the results do not depend on models used. Firstly, we re-estimate the models with a logit specification. The competing risks of leaving employment after the age of 50 is also estimated with a multinomial logit model. Unobserved heterogeneity is included and it is assumed to follow a Normal distribution with a zero mean and a variance. Overall, our findings are consistent across specifications and show differences in the estimates across destination states. Results are available upon request.

6. Conclusion

In this paper, we analyze the risk of older workers of leaving employment as retirement approaches in Great Britain. We use a discrete-time competing risks model to identify the factors explaining the employment duration. The model allows for observed and unobserved characteristics to affect the employment exit process. A competing risk model seems to be appropriate for our data because older workers are facing several and distinct exits near retirement. Elderly workers can remain in employment until the state retirement age; they can withdraw from the labour force to early retirement or to other states of inactivity; or they can lose their job at the end of working career. Results show the usefulness of taking account several destination exits because factors and duration affect differently workers' behaviour according to the exits.

We find that workers with lower educational attainment have higher risk of getting unemployed latter in life. Education level seems to protect workers from unemployment risk. They are more risky to lose their jobs when they have poor job experience, and when they work in private sector. Early retirement decisions are affected differently by education level. Higher educated workers have the highest risk of moving into early retirement. Being a male increases the probability of early retirement relative to a female but has not effect on probability of observing an unemployment or inactivity episode. Occupation and firms characteristics strongly influence the early retirement process. The probability to early retire is lower for skilled manual workers, for those working in non commercial industry and in small/medium company. On the contrary, professional or managerial occupation have a negative effect on the likelihood of inactivity, while workers with part-time job have noticeably higher probability of transitions to inactivity. The distinction of different destination state indicates role play by private pension plans on workers' behaviour. Having occupational pension right encourages older workers to retire before the state retirement age, while it postpones unemployment exit. We also find that the exit from employment does not appear to be due to voluntary non-participation. Part of the non-employment transition is due to involuntary decisions to leave employment. Older workers are pushed out of the labour force by employers, and this could explain the low employment rate of older workers observed in European countries.

Finally, we considered alternative specifications to check the sensitivity of parameter estimates. The shape of the duration dependence is treated with a parametric (log duration of spells) and a flexible specifications. The advantage of the nonparametric approach permits the identification of the survival time's effect on the employment duration. We also specify the hazard rate with alternative functional form: a logit and a multinomial logit model. Estimates give similar results over models.

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7. Appendix

7.1. Variables definitions

Education

Higher educational level: Advanced Level university entrance-level qualification or higher.

Job Related Characteristics

Private firms and non-profit organizations are classified as *private sector*.
Civil servants, employees in central and local government, town halls, the NHS, High Education, nationalized industries and in the armed forces are classified as *public sector*.

Part-Time Jobs: workers who work less than 30 hours per week

Sector

Primary sector: if respondent works in agriculture, forestry and fishing; energy, water and supplies; extraction of minerals, manufacture of metals, mineral products and chemicals industry.
Commercial services: if respondent works in distribution; hotels and catering (repairs); transport and communication; banking, finance, insurance, business services, leasing and other services.
Non commercial services: if respondent works in metal goods, engineering and vehicles industries, other manufacturing industries and construction.

Size of firms
Small firm: less than less than 25 employees
Medium firm: between 25 to 499 employees
Large firm: more than 500 employees

Unemployment Rate: Regional yearly unemployment rate.

7.2. About the data:

To estimate the model with a binary regression, the data must be re-organized into individual-year format data. For each individual, there is one row each time interval at risk of the event occurs and each individual contributes as much he has row of risk of having an events. For example, if individual i is in employment 5 years and then leaves the labour force, this individual contributes 5 rows, the rows are the number of time periods that i was at risk of the event. The re-organization of the data allows an easy estimation of discrete-time hazards models and also to include time-varying variables.

Table 1: Sample descriptive statistics by destination exits, Great Britain (All sample)

	Whole sample	Men					Women				
	All	**All**	**Working**	**Unempl.**	**Retire**	**Other**	**All**	**Working**	**Unempl.**	**Retire**	**Other**
Highest education attainment											
High education level	0.531	0.577	0.635	0.079	0.213	0.073	0.475	0.756	0.039	0.130	0.075
Demographics											
Married	0.824	0.855	0.606	0.103	0.206	0.084	0.794	0.674	0.073	0.123	0.013
Partner is working	0.592	0.571	0.65	0.106	0.169	0.075	0.608	0.7	0.076	0.1	0.124
Job characteristics											
Professional	0.045	0.069	0.486	0.129	0.343	0.042	0.015	0.813	0.00	0.187	0.00
Managerial	0.329	0.326	0.62	0.08	0.243	0.056	0.337	0.752	0.035	0.144	0.069
Skilled manual	0.230	0.119	0.65	0.094	0.161	0.094	0.346	0.693	0.087	0.109	0.112
Skilled non manual	0.199	0.298	0.575	0.1	0.225	0.1	0.102	0.670	0.113	0.057	0.16
Unskilled	0.196	0.179	0.607	0.14	0.15	0.103	0.202	0.589	0.105	0.119	0.187
Occupational pension right	0.725	0.728	0.611	0.069	0.246	0.074	0.667	0.737	0.054	0.126	0.084
Tenure before 50	5.6	5.8	5.0	6.6	6.3	5.5	5.3	4.5	3.6	6.7	5.8
Private sector	0.649	0.769	0.65	0.106	0.169	0.075	0.579	0.66	0.108	0.108	0.123
Part time job	0.243	0.076	0.597	0.052	0.208	0.143	0.412	0.63	0.70	0.122	0.178
Sector											
Primary	0.067	0.120	0.562	0.157	0.239	0.041	0.024	0.76	0.00	0.16	0.08
Commercial services	0.737	0.554	0.604	0.089	0.222	0.084	0.878	0.698	0.065	0.121	0.116
Non commercial services	0.195	0.326	0.628	0.116	0.165	0.091	0.098	0.61	0.178	0.089	0.119
Job in a small firm	0.334	0.281	0.635	0.145	0.128	0.092	0.361	0.662	0.080	0.096	0.161
Job in medium sized firm	0.484	0.524	0.621	0.099	0.209	0.070	0.465	0.719	0.071	0.112	0.098
Job in a large firm	0.179	0.195	0.536	0.071	0.301	0.092	0.174	0.689	0.072	0.178	0.061

Table 2: Sample descriptive statistics, Great Britain (Uncensored Spells)

	Men	**Women**
Highest education attainment		
High education level	0.639	0.361
Demographics		
Married	0.558	0.442
Partner is working	0.515	0.485
Job characteristics		
Professional	0.923	0.077
Managerial	0.598	0.402
Skilled manual	0.317	0.683
Skilled non manual	0.771	0.229
Unskilled	0.423	0.577
Occupational pension right	0.61	0.39
Tenure before 50	6.2	5.6
Private sector	0.59	0.41
Part time job	0.164	0.836
Sector		
Primary	0.899	0.101
Commercial services	0.446	0.554
Non commercial services	0.758	0.242
Job in a small firm	0.449	0.551
Job in medium sized firm	0.596	0.404
Job in a large firm	0.619	0.381

Note: Descriptive statistics are given conditional on having left employment status

Table 3: Transition by Age and Gender, Great Britain (All sample)

	Exit from Employment to					
	Unemployment		Retirement		Other	
	Freq.	%	Freq.	%	Freq.	%
Whole Sample						
50-54	126	34.2	110	29.2	141	37.4
55-59	69	18.4	217	58	88	23.5
60-64	20	14.5	89	64.5	29	21
Males						
50-54	69	46.2	42	28.4	37	25
55-59	41	19.8	127	61.3	39	18.9
60-64	20	14.5	89	64.5	29	21
Females						
50-54	57	24.9	68	29.7	104	45.4
55-59	28	16.8	90	53.9	49	29.3

Note: Exits are given conditional on having left employment status

Table 4: Descriptive Statistics for the Items Constituting the Scale for Perceptions of Involuntary Early Retirement

Item	%
Was retirement wanted or forced?	
Wanted	72.6
Forced	27.4
What was the main reason for retired early?	
Ill health	11.3
Redundancy/dismissed	3.8
Financial inducement	28.8
Time with family	5
Enjoy life	31.3
Needed change	12.5
Retire same time as partner	6.3
Other	1.3

Table 5: Results of Discrete-Time Hazard Model with a Nonparametric Baseline Hazard

	Exit from Employment	
	$\hat{\beta}$	$exp(\hat{\beta})$
High education level	0.106	1.111
	(0.101)	
Male	0.00746	1.007
	(0.109)	
Married	0.0868	1.090
	(0.132)	
Spouse in employment	-0.0686	0.933
	(0.0948)	
Professional	0.437**	1.548**
	(0.205)	
Managerial	0.285**	1.329**
	(0.132)	
Skilled non manual	0.187	1.205
	(0.135)	
Skilled manual	-0.317**	0.728**
	(0.139)	
Tenure before age of 50	-0.0180***	0.982
	(0.00588)	
Private sector	0.146	1.157
	(0.105)	
Part time	0.0748	1.077
	(0.114)	
Commercial services	-0.146	0.864
	(0.159)	
Non commercial services	-0.508***	0.601***
	(0.166)	
Small, less than 25 employees	-0.271**	0.762**
	(0.123)	
Medium, 25 to 499	-0.206*	0.813*
	(0.110)	
Occupational pension right	0.123	1.130
	(0.106)	
Involuntary exit	2.453***	11.6***
	(0.192)	
Baseline Hazard		
Interval-1	-1.551***	0.212***
	(0.331)	
Interval-2	-1.611***	0.199***
	(0.306)	
Interval-3	-1.552***	0.211***
	(0.293)	
Interval-4	-1.723***	0.178***
	(0.292)	
Interval-5	-1.537***	0.215***
	(0.285)	
Interval-6	-1.349***	0.259***
	(0.278)	
Interval-7	-0.932***	0.393***
	(0.266)	
Interval-8	-0.815***	0.442***
	(0.266)	
Interval-9	-0.921***	0.398***
	(0.280)	
Interval-10	-0.499*	0.607*
	(0.269)	
Interval-11	-0.438	0.645
	(0.302)	
Interval-12	-0.160	0.852
	(0.314)	
Regional unemployment rate	0.114***	1.120***
	(0.0253)	
Constant	-2.992***	0.050***
	(0.471)	
Number of individuals	2,599	
Observations (indiv.-spell)	14,611	
LR χ^2	351.8	
Prob $< \chi^2$	0.000	
log likelihood	-2438	
Likelihood-ratio test		
χ^2	1.94*	
Prob $\geq \chi^2$	0.082	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Results of Competing Risk Model with a Nonparametric Baseline Hazard

	Exit from Employment to					
	Unemployment		Retirement		Other	
	$\hat{\beta}$	$exp(\hat{\beta})$	$\hat{\beta}$	$exp(\hat{\beta})$	$\hat{\beta}$	$exp(\hat{\beta})$
High education level	-0.441**	0.643***	0.419***	1.520***	0.396	1.485
	(0.186)		(0.150)		(0.245)	
Male	-0.0398	0.960	0.316**	1.371**	-0.708***	0.492***
	(0.209)		(0.156)		(0.267)	
Married	-0.501**	0.605**	0.297	1.345	0.299	1.348
	(0.247)		(0.194)		(0.335)	
Spouse in employment	0.286	1.331	-0.121	0.886	-0.0249	0.975
	(0.189)		(0.135)		(0.219)	
Professional	0.643	1.902	0.465*	1.592*	-1.561	0.209
	(0.401)		(0.277)		(1.048)	
Managerial	-0.235	0.790	0.507***	1.660***	-0.118	0.888
	(0.253)		(0.194)		(0.308)	
Skilled non manual	0.215	1.239	0.370*	1.447*	-0.184	0.831
	(0.240)		(0.205)		(0.263)	
Skilled manual	-0.169	0.844	-0.485**	0.615**	-0.0269	0.973
	(0.233)		(0.232)		(0.282)	
Tenure before age of 50	-0.0365***	0.964***	0.0027	1.002	-0.0386**	0.962**
	(0.0110)		(0.00786)		(0.0166)	
Private sector	0.263	1.300	0.0616	1.063	0.570**	1.768**
	(0.249)		(0.142)		(0.244)	
Part time	-0.498**	0.607**	0.234	1.263	0.216	1.241
	(0.240)		(0.171)		(0.241)	
Commercial services	-0.224	0.799	-0.223	0.800	0.640	1.896
	(0.267)		(0.224)		(0.552)	
Non commercial services	-0.623**	0.5536**	-0.445*	0.640*	-0.114	0.892
	(0.275)		(0.240)		(0.574)	
Small, less than 25 employees	0.372	1.450	-0.731***	0.481***	0.443	1.557
	(0.241)		(0.196)		(0.307)	
Medium, 25 to 499	0.327	1.386	-0.478***	0.620***	0.299	1.348
	(0.231)		(0.158)		(0.308)	
Occupational pension right	-0.577***	0.561***	0.806***	2.238***	-0.101	0.903
	(0.177)		(0.195)		(0.224)	
Involuntary exit	4.053***	57.5***			2.493***	12.1***
	(0.204)				(0.314)	
Early retirement forced			0.898***	2.454***		
			(0.196)			
Baseline Hazard						
Interval-1	-1.343***	0.261***	-1.976***	0.138***	-0.658	0.517
	(0.500)		(0.673)		(1.041)	
Interval-2	-1.580***	0.205***	-1.861***	0.155***	-0.632	0.531
	(0.509)		(0.622)		(1.044)	
Interval-3	-1.381***	0.251***	-1.764***	0.171***	-0.813	0.443
	(0.509)		(0.586)		(1.053)	
Interval-4	-1.627***	0.196***	-1.762***	0.171***	-1.330	0.264
	(0.530)		(0.560)		(1.087)	
Interval-5	-1.816***	0.162***	-1.506***	0.221***	-0.845	0.429
	(0.559)		(0.530)		(1.071)	
Interval-6	-1.795***	0.166***	-1.289***	0.275***	-0.603	0.547
	(0.576)		(0.497)		(1.070)	
Interval-7	-1.028*	0.357*	-0.961**	0.382**	-0.382	0.682
	(0.538)		(0.461)		(1.069)	
Interval-8	-1.355**	0.257**	-0.823*	0.439*	0.163	1.177
	(0.598)		(0.430)		(1.061)	
Interval-9	-1.859**	0.155**	-0.824**	0.438**	-0.144	0.865
	(0.739)		(0.411)		(1.105)	
Interval-10	-1.927**	0.145**	-0.233	0.792	-0.622	0.536
	(0.843)		(0.364)		(1.231)	
Interval-11	-1.436*	0.237*	-0.348	0.706	0.710	2.033
	(0.843)		(0.381)		(1.124)	
Interval-12	-1.014	0.362	-0.0129	0.987	0.621	1.860
	(0.842)		(0.368)		(1.230)	
Regional unemployment rate	0.137***	1.146***	0.169***	1.184***	0.0799	1.083
	(0.0459)		(0.0393)		(0.0518)	
Constant	-3.249***	0.038***	-4.967***	0.006***	-7.282***	0.000***
	(0.842)		(0.660)		(1.639)	
Number of individuals	2,599		2,599		2,599	
Observations (indiv.-spell)	14,611		14,611		14,611	
LR χ^2	575.3		85.76		449.9	
Prob $< \chi^2$	0.000		0.000		0.000	
log likelihood	-669.5		-1672		-493.3	
Likelihood-ratio test						
χ^2	5.9e-04		2.33*		4.8e-05	
Prob $\geq \chi^2$	0.497		0.064		0.497	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: The Role of Health on Non-Employment Decisions, Great Britain

	Exit from Employment to		
	Unemployment	**Retirement**	**Other**
	$\hat{\beta}$	$\hat{\beta}$	$\hat{\beta}$
High education level	-0.425**	0.422***	0.362
	(0.187)	(0.147)	(0.271)
Married	-0.541**	0.269	0.309
	(0.246)	(0.188)	(0.409)
Spouse in employment	0.280	-0.116	0.0332
	(0.189)	(0.132)	(0.262)
male	-0.0225	0.299**	-1.015***
	(0.207)	(0.147)	(0.373)
Professional	0.615	0.497*	-1.550
	(0.403)	(0.268)	(1.143)
Managerial	-0.221	0.539***	0.132
	(0.249)	(0.188)	(0.363)
Skilled non manual	0.159	0.395**	0.0772
	(0.234)	(0.201)	(0.339)
Skilled manual	-0.280	-0.473**	-0.0310
	(0.226)	(0.225)	(0.345)
Tenure before age of 50	-0.0356***	0.00369	-0.0471**
	(0.0110)	(0.00767)	(0.0206)
Private sector	0.168	0.0420	0.495*
	(0.241)	(0.126)	(0.293)
Part time	-0.491**	0.228	0.340
	(0.242)	(0.168)	(0.299)
Small, less than 25 employees	0.426*	-0.696***	0.544
	(0.237)	(0.184)	(0.356)
Medium, 25 to 499	0.318	-0.460***	0.249
	(0.229)	(0.152)	(0.352)
Occupational pension right	-0.567***	0.802***	-0.180
	(0.174)	(0.190)	(0.259)
Involuntary exit	4.010***		2.578***
	(0.202)		(0.387)
Early retirement forced		0.795***	
		(0.192)	
Regional unemployment rate	0.136***	0.165***	0.102
	(0.0465)	(0.0381)	(0.0699)
Health problem	1.820***	0.372	4.719***
	(0.339)	(0.268)	(0.670)
Constant	-3.593***	-5.246***	-7.006***
	(0.795))	(0.605)	(1.655)
Number of individuals	2,599	2,599	2,599
Observations	14,611	14,611	14,611
log likelihood	-672.8	-1673	-496.8
χ^2	574.0	89.70	155.3
Prob $\geq \chi^2$	0.000	5.77e-05	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Specification Tests

LR test	χ^2 **(Prob** $> \chi^2$**)**
Combining outcomes	
Pooled Exit and Unemployment	3504.68 (0.00)
Pooled Exit and Inactivity	1068.96 (7.55e-23)
Unemployment and Inactivity	2413.91(0.00)
Unemployment and Retirement	1068.89 (7.79e-23)
Unemployment and Other	175.99 (6.082e-39)
Pooled Exit and Retirement	2435.78 (0.00)
Retirement and Other	892.90 (1.28e-19)
Pooled Exit and Other	3328.69 (0.00)

Figure 1: Employment rate in Great Britain

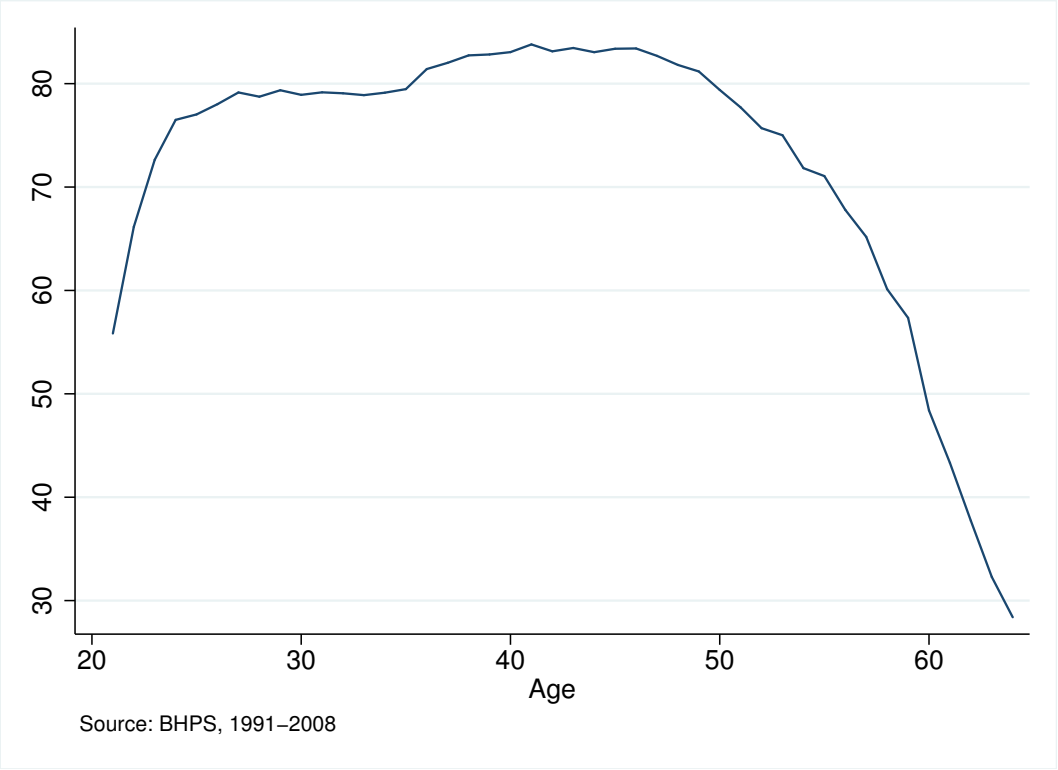

Figure 2: Employment rate in Great Britain, by gender

Figure 3: Labour force participation rates by single year of age around the State Pension Age in the UK, 2002 (in %)

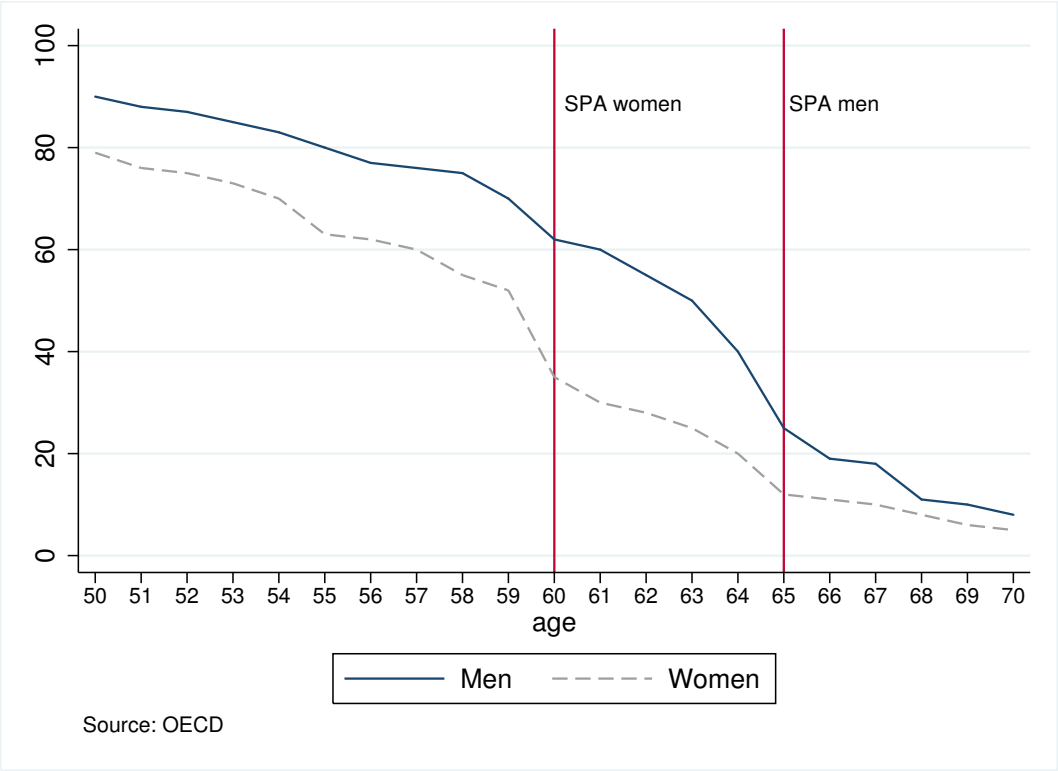

Figure 4: Employment status in Great Britain, by gender

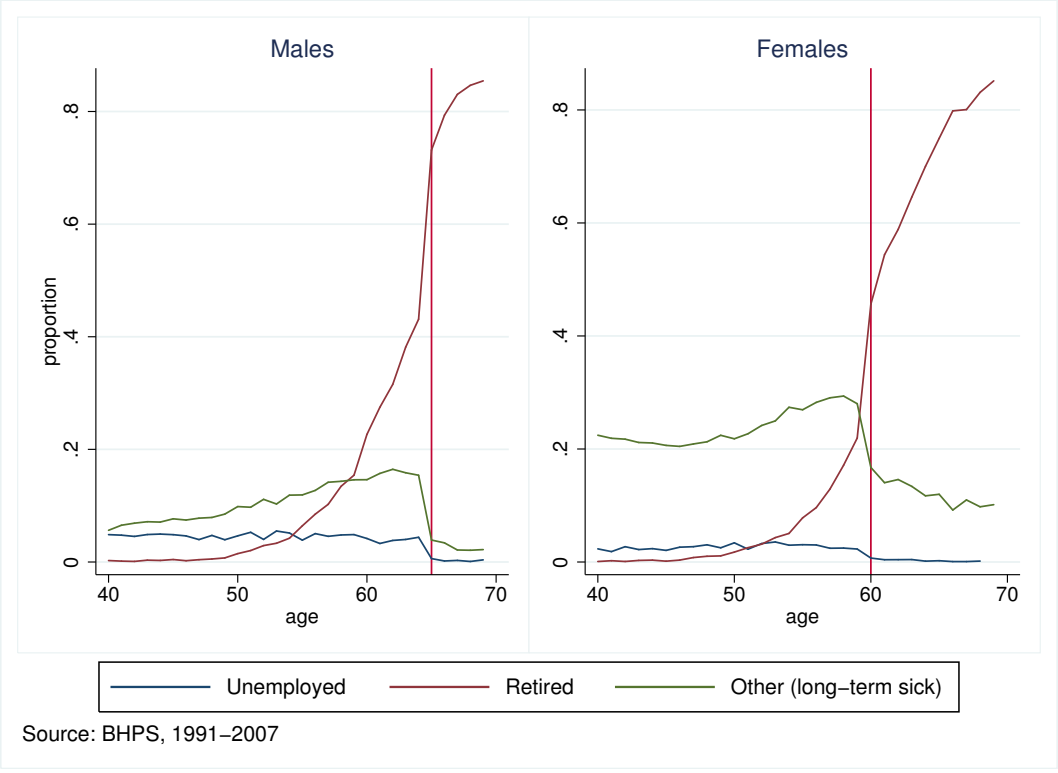

Figure 5: Survivor Functions in Employment, Great Britain

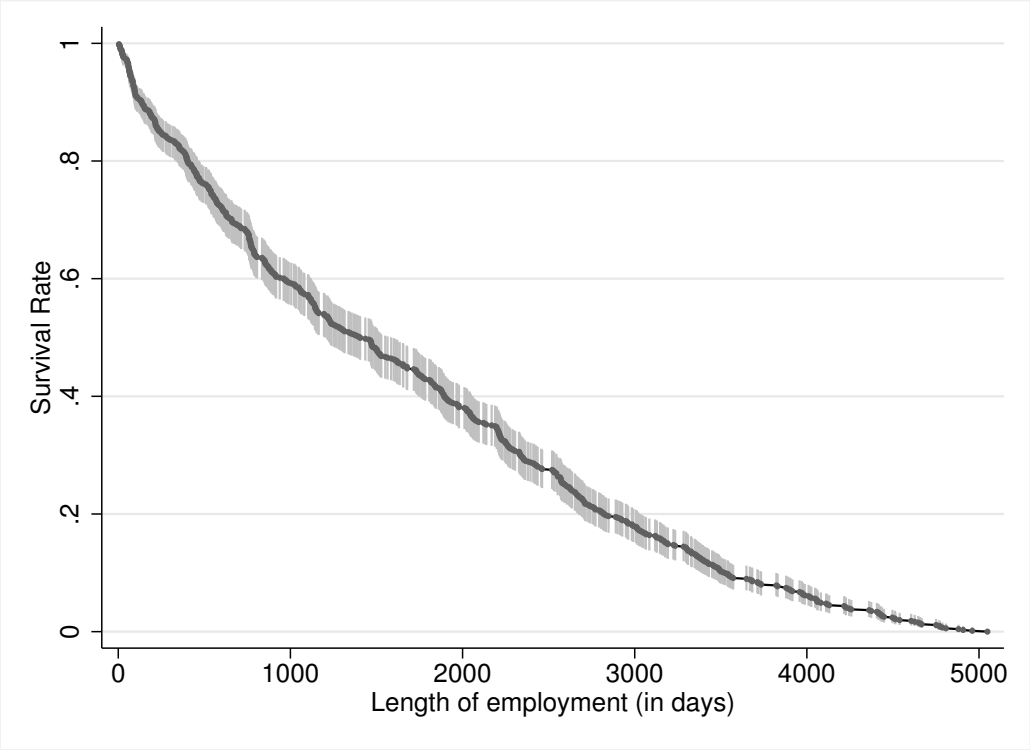

Figure 6: Survivor Functions in Employment by Destination States by Destination States, Great Britain

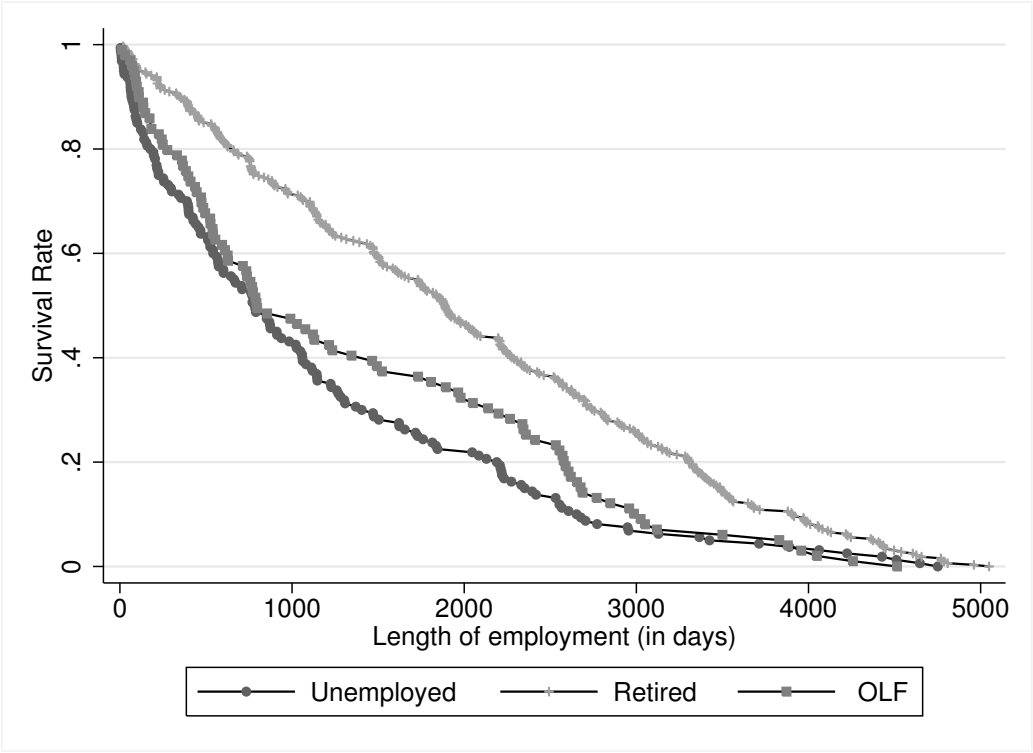

Figure 7: Cumulative Distribution Function in Employment, Great Britain

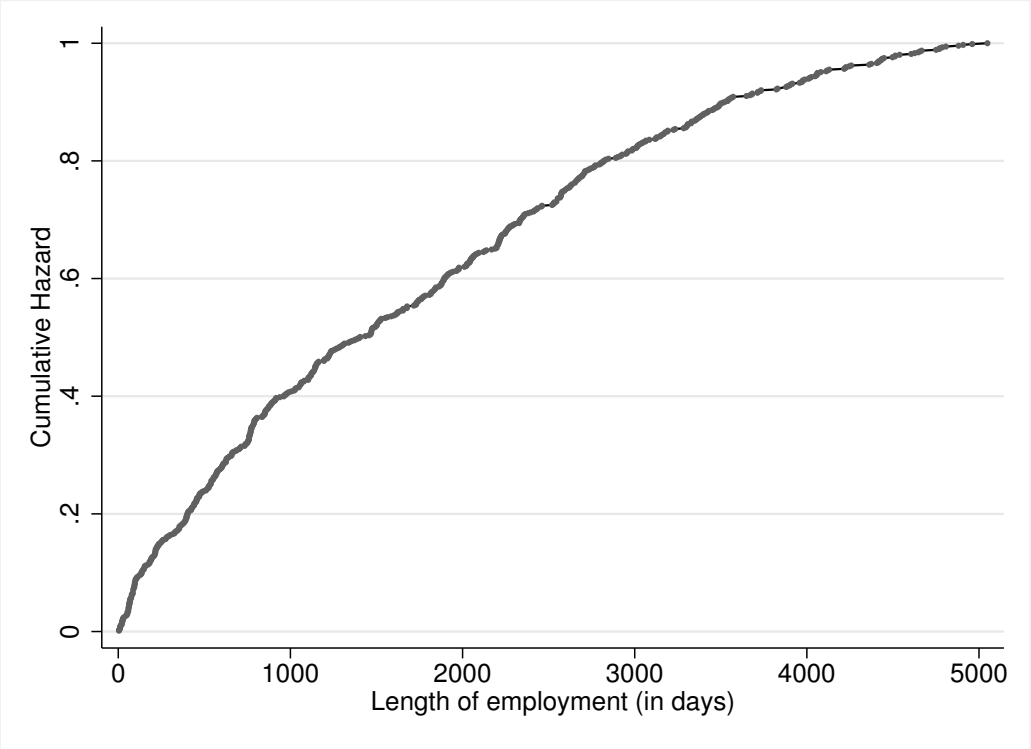

Figure 8: Cumulative Distribution Functions in Employment by Destination States, Great Britain

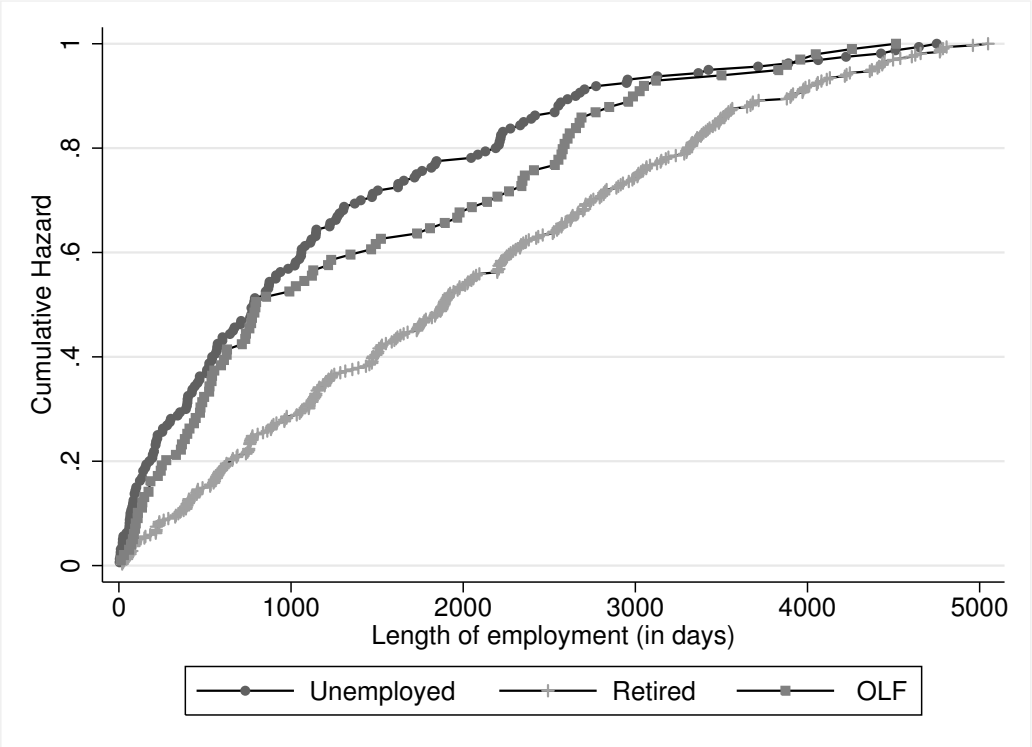

Figure 9: Hazard Rates, Great Britain

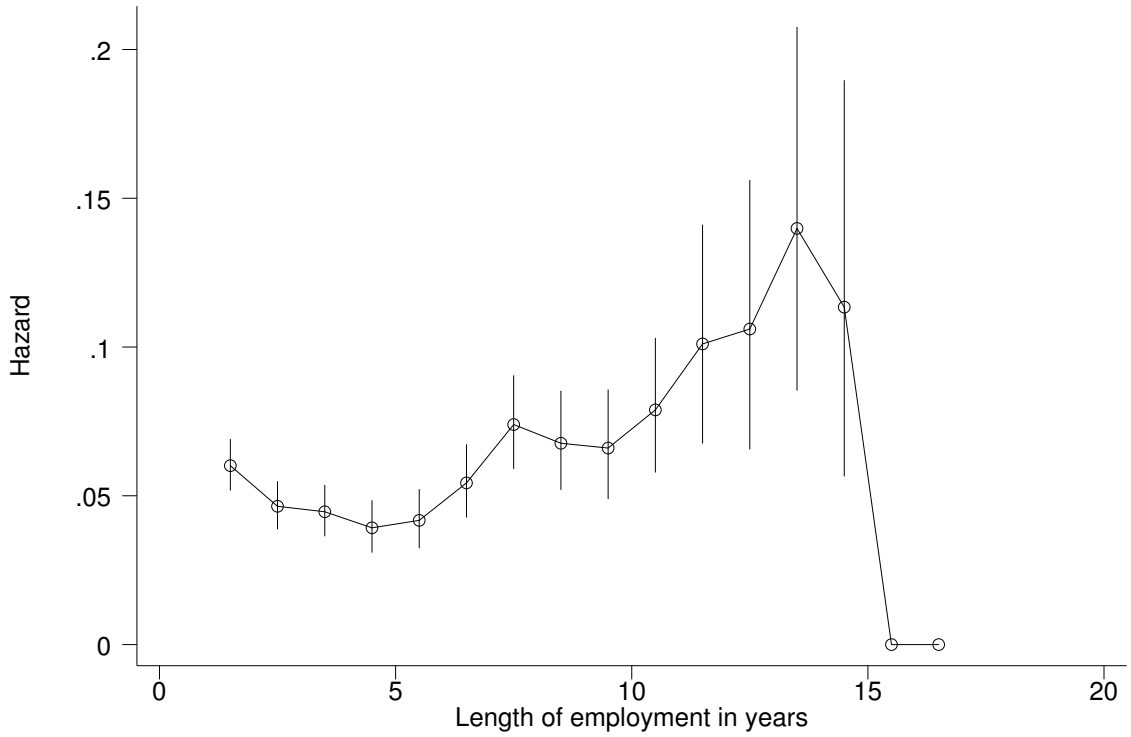

Figure 10: Hazard Rates by Destination States, Great Britain

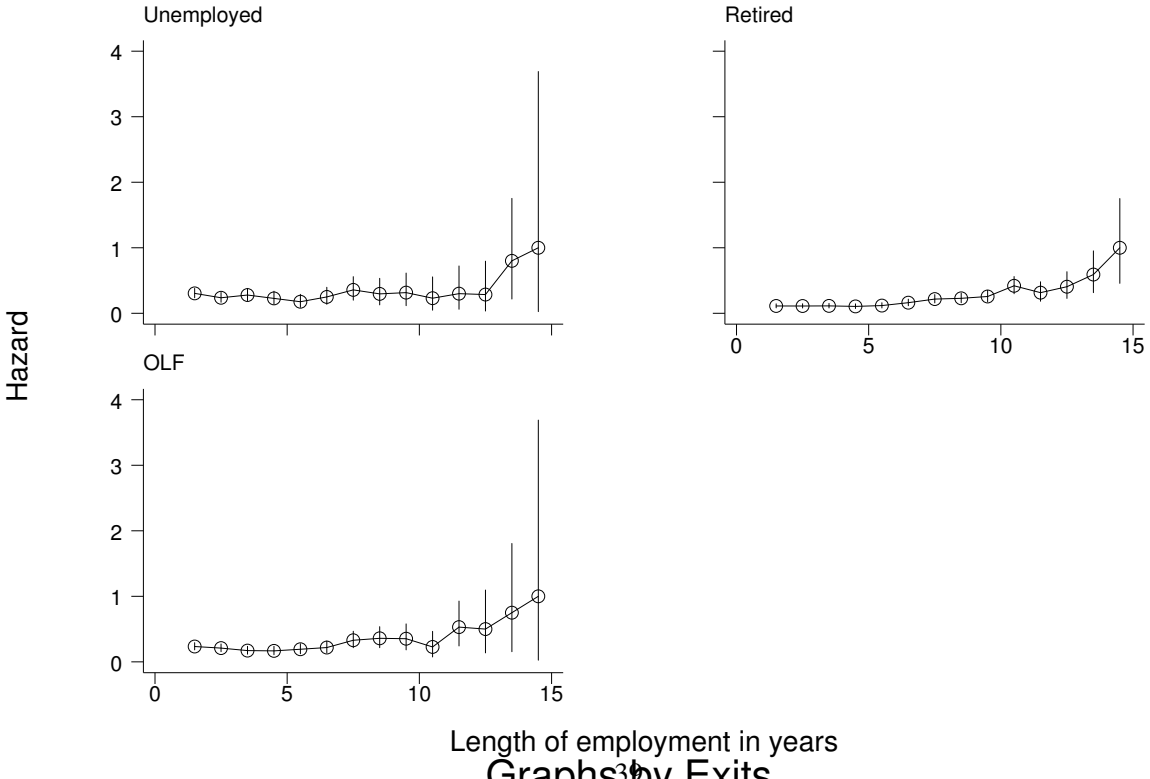

Figure 11: Estimated Baseline Hazard from Single Competing Risks Model, Great Britain

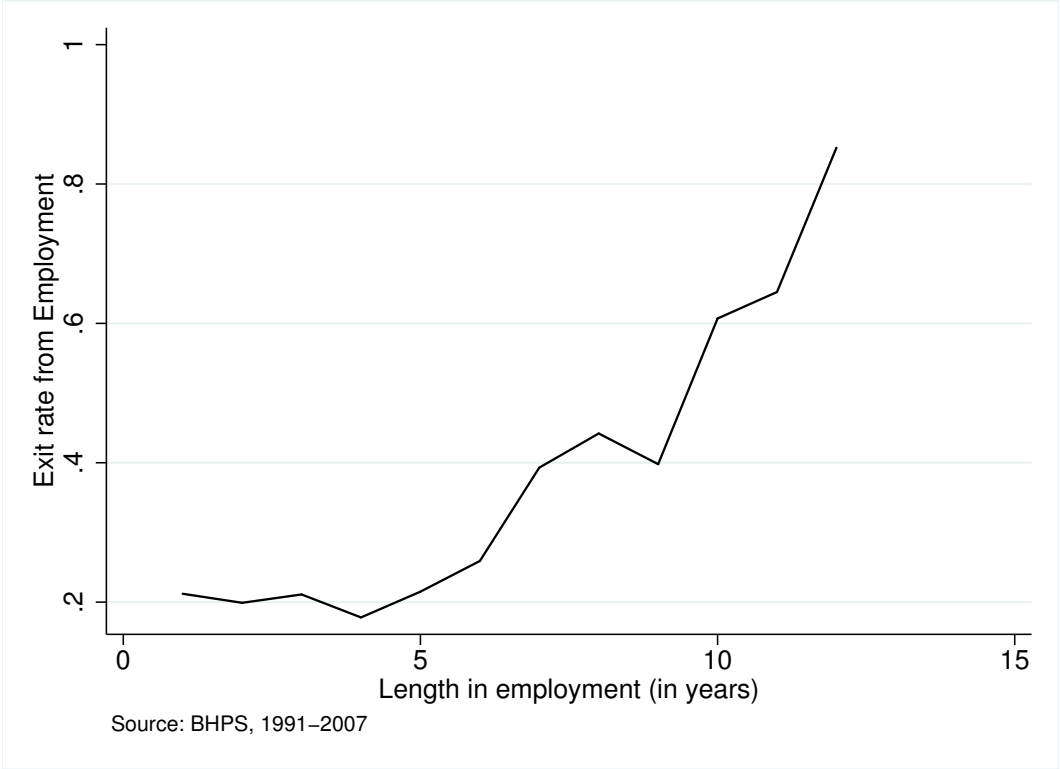

Figure 12: Estimated Baseline Hazard from Single Competing Risks Model, Great Britain