DOCUMENTO DE TRABAJO. E2012

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E2010/12

Retirement incentives, individual heterogeneity and labour transitions of employed and unemployed workers

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Abstract

In this paper we analyze the sensitivity of the labour market decisions of workers close to retirement with respect to the incentives created by public regulations. We improve upon the extensive prior literature on the effect of *pension incentives* on retirement in two ways. First, by modeling the transitions between employment, unemployment and retirement in a simultaneous manner, paying special attention to the transition from unemploymente to retirement (which is particularly important in Spain). Second, by considering the influence of unobserved heterogeneity in the estimation of the effect of our (carefully constructed) incentive variables.

Using administrative data, we find that, when properly defined, economic *incentives* have a strong impact on labour market decisions in Spain. Unemployment regulations are shown to be particularly influential for retirement behaviour, along with the more traditional determinants linked to the pension system. Pension variables also have a major bearing on both workers' reemployment decisions and on the strategic actions of employers.

* We gratefully acknowledge the support from Project ECO2008-06395-C05-01 and SEJ2006-04803/ECON.Our thanks to the audience and seminar participants at ESPE-2009, Alicante, IEF and SAE2009.

The quantitative impact of the *incentives,* however, is greatly affected by the existence of unobserved heterogeneity among workers. Its omission leads to sizable biases in the assessment of the sensitivity to economic *incentives*, a finding that has clear consequences for the credibility of any model-based policy analysis. We confirm the importance of this potential problem in one especially interesting instance: the reform of early retirement provisions undertaken in Spain in 2002. We use a *difference-in-difference* approach to measure the behavioural reaction to this change, finding a large overestimation when unobserved heterogeneity is not taken into account.

Keywords: Retirement, unemployment, incentives, Pension system, Unobserved heterogeneity, Spain.

JEL Classification: J14,J26;J64

* We gratefully acknowledge the support from Project ECO2008-06395-C05-01 and SEJ2006-04803/ECON.Our thanks to the audience and seminar participants at ESPE-2009, Alicante, IEF and SAE2009.

1 Introduction

All around the world, demographic aging is expected to produce significant changes in the size and composition of the labour force. In the European Union, for instance, the old-age dependency ratio is projected to more than double from 25.4% to 53.5% over the 2008/2060 period.[1] As a result, the overall labour force in the EU is expected to decrease by as much as 13.6%, equivalent to around 24.4 million people (if compared with the number in 2007). This type of severe predicted labour shortages is in no way solely applicable to European countries. According to the 2008 UN population projections, old-age dependency ratios will increase in 2000/2050 by almost 50 percentage points in Japan, by almost 30 pp in China, and around 15 pp in the United States.[2] Seen in this perspective, the labour imbalances created by the latest cyclical downturn 2007/2009 (most visibly in countries like the USA where the unemployment rate has doubled over this period, and Spain and Ireland whose unemployment rates have skyrocketed to figures well above 10%) look like a transitory phenomena. In our view, the real challenge for future governments will most probably lie in attracting older individuals back to the labour force rather than the opposite. Actually, most of the policy reforms recently implemented clearly point in this direction[3]. Succeeding in this endeavour requires a better understanding of labour supply than that achieved so far, specially regarding the ability of policy makers to influence individual behaviour via *incentives* (ie. by changing the institutional environment without imposing specific choices on individuals).

In this paper we contribute to this inquiry in three ways. First, by exploring the labour supply of both employees and unemployed workers of advanced age. In our view, the latter group has been somewhat overlooked in previous research, despite being large enough to make a significant contribution to labour supply in a number of OECD countries[4]. Secondly, we carefully model the variables that capture the complex incentives provided by public institutions. For example, access to high quality administrative data means we can ensure that public benefits are only applied to those in the sample who comply with all the entitlement requirements. Finally, we contribute by explicitly considering multispell data and including unobserved heterogeneity in the assessment of the impact of *financial incentives*.Note that our analysis is centered on Spanish data, but the methodology and the lessons obtained are of far broader applicability. As detailed below, Spain is an interesting case study for this analysis thanks to the rather extreme incentives provided in its pension and unemployment insurance programs, but similar institutions are found elsewhere.[5]

The empirical literature exploring the retirement behaviour of employed workers with reduced-form models constitutes a natural reference point for this work.[6] Loosely speaking, the methodology employed involves two steps: the measurement of the key incentive variables and, in a second step, the quantification of their influence on retirement decisions via reduced-form econometric analysis. Examples of descriptive analyses of pension systems, their financial incentives and their impact on behaviour can be found in eg. Gruber & Wise (1999) or Casey *et al.,* (2003). As for the formal estimation of econometric models including incentive variables as key regressors, Samwick (1998); Borsch-Supan (2000) or Belloni & Alessie (2009) illustrate the development of this branch of the literature. The Spanish case has also received a great deal of attention, as exemplified by Boldrin *et al.* (1999), Jiménez-Martín & Sánchez-Martín (2004, 2007) or Cairó-Blanco (2010). A significant

[1] Economic Policy Committee and European Commission (2009) page 24. The old-age dependency ratio is the ratio of people aged 65 or above relative to the working-age population aged 15-64.

[2] Some recent research cast some doubts over the long-term predictions of the dependency ratios, see Sanderson & Scherbov (2010)

[3] The widespread delays in normal retirement ages (specially for women) in OECD countries is a good example. See eg. Whiteford & Whitehouse (2006)

[4] They represent an important fraction of the labour force aged 50-64 in 2009: for example, 7.5 percent of the LF in Germany, 6 in the UK, 6.8 in France, and 11.3 in Spain. Source: European Labour Force Survey.

[5] The disincentive to work stems from the combination of early retirement, generous unemployment protection and a permissive attitude towards the search effort of the unemployed approaching retirement. This framework is shared by a large number of European and OECD countries.

[6] A parallel structural literature is not covered in this paper. Mira & Aguirregabiria (2010) is an excellent survey of the econometrics of dynamic discrete choice structural models.

(although somewhat weaker than expected) influence of financial incentives on retirement from employment is the typical conclusion of these studies (see, for example, Gruber & Wise (2004)). Our work expands this literature in several dimensions.

First, we joint a recent literature that incorporates into the analysis the labour supply patterns of the unemployed and the determinants of the transition from unemployment into retirement. In the US, Coile and Levine (2006) explore the influence of changes in the labor market conditions and unemployment benefits on retirement. In a more recent paper (Coile and Levine (2009)) they evaluate the relative impact of changes in the labor market conditions vs changes in the value of wealth. Benítez-Silva and Ni (2010) focus on the determinants of the job search of individuals approaching or having reached retirement. These papers are especially relevant after the surge in unemployment in US caused by the latest cyclical downturn. Here we extend these analyses to an economy with even higher incidence of unemployment: Spain. Based on a new sample of administrative records from the Spanish Social Security (MCVL) we explore the impact of the financial incentives implicit in the Spanish regulations on the retirement and reentry decisions of both employed and unemployed workers.[7] We also explore the transition into unemployment, bearing in mind the possible strategic use of unemployment insurance as an early retirement device.

Spain is a particularly interesting case because of the strong incentives embedded in public regulations. Early retirement penalties provide a clear illustration of the type of problems involved. Under the standard program, the early claiming of the pension benefit is only possible over the age of 60, and subject to rather severe penalties.[8] This is a clear deterrent for employees, but has unintended consequences for the unemployed. In Spain, the unemployment insurance authority provides a cash benefit of 60-70% of the previous wage (for up to two years) and pays social contributions to the Social Security. It is, also, remarkably tolerant regarding the search effort demanded from its registered unemployed.[9] This is, therefore, a textbook example of moral hazard problems, created by the interaction of pension and unemployment regulations: for a large number of unemployed, the optimal response is to stay unemployed without searching while accumulating pension rights (ie. being effectively early retired but still being paid as if they were looking for jobs).[10] Inefficiencies of this type are common across OECD countries. Germany and France, for instance, combine a generous unemployment benefit with an exemption from job seeking before the Early retirement age (60). Unsurprisingly, the early retirement route via unemployment is very popular in both countries (see chapters 3 and 4 in Gruber and Wise (1999). In this paper we quantify the behavioural consequences of this and other regulations and their contribution to the generation of an alternative exit route out of the labour force. Our quantitative findings apply only to the Spanish case, but the general message is of much wider applicability.

A second contribution of our work is more methodological: the explicit inclusion of unobserved heterogeneity in a multiple spell multi-state competing risk model. We think of this as a relevant improvement because the omission of unobservable differences in preferences and individual-specific labour market characteristics can easily bias the estimated results on the effect of financial incentives over individual behaviour. An example may illustrate this point. In countries with generous minimum pensions, they usually take the blame for the peak in retirement hazard observed at the Early Retirement Age (60 in Spain).[11] However, it may be the case that the observed peaks are entirely due to a composition effect. They may reflect the existence of a group of people whose unobservable characteristics (preferences, non-labour wealth, etc.) lead them to coordinate retirement, typically under the effect of credit constraints, at the age when pension benefits are first available.[12] Most

[7] The MCVL database is an random extraction from the administrative register of the Spanish Social Security. As described in section 3, it provides the complete labour history of more than one million workers in Spain.

[8] The pension is reduced by 7.5% for each year that the individual claims before the normal retirement age of 65.

[9] Strictly speaking, unemployed people in Spain cannot remain inactive according to the current legislation; Nonetheless, the authorities largely turn a blind eye on this common practice.

[10] The unemployed aged 52 or older are entitled to a special unemployment program (UB52+) that provides an assistance benefit, once the individual contributive benefits are exhausted. The benefit can be enjoyed on a continuous basis until the individual retires.

[11] Minimum pensions remove the financial incentives to work provided by early retirement penalties and also increase lifecycle wealth. See Jiménez-Martín & Sánchez-Martín (2007) for more details. Also note that the existence of borrowing constraints typically share some of the blame for the large early retirement hazards in the data.

[12] Gustmann and Steinmeier (2005) is a good example of this approach. The population is split into two groups according to

likely, the two hypotheses are intertwined. If a high propensity to leave the workforce early is partly the product of individual preferences, it will probably result in low life-cycle contributions and, consequently, pension benefits. This will make these workers qualified for the perception of minimum pensions. In this paper we allow the two mechanisms to reveal themselves in the estimation process. In particular, our estimation of the impact of financial incentives includes the possible existence of these unobserved differences among the individuals in the sample.

Our empirical strategy is based on the joint estimation of two duration models, one for the exit from employment and another one for the exit from unemployment. We adopt a multiple risk approach with three destination states (employment, unemployment and retirement), and explicitly take into account unobserved heterogeneity. The transition rates are specified in a flexible way and are allowed to depend on both observed and unobserved characteristics of the worker, as well as on the time spent in the respective state. Consequently, we derive the *joint* likelihood of all the observed transitions each individual in the sample may go through, taking into account the effects of unobserved factors in those transitions. The joint consideration of both the employment and unemployment spells of the same worker is important in order to properly identify the effect of economic incentives over their decisions of quitting from the job, searching for a new job or retiring (as employed or as unemployed). It is important to control for unobserved heterogeneity, since lack of control of this problem introduces biases in the coefficients obtained from independent estimations of the different hazard rates.

Our findings can be categorized in three groups. A first set of results provides a robust confirmation of the importance of economic incentives. While the previous literature has struggled to confirm the size (and in some cases even the sign) of the incentive effects, our estimations are clearly consistent with the theoretically expected value of the effects. We find that the amount of disposable income (in the current and alternative labour states), the amount of accrued pension rights and their change with current decisions are all strong predictors of individual behaviour. The financial opportunities captured by our incentive variables stem from both the pension and the unemployment insurance systems. The cross-effects between the two systems are large: unemployment regulations are extremely important for the timing of retirement, while pensions rules affect the transition between employment and unemployment (over and above the well-known effects on retirement). Finally, we find that, in addition to the effect on individual decisions, public policies also seem to have an influence on the timing of the firing decisions made by the employers in our sample. A second set of results stresses the importance of controlling for unobserved heterogeneity in the estimation of the effects of the incentives. Ignoring this heterogeneity leads to sizable biases in the quantification of the effect of incentives. For example, the tendency to quickly change states with a low disposable income is underestimated if unobserved heterogeneity is ignored. At the same time, we show that the peak in the retirement hazard at the normal retirement age is created by the coexistence of several types of workers with markedly different retirement propensities. Ignoring this possibility will lead to an overestimation of the sensitivity to pension rules (once individuals reach the age of 65).

Finally, we assess the extent to which policy makers can alter aggregate labour behaviour by changing the economic incentives. We undertake two policy experiments with our simulated model, exploring the consequences of modifying the pension and/or unemployment regulations. First we use the model to explore the consequences of the change in early retirement rules in 2002 in Spain. Using a *difference-in-difference* approach we find a sizable impact of the new early retirement provisions (shifting the initial retirement age from 60 to 61) on the retirement decisions of the affected workers and on the firing decisions of employers. In a second experiment we evaluate the effects of a further tightening of the pension/unemployment legislation. We simulate a cut in the length of time benefits are available and a reduction in the pace of accumulation of pension rights during the unemployment spell. These changes lead to large increases in the predicted reemployment and retirement hazard rates, with gains ranging between 10 and 20% of the initial hazard, depending on age.

the time-discount factor. As a result, early retirement is less dependent (although not completely independent) on the financial incentives provided by the Social Security system.

The structure of the paper is as follows. Firstly,in section 2 we present the theoretical background in order to understand the main behavioural components of our empirical approach. Section 3 presents the data we use, reviewing the main descriptive statistics of our estimation sample and other relevant empirical evidence. We then proceed to present our econometric techniques in section 4. Section 5 presents the main results of the analysis and section 6 presents some policy simulations. Finally, section 6 concludes.

2 Rational retirement behaviour

In this section we explore the determinants of the optimal retirement decisions made by both employees and unemployed workers. This provides the rationale for our choices of regressors in the econometric analysis of section 4.

Consider an **employed worker** first. At age τ, the worker is considering whether to stay employed or to retire (i.e. to leave the labour force).[13] We represent current labour income by $w(\tau)$ and the pension available in case of retirement by $B(\tau)$. If the worker decides to stay employed at age τ, the marginal change in their life-cycle wealth, y' is:

$$y'(\tau) = \begin{cases} w(\tau)(1-\varsigma) + B'(\tau)\,\mathcal{A}(60) & \text{if } \tau < 60 \\ w(\tau)(1-\varsigma) - B(\tau) + B'(\tau)\,\mathcal{A}(\tau) & \text{if } \tau \geq 60 \end{cases} \tag{1}$$

where ς stands for the pay-roll tax rate, B' is the marginal change in the value of the pension benefit in case the individual continues working and $\mathcal{A}$ is a constant that measures (in expected, discounted terms) the length of the period during which the individual enjoys the extra pension obtained. Note that we are taking 60 as the Early Retirement Age. Equation (1) shows how, before the Normal Retirement Age, typical workers can increase income by delaying retirement. The gains are both immediate (in as far as current net labour income exceeds the pension benefit) and differed in time (later retirement means smaller early retirement penalties, resulting in larger pensions in the future). "Financial" incentives, therefore, favor delaying retirement until, at least, the Normal Retirement Age. This general observation, however, depends on the details of the pension formula and the individual circumstances of the worker (as further discussed below). Besides, the benefits of retirement go beyond purely economic incentives, as people enjoy the opportunities derived from alternative uses of time. By labeling all those benefits together as "leisure", l, the optimal retirement can be easily framed as an intertemporal income-vs-leisure choice. To be more specific we assume individuals' relative preferences for consumption/leisure at a point in time are captured by a separable utility function $U(t) = u(c(t)) + \nu(l(t))$. By solving a standard life-cycle problem (see Jiménez-Martín & Sánchez-Martín (2007)), it can be shown that it is optimal to stop working at age τ^* if:[14]

$$\lambda^*\, y'(\tau^*) < \Delta\nu(\tau^*) \tag{2}$$

where λ^* is the marginal utility of wealth (the lagrange multiplier of the problem when $\tau = \tau^*$) and $\Delta\,\nu$ stands for the change in utility generated by the increase in leisure after retirement. In words, equation (2) says it is optimal to stop when the welfare gain derived from working (expressed in utility terms by multiplying the "financial" change y' by λ) does not compensate for the utility value of the forgone leisure.

Our empirical exercise explores the connection between the observed variability in retirement ages and the observed variability on the left hand side of equation (2), controlling for unobserved heterogeneity.[15] More precisely, we will construct a set of regressors that capture the variability in

[13] In this brief explanation of the individual's decisions we leave aside the risk of being fired or any other of the uncertainties suffered at the end of the professional career. This is for expositional simplicity: in our empirical application we do include the probability of being separated from the job.

[14] More generally, the optimal retirement age, τ^*, for a worker planning at age t_0 is characterized by the first order condition:

$$\lambda\, e^{-r\,(\tau^* - t_0)}\, y'(\tau^*) - e^{-\delta(\tau^* - t_0)}\, \Delta\,\nu(\tau^*) = 0$$

[15] Note that the variability in $\lambda\, y'(\tau)$ is brought about both by the time and cross-section variability in individual characteristics and the time variability in pension rules.

the financial incentives $y'(t)$ generated by Spanish pension rules. First, we develop the expression of the financial incentives (1) a bit further by including the details of the pension formula:

$$B(\tau) = \begin{cases} \alpha(\tau)\,\overline{w}(\tau) & \text{if } B(\tau) > B_m \\ B_m & \text{if } B(\tau) \leq B_m \end{cases}$$

In Spain, the individual pension is obtained by combining three main ingredients (see Appendix A.1 for the main details of the Spanish Pension System):

(i) Accrued pension rights, $\overline{w}(\tau)$, a moving average of gross labour income in the D years before retirement, $\overline{w}(\tau) = \int_{\tau-D}^{\tau} w(t)\,dt$.

(ii) $\alpha(\tau)$, a replacement rate that combines penalties for early retirement and for an insufficient number of contributed years.

(iii) B_m, a guaranteed minimum pension benefit.

Note, in particular, that $B'(\tau)$ is 0 when the individual is drawing the minimum pension and $\alpha'(\tau)\,\overline{w}(\tau) + \alpha(\tau)\,\overline{w}'(\tau)$ otherwise. $\alpha'(\tau)$ is a non-linear function of the age and of the length of the individual's contributive record; $\overline{w}'(\tau)$ reflects the changing slope of gross labour income during the life cycle ie. $\overline{w}'(\tau) = w(\tau) - w(\tau - D)$. Taking all the above into account, we can obtain detailed expressions for the financial incentives experienced at different ages. Before the Early Retirement Age the expression is:

$$y'(\tau) = \left\{ \begin{array}{cc} w(\tau)(1-\varsigma) & \text{if } B(\tau) \leq B_m \\ w(\tau)(1-\varsigma) + \mathcal{A}(60)\alpha'(\tau)\,\overline{w}(\tau) + \mathcal{A}(60)\,\alpha(\tau)\,\overline{w}'(\tau) & \text{otherwise} \end{array} \right] \quad (3)$$

while after the Early Retirement Age, the incentives take the form:

$$y'(\tau) = \left\{ \begin{array}{cc} w(\tau)(1-\varsigma) - B_m & \text{if } B(\tau) \leq B_m \\ w(\tau)(1-\varsigma) + [\mathcal{A}(\tau)\alpha'(\tau) - \alpha(\tau)]\,\overline{w}(\tau) + \mathcal{A}(\tau)\,\alpha(\tau)\,\overline{w}'(\tau) & \text{otherwise} \end{array} \right. \quad (4)$$

We use these equations to formulate our econometric model (see equation (5) below), but we explore first how they change when we model the behaviour of unemployed workers.

Unemployed workers

The optimal behaviour of the unemployed is harder to model, but the trade-offs involved in retirement decisions are not very different from those described above. Retirement is still a trade-off between current and future income and leisure, and can be formally captured by expressions similar to (2) and (3)-(4) [16]. In general, the same mechanisms that prevent employees from retiring operate in the case of the unemployed, with the (probably unintended) consequence of prolonging the duration of the unemployment spells. This tendency is limited by the dependence of the unemployment benefits on the duration of the unemployment spells (see Appendix A.2 for the details of the Spanish UB System):

- The cash benefit provided by the Unemployment Services, b, is a decreasing function of the length of the spell. Roughly speaking, it amounts to 70% of the previous gross wage in the first 6 months of the spell; 60% in the ensuing year and a half and a subsistence subsidy thereafter.

[16] Simple expressions of the financial incentives miss the uncertainty and complexities involved in the process of searching for a new job. We refer the interested reader to Garcia-Perez & Sanchez Martín (2009), where a formal analysis of the optimal retirement and search behaviour of the unemployed can be found. In the empirical specification use in the present paper, the options opened to the unemployed are captured by a set of individual characteristics (eg. level of qualifications and age) and a set of variables reflecting the state of the labour market.

- Similarly, the Unemployment Services protect the future income of the unemployed by paying their social contributions to the Social Security System according to the worker's previous wage. In this way, they prevent a very unfavorable updating of $\overline{w}$ while the worker is unemployed. This protection is, however, provided solely during the first two years of the unemployment spell as a maximum.[17]

All in all, equations (3)-(4) are still valid with the substitution of unemployment benefits, b, for net wages, $w(\tau)(1-\varsigma)$, and keeping in mind the dependence b and the change in pension rights $\overline{w}'(\tau)$ have on the duration of the unemployment spell.

Empirical specification

Guided by the expressions above, our empirical approach will be based on the following expression:

$$P(\tau) = \beta_1 \, Inc(\tau) + \beta_2 \, \alpha(\tau) + \beta_3 \, \overline{w}(\tau) + \beta_4 \, \overline{w}'(\tau) + \beta_5 \, Y(\tau) + \gamma' Z + \epsilon \tag{5}$$

Where $P(\tau)$ is the probability of retirement which, in our empirical application, means being classified as retired by the Social Security administration. This equation includes the following regressors:

- Current income Inc, ie. current labour income if employed, $w(\tau)$ or unemployment benefits b if unemployed.

- The pension replacement rate associated with the length of the individual's contributive record $\alpha(\tau)$.[18]

- The accrued pension rights, $\overline{w}(\tau)$.

- The change in pension rights, $\overline{w}'(\tau)$.

- A proxy of life-cycle wealth, $Y(\tau)$, included as a determinant of the marginal utility of wealth, λ. More precisely, larger values of $Y(\tau)$ imply lower values of λ and a stronger valuation of leisure versus income. For a formal understanding, it should be remembered that according to equation (2) it is best to retire when $y'(\tau) < \Delta \, \nu(\tau^*)/\lambda$.

- A set of other variables, Z, including information on demographic characteristics and previous labour market experiences. This information acts as proxy for the dis-utility of work (and the reemployment opportunities of the unemployed). For the unemployed we also allow for a direct effect of the duration of the unemployment spell (over and above the impact of duration on benefits and the update of pension rights).

3 Data and descriptive statistics

3.1 The data set

We use Spanish administrative data from the *Muestra Continua de Vidas Laborales* (MCVL). This data set is based on a random draw from the Social Security archives. Each year, it provides a sample of 4% among all the affiliated workers, employed or otherwise, and pensioners in that year. The MCVL reports information for about 1.1 million people on their personal characteristics and employment and unemployment spells throughout their entire labour history. Here we use the 2008 wave, supplemented by the employment histories of workers present only in some of the previous three waves (2005-2007).

For each worker, we have the date when each job begins and ends. This provides us with quite detailed information about employment duration. Periods of unemployment can also be identified from

[17] From then on the Unemployment Services pays only the minimum contribution on behalf of the worker who has access to non-contributive Unemployment Benefits.

[18] Note that the replacement rate is also a function of age. As we are including age as an independent regressor, we make α represent just the penalties derived from an insufficient number of contributive years.

the dates when the firm ceases to pay Social Security contributions for the worker. Furthermore, we can differentiate between unemployment spells in which the worker receives Unemployment Benefits (those in which payroll taxes are paid) and those which correspond to both periods of unemployment without benefits or periods of inactivity (those in which worker contributions to Social Security are not paid). Moreover, we know whether the Unemployment Benefits are contributive (corresponding to the Unemployment Insurance system, which pays benefits to workers who have previously contributed when employed) or assistance ones (corresponding to the Unemployment Assistance system, which pays workers who have exhausted previous ones or do not qualify for receiving them).[19] Given that we have the complete labour history of the worker, we can also get the entitlement period for each benefit spell.

The main shortcoming of this data set is the lack of certain personal or family characteristics, such as marital status or number of children, which could be important to determine, for example, the exact amount the worker may receive from Unemployment Benefits. Another important caveat is that we cannot measure the educational level of the worker, but only the qualification level of the previous job held. Hence, our measure of qualification has to be taken with caution as it does not reflect the actual level of qualification of the worker but the one corresponding to the job previously occupied.

3.2 Descriptive Statistics

Our estimation sample includes the complete labour career (from the age of 50 onward) for a sample of 42,117 workers in the period 1988-2008. Each of these workers may have both some employment and unemployment spells. The first important difference emerges by comparing these workers in their first observation in our sample, that is, when they are 50. In that observation, the worker may be either employed or unemployed. Those workers who are initially employed have more stable labour careers (around 3.7 previous employment spells, whereas this figure is 5.3 for those initially unemployed). They have access also to larger life-cycle income (13,941 vs. 9,730 euros). Finally their qualification level is higher (56.4% are working in a qualified job vs. 44.5% among the initially unemployed).

For the workers in our sample, we are able to analyze 22,640 unemployment spells and 52,764 employment spells. Among them, 12,160 unemployment spells and 13,140 employment spells are taking place when the worker is aged 60 or over.

Finally, almost 50% of the sample of workers have at least one unemployment spell and one employment spell. For the rest of the sample we have just one employment spell that finishes either in unemployment or retirement, 39.4%, or just one unemployment spell that finishes in a new job or retirement, 15.7%.

In Tables 1 and 2 we present the main descriptive statistics for the spells over the age of 60[20] as well as the main characteristics of the workers included in our estimation sample. These tables feature all completed and censored employment and unemployment spells,[21] distinguishing between those that finish in a new job (or in unemployment, in the case of employment spells) and those that end up in retirement. Beginning with unemployment spells, Table 1 shows that the access to Unemployment Benefits (UB) is quite general in our sample. Only fewer than 20% of all completed unemployment spells begin with neither contributive nor assistance benefits. Moreover, the possibility of having the maximum level of contributive benefits, truncated UB, is quite likely, especially among those who finish by entering retirement. As it is to be expected, qualified workers are much more likely to be entitled to the maximum level of unemployment benefits. The rest of the parameters determining the pension level also constitute a quite relevant set of variables which show substantial variation among unemployment spells. Those entitled to a minimum pension are much more prone to retire after unemployment, with the pension rights of these workers being the largest among all unemployed. Furthermore, the previous wage of these workers, €1,586 , is also the largest among all unemployment spells. This is the basic explanation for the aforementioned fact about the access to truncated UB. Finally, the change in pension rights throughout the unemployment spell seems to be smaller for

[19] See Bover *et al.,* (2002) for details.

[20] Those for the spells before age 60 are available upon request. They are basically showing the same figures although, of course, the economic variables are in a somewhat lower level than they show once the worker is older.

[21] More than 70% of all observed unemployment spells are not censored and almost 43% of the employment spells are also completed spells.

Table 1: Descriptive Statistics, Unemployed workers (over age 60)

	Censored observations	Exit to employment	Exit to retirement
At the beginning of the Unempl. spell:			
Without Unempl. Benefits	34.15%	19.51%	19.45%
With Truncated Unempl Benefits	20.03%	39.02%	28.63%
With non-truncated Unempl. Benefits	32.48%	26.27%	41.60%
With Unempl. Subsidy	13.34%	15.20%	10.31%
At the end of the Unempl. Spell:			
Without Unempl. Benefits	58.79%	43.53%	68.06%
With Truncated Unempl Benefits	9.05%	25.14%	11.22%
With non-truncated Unempl. Benefits	18.51%	17.64%	13.49%
With Unempl. Subsidy	13.65%	13.70%	7.22%
Pension Rights	10,261 €	8,824 €	11,983 €
Change in Pension Rights	-1,282€	-420€	-1,846€
% with access to Minimum Pension	33.52%	25.14%	11.22%
Life-cycle income	10,648 €	9,598 €	10,830 €
Other individual characteristics:			
Qualified worker	52.41%	41.09%	46.20%
Voluntary exit from previous job	23.90%	11.07%	16.57%
Previous job duration. years	6.35	4.35	7.33
Number of previous employment spells	3.61	5.71	3.45
Number. of observations	1.912	533	9.715

those who decide to return to a new job, being almost zero among censored unemployment spells. Thus, it is quite clear that leaving unemployment is negatively correlated with this variable. Table 1 also has some other individual variables related to the previous job of the unemployed worker. We can see, firstly, that the previous job duration was longer than seven years for those who decide to retire, after being unemployed, whereas this figure is less than five years for those who re-enter a new job. In fact, the likelihood of entering unemployment by voluntary quitting is almost double among the former than among the latter. Another signal that the labour history of workers exiting to retirement is more stable is the number of previous employment spells of these unemployed workers: this rate is around 3 for those who exit to retirement whereas it is almost 5 for those who re-enter employment. Finally, we can see that the majority of unemployed workers are from very small firms, with the exit to retirement being more likely among unemployed workers from big firms.

Table 2 presents the main characteristics of the employment spells included in our estimation sample. As for unemployed workers, we find that the entitlement to minimum pensions is a substantial predictor of retirement. This figure is almost three times larger among those employed workers who exit directly to retirement than for those who exit to unemployment. However the level of their pension rights is not so different. In fact, those rights are slightly larger (€8.838 vs. €8.271) for those who retire, although the largest pension rights are observed among those workers who are not observed exiting from employment by the time the data were extracted, that is, among censored observations. The main observed difference between unemployed and employed workers is that the change in pension rights among the latter is almost double the case of unemployed workers. Furthermore, their wages are also somewhat higher: €1.744 for employed workers who exit directly to retirement and €1.581 for those who exit to unemployment. In fact, the proportion of workers with the maximum contribution base is more than 30% for retiring employed workers, which is another clear signal that these workers are the ones in the best position in terms of all the parameters determining their pension level. The likelihood of being separated from the job and entering unemployment

Table 2: Descriptive Statistics, Employed workers (after age 60)

	Censored observations	Exit to unemployment	Exit to retirement
Pension Rights	11,405€	10.353 €	10,694 €
Change in Pension Rights	932€	1,095 €	1,140 €
% with access to Minimum Pension	20.22%	21.04%	10.62%
Wage	1,868€	1,977 €	1,952€
Lify Cycle Income	13,968€	11,794€	11,924€
Qualified worker	58.89%	45.25%	55.39%
Job duration, in years	9.27	5.83	8.15
Number of previous employment spells	5.55	5.28	4.94
# of observations	5,539	3,779	3,822

is substantially larger in small firms whereas, as it was the case before, the likelihood of exiting to retirement is larger within big firms. Finally, the previous employment history of workers exiting to retirement is slightly more stable than for those who exit to unemployment although these differences are quite small.

Figure 1: Kaplan-Meier estimates of the four flows analyzed, by age

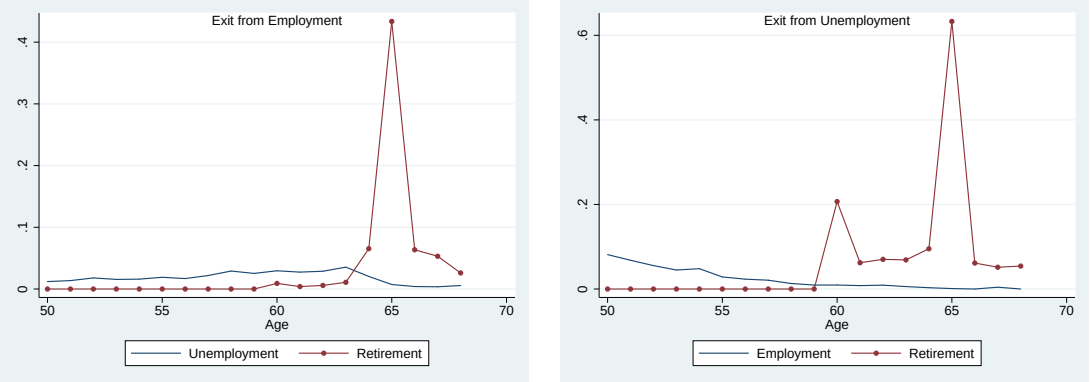


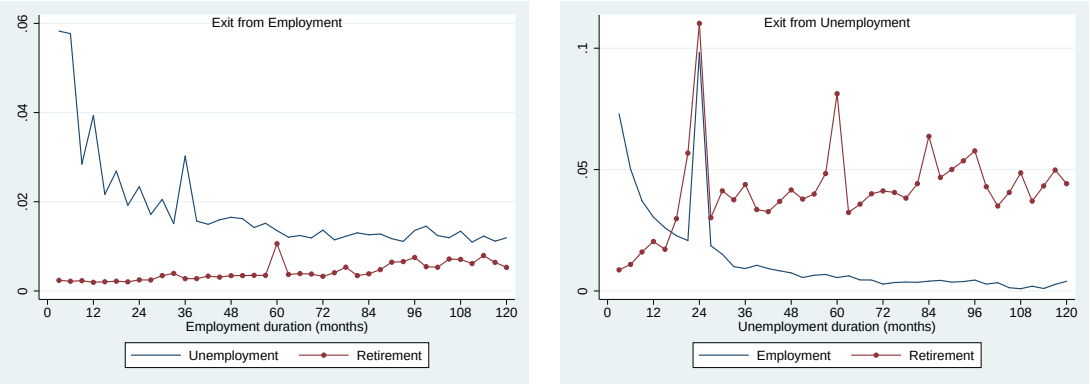
Figure 1 shows what is the main four elements of our estimation strategy, the different hazard rates conditional on age, that is, the conditional exit rates from one particular state to another one, for each age in the relevant interval we are analyzing (50-68). We have the exit rate from employment into the two possible alternative destinations: unemployment and retirement (without passing through unemployment) and we also have the exit from unemployment to both a new job and into retirement. With respect to age, we find the typical results already well documented in the literature (See Jiménez-Martín & Sánchez-Martín (2004, 2007)): the exit to retirement is mainly at the normal retirement age, 65. But distinguishing between those who access to retirement with and without an unemployment spell in the middle, a clear result is another important peak at the Early Retirement age, 60, but only for those who are unemployed before drawing retirement benefits.[22] Conditional on age, the exit from employment to unemployment is almost flat, whereas the flow in the other direction changes slightly more with age: the likelihood of re-employment decreases with age until 60, being almost negligible after that point, which may indicate how bad labour market opportunities are for older unemployed workers.

Finally, Figure 2 show the same hazard rates albeit conditional on both employment and unem-

[22]Coile and Levine (2009) also finds a substantial difference in the retirement hazard rate for unemployed and employed workers

ployment duration, that is, they provide the Kaplan-Meier estimate of the conditional probability of exiting from one particular state to another one, in each month of the corresponding employment or unemployment spell. This figure shows that the flows between employment and unemployment decrease sharply according to the duration of employment and unemployment. This is quite standard in the literature (see, for example, Mortensen (1986) for the exit from unemployment and Jovanovic (1979) for the exit from employment). On the other hand, the exit from employment to retirement is almost flat and the exit from unemployment to retirement decreases with unemployment duration. These figures provide one of our main stylized facts which is the important peak in the 24th month of unemployment, both in the exit to a new job and into retirement. This is directly linked to the rules on Unemployment Benefits in Spain which sets the maximum duration for drawing such benefits at two years. Hence, the exhaustion of unemployment benefits seems to be one of the main determinants of such transition, although it also has a very important effect in the exit to a new job, especially for qualified male workers.

Figure 2: Kaplan-Meier estimates of the four flows analyzed, by duration (months)



4 Econometric specification

Our main objective is to study the hazard rate out of both employment and unemployment for all workers in our sample. Given that our data are measured in quarterly terms, it is natural to use a discrete-time duration model (See Lancaster (1990), or Jenkins (1995) for the basic features of such models) where the hazard rate is given by the following conditional probability:

$$\phi(t) = \Pr\left(T = t \,|T \geq t\right)$$

and T is a discrete random variable denoting the duration of either employment or unemployment. Following Bover *et al.* (2002) and García-Pérez (1997), we parametrise the hazard rates as follows:

$$\phi_u^j(t) = F\left(\theta_0^j(t) + \theta_1^j(t)x(t) + \eta^j\right), \qquad j = \{ue, ur\}$$

$$\phi_e^k(t) = F\left(\gamma_0^k(t) + \gamma_1^k(t)x(t) + \eta^k\right) \qquad k = \{eu, er\}$$

where $x(t)$ denotes the vector of explanatory variables, some of them varying with the spell's duration (t), j is a counter for the two possible destinations when exiting from unemployment (retirement, ur, or re-employment, ue) and k is a counter for the destinations when exiting from employment (unemployment, eu, or retirement, er). $\theta_0^j(t)$ and $\gamma_0^k(t)$ represent the additive terms of the duration dependence in the hazard rates, the baseline hazard, which will be estimated in the most general way

as possible. Finally, $\theta_1^j(t)$ and $\gamma_1^k(t)$ are the coefficients for the explanatory factors which may depend on duration. The last component in the hazard rate is unobserved heterogeneity. It is well known that if this is not taken into account, we may incur in problematic inferences in so far as the rest of parameter estimates may be inconsistent (Flinn and Heckman (1982)). For instance, as commented before, the empirical hazard functions of unemployment decline steadily over duration in unemployment (See Figure 2). This implies that individuals have a higher probability of re-employment at the beginning of their unemployment spell than afterwards. The same happens with the exit from employment to unemployment: workers run a much larger risk of being made redundant when their experience in the job is low than once they have gained experience, when the risk of leaving employment declines. Because of the possible existence of unobserved heterogeneity, this simple conclusion may be wrong. Consider the case of two types of individuals: (a) "high risk" individuals who have a high hazard rate out of employment; and (b) "low risk" individuals who have a low hazard rate out of employment. Furthermore, suppose that for each group, the risk of leaving the job is constant over time. If we ignore the fact that these individuals come from two separate and distinct groups (this is what we do if we omit the —admittedly unobserved— predictor that distinguishes the two groups), the hazards would fall given the existence of two such levels of risk. Thus, unobserved heterogeneity raises a serious interpretive problem. This same problem may exist when analyzing exits from unemployment, as long as there are different groups of individuals who exit from unemployment at different rates (according to some unobserved characteristics). This is the basic reason why both η^j and η^k have to be considered when estimating our model.

As we are considering a competing risk framework, the exit from a given state (either unemployment or employment), is specified as:

$$\phi_u(t) = \phi^{ue}(t) + \phi^{ur}(t)$$

$$\phi_e(t) = \phi^{eu}(t) + \phi^{er}(t)$$

A natural specification for this competing risk model is a multinomial one in which each risk considers the exit to a particular destination state, conditional on not having exited to the alternative one. Hence, for example, for the exit from unemployment we use the following specification:[23]

$$\phi_u^{ue}(t) = \frac{\exp(\theta_0^{ue}(t) + \theta_1^{ue}(t)x(t) + \eta^{ue})}{1 + \exp(\theta_0^{ue}(t) + \theta_1^{ue}(t)x(t) + \eta^{ue}) + \exp(\theta_0^{ur}(t) + \theta_1^{ur}(t)x(t) + \eta^{ur})}$$

$$\phi_u^{ur}(t) = \frac{\exp(\theta_0^{ur}(t) + \theta_1^{ur}(t)x(t) + \eta^{ur})}{1 + \exp(\theta_0^{ue}(t) + \theta_1^{ue}(t)x(t) + \eta^{ue}) + \exp(\theta_0^{ur}(t) + \theta_1^{ur}(t)x(t) + \eta^{ur})}$$

There is a fairly significant list of variables that should be taken into account when estimating labour flows to retirement (individual preferences, wealth, health status, family characteristics, etc.) but some of them are totally unavailable to our study. This is the main reason why such unobserved factors have to be properly controlled for. It may be the case that unobserved heterogeneity may be correlated across unemployment and employment spells for the same individual. This is quite sensible if the individual behaviour is affecting the different hazard rates in our model. Thus, in order to allow for this correlation, we estimate both the unemployment and employment hazard rates simultaneously, and assume that unobserved heterogeneity is present in both hazard rates. We assume that such unobserved factors follow a discrete distribution function with different mass points (as in Heckman & Singer (1984)). Accordingly, we assume that the unobserved heterogeneity component,

[23] An alternative way of specifying our competing risk model would be using a type-1 extreme-value distribution function for function $F(\,)$ .This function, as stated in Meyer (1990) for example, allows testing whether the Mixed Proportional Hazard assumption (see van den Berg (2001)) is verified in our data. However, the interpretation of the estimated effects is a bit more complicated, given we have to use the coefficients in both hazard rates to analyze the effect of each particular regressor. Given this, we have opted for the multinomial model which is much easier to interpret. Moreover, as we are allowing for the presence of unobserved heterogeneity, the problem of independent irrelevant alternatives is not a real issue in our model.

η, is a discrete random variable with finite support given by r mass points $s_1, ..., s_r$. There are four potential heterogeneity components, η^{eu}, η^{ue}, η^{er}, η^{ur}, each of them associated with one transition in the model. However we assume equal heterogeneity for transitions between employment and unemployment, $\eta^{eu} = \eta^{ue} = \eta^u$, and also for transitions regarding retirement, $\eta^{er} = \eta^{ur} = \eta^r$. We refer to η^u and η^r as the unemployment component and the retirement component, respectively. We allow for two different levels of η^u for the hazard rates between employment and unemployment, (s_1^u, s_2^u) , and another two levels for the exit from both employment and unemployment to retirement, (s_1^r, s_2^r). A given individual, therefore, may have, for example, a high exit rate from unemployment to a new job and a low exit rate from unemployment to retirement. Hence, we estimate the probability of each of the four possibilities allowed in this specification: $\Pr(\eta^u = s_1^u, \eta^r = s_1^r) = P_{11}$, $\Pr(\eta^u = s_1^u, \eta^r = s_2^r) = P_{12}$, $\Pr(\eta^u = s_2^u, \eta^r = s_1^r) = P_{21}$ and $\Pr(\eta^u = s_2^u, \eta^r = s_2^r) = P_{22}$.[24]

Given all these assumptions, employment and unemployment spells cannot be treated separately when estimating the model. Thus, we need to specify the likelihood function for all spells and integrate out the random effects (see Cheser and Lancaster (1983) for a detailed discussion). That is, the likelihood function for individual i subject to unobserved heterogeneity η_ℓ^u in the flow rates between employment and unemployment and η_ℓ^r in the exit rates to retirement takes the form:

$$\log L = \sum_{i=1}^{N} \sum_{\ell=1}^{2} \sum_{m=1}^{2} \log L_i \left(s_\ell^u, s_m^r\right) \Pr(\eta_i^u = s_\ell^u, \eta_i^r = s_m^r), \tag{6}$$

where $\log L_i \left(s_\ell^u, s_m^r\right)$ is given by:

$$\sum_{t=1}^{\bar{t}_i} \left\{ \begin{array}{l} \left[u_{it} \left\{ \begin{array}{c} (1 - y_{it}^{ue} - y_{it}^{ur}) \log(1 - h_i^{ue}(t, s_\ell^u) - h_i^{ur}(t, s_m^r)) \\ + y_{it}^{ue} \log h_i^{ue}(t, s_\ell^u) + y_{it}^{ur} \log h_i^{ur}(t, s_m^r) \end{array} \right\} \right] + \\ \left[(1 - u_{it}) \left\{ \begin{array}{c} (1 - y_{it}^{eu} - y_{it}^{er}) \log(1 - h_i^{eu}(t, s_\ell^u) - h_i^{er}(t, s_m^r)) \\ + y_{it}^{eu} \log h_i^{eu}(t, s_\ell^u) + y_{it}^{er} \log h_i^{er}(t, s_m^r) \end{array} \right\} \right] \end{array} \right\}. \tag{7}$$

In this expression $\overline{t^i}$ is the last observed period for individual i, $u_{it} = 1$ if during the period t a spell of unemployment is observed for individual i and zero if a spell of employment is observed in such period. Finally y_{it}^{ue} is an indicator of whether the individual i exits from unemployment to employment in period t and the same, albeit changing the origin and the destination state, for the other three variables of this type.

A final important remark is that, as reported in Abbring and van den Berg (2003), the availability of multiple employment and/or unemployment spells for the individuals in our sample ensures the identification of all parameters in our model, given we have enough variation in the observed regressors, $x(t)$, across the spells for each individual. Moreover, as we can think of the baseline hazards in each exit rate as being specific to certain values of $x(t)$, for example Unemployment Benefits, we will be able to better identify and test for some duration dependence in the effect of such regressors over each exit rate.

4.1 The problem of initial conditions

As usual in models of this type, and given we are working with older workers, the initial observed period does not correspond to the date of entry into the labour market. The previous labour market history of the workers in the sample is therefore unobserved for the econometrician and possibly correlated with the rest of unobserved heterogeneity. Consequently we have to consider the problem of initial conditions. In this sense, we specify the joint distribution of all outcomes -including that in the initial time period- conditional on unobserved heterogeneity. Within this framework, this means specifying the distribution of the initial condition given unobserved heterogeneity. In this sense, we also estimate a process for each individual being employed or unemployed in the first observation and we make this process conditional on certain observed worker characteristics and also on the unobserved heterogeneity. We shall therefore add the following extra term to expression (1):

$$\left[u_{i0} \log(1 - h_i^0(s_\ell^u)) + (1 - u_{i0}) h_i^0(s_\ell^u)\right] \tag{8}$$

[24] Of course, we have to estimate only three different probabilities given that $P_{22} = 1 - P_{11} - P_{12} - P_{21}$.

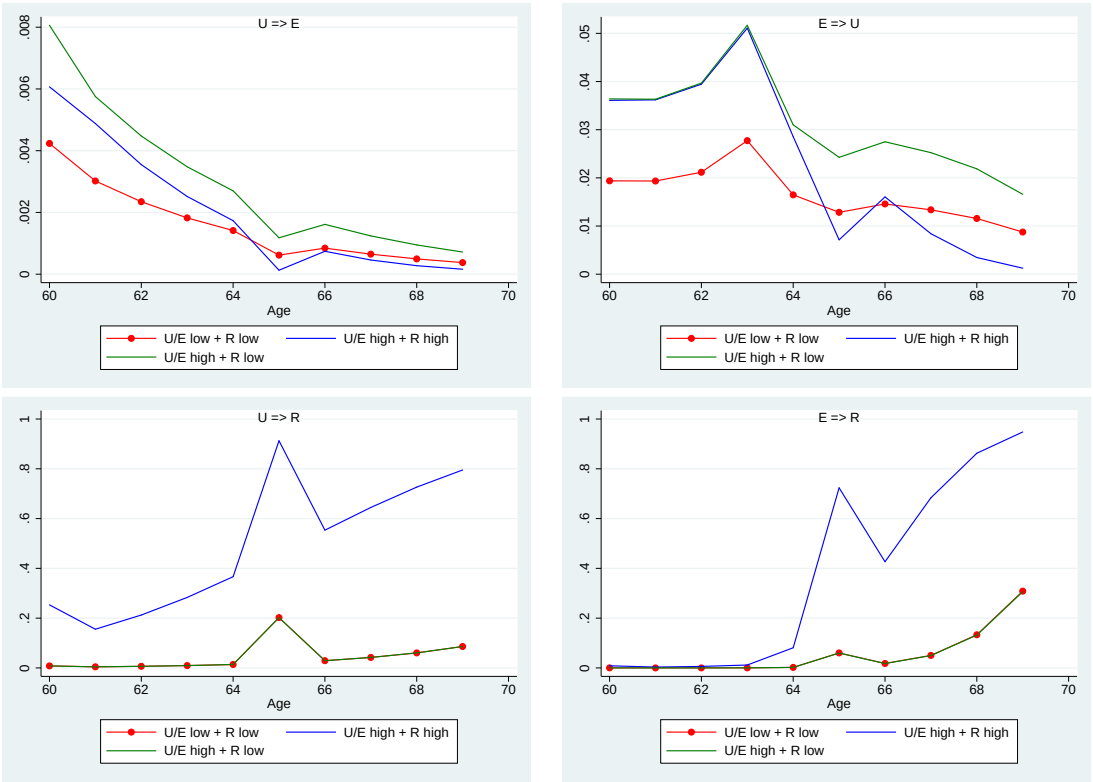
where $h_i^0(s_\ell^u)$ is the process for the initial condition that will be estimated using a $logit$ specification. We assume that this process depends only on the unemployment component of unobserved heterogeneity. This is sensible given that initial conditions basically consider the probability of the worker being employed or unemployed at the beginning of the observed period.

5 Results

In this section we review the findings obtained in the maximum likelihood estimation of the model of labour transitions in section 4, using a sample of workers between 50 and 68 years old. Our main interest is in the transitions observed after the age 60, ie. once retirement is a relevant option for the worker. The spells before the age of 60 are essentially used to identify the distribution of unobserved heterogeneity in the sample, which is assumed to be constant through time for each individual. Consequently the results for the transitions between unemployment and employment before the age of 60, together with the results for the initial conditions process, are confined to Tables A2-A4 in the Appendix.

We start by reviewing the estimated distribution of unobserved heterogeneity in section 5.1. We then introduce our estimation of the determinants of the transitions originated from unemployment (section 5.2) and employment (section 5.3). A brief discussion of the differences in the estimations with and without unobserved heterogeneity is left to appendix B.

Figure 3: The effect of unobserved heterogeneity over the predicted hazards



5.1 The importance of unobserved heterogeneity

Our estimation procedure uncovers three different *types* of individuals in terms of employment-unemployment transitions and two basic *types* in terms of the exits to retirement (table 3 and figure

Table 3: The Estimated Unobserved Heterogeneity Distribution Function

	Coef.	T Stat.	E/U transit.	transit. to R
$\Pr(\eta^u = 0, \eta^r = s^r)$	28.74%	6.51	low	low
$\Pr(\eta^u = s^u, \eta^r = 0)$	19.52%	11.24	high	high
$\Pr(\eta^u = s^u, \eta^r = s^r)$	51.74%		high	low
s^u	0.6474	15.55		
s^r	-3.7199	-53.10		

3). Note that we introduce an empirically motivated, *ex-ante* constraint in the distribution of unobserved heterogeneity: our first mass point (the one with location points s_1^u and s_1^r) is assumed to have zero probability.[25] We, therefore, estimate the three remaining mass points: $(s_1^u, s_2^r), (s_2^u, s_1^r)$ and (s_2^u, s_2^r).[26]

Around 19.5% of the sample is made up of individuals characterized by a very large propensity to change their labour state, both in the exit to retirement and in the transitions between employment and unemployment. This group is identified with the label " U/E high + R high" and by a red line in the graphs in figure 3. The rest of the population shows a much larger attachment to the workforce, with a very low estimated hazard rate into retirement. Within this group, in contrast, there are strong differences in the propensity to change between employment and unemployment: around 51.7% of the population have low exit rates into retirement but high employment-unemployment transition rates (group " U/E high + R low" and green line in figure 3), while the remaining 28.7% of the population have both low retirement and employment-unemployment hazard rates (group " U/E low + R low" and blue line).

Hence, around 1 out of 5 workers in the sample may be defined as very *mobile* individuals, with a very high intrinsic propensity to switch back and forth between employment states, and also to change from inside the workforce into retirement. This intrinsic mobility should be the result of a combination of different characteristics that we cannot directly observe in our data set. Economic theory suggests some of those possible unobservable factors. At the individual level, the high retirement propensity points towards high time discounting, high risk aversion, high valuation of leisure and a relatively low life expectancy; It may also be associated to a large stock of non-human wealth, maybe due to the receipt of sizable severance payments after departure from previous job spells. At the firm level, the high turnover may reflect job matches with high termination risks; The high rotation across employment spells is shared by a second population group, adding up to 51.7% of the total population (ie, the largest group in terms of size) which is characterized by low exit rates into retirement and high employment-unemployment transition rates.

These two groups of workers have large exit rates from unemployment to employment and, more significantly, larger firing rates, especially before the age of 65. These workers should be attracting more offers, when unemployed, or should have lower reservation wages, making them more willing to return to the workforce. The larger firing rates could be connected to certain job-specific or firm-specific characteristics, but also to a more systematic strategic use of the unemployment benefits for voluntary relocations or early retirement. What seems unquestionable from our estimation results is that the unobserved determinants behind a high propensity to retire should be different from those behind a large employment/unemployment mobility, the latter being more closely linked to job and firm characteristics than the former.

[25] The combination of low exit rates between employment and unemployment and, at the same time, large hazard rates into retirement seems to be extremely rare in our sample.

[26] In fact, given that we have a constant term in each of the hazards analyzed, the first location point in each of the two components of unobserved heterogeneity is assumed to be equal to zero. Thus, we estimate two location points and three probabilities for the three allowed groups in the unobserved heterogeneity distribution.

Table 4: Exit from unemployment, after age 60. Model with unobserved heterogeneity control

	to Employment		to Retirement	
	Coef.	T Stat.	Coef.	T Stat.
Truncated Unempl. Benefits (dummy)	-2.0731	-5.00	-1.9358	-9.46
Un-truncated Unempl. Benefits (dummy)	-1.1351	-2.86	-1.3977	-7.68
Unemployment Subsidy (dummy)	-1.0664	-5.55	-1.0398	-12.84
Unemployment Benefits (level in €)	-0.0006	-1.05	-0, 0007	-2.31
Entitled to Minimum pension (dummy)	-0.4545	-1.93	0.2454	2.84
Un-truncated pension rights (in 1,000 €)	-0.0375	-1.66	0.0382	4.35
Replacement rate	0.0130	2.24	0.0728	14.03
Change in pension rights (in 1,000 €)	0.2671	2.87	0.1005	2.63
* Age 60 (dummy)	0.0911	0.62	-0.0236	-1.77
* Unemployment < 24 months (dummy)	-0.2871	-4.70	-0.1012	-5.49
* with no Unempl. Benefits (dummy)	0.1212	1.61	-0.0960	-3.27
Life-cycle wealth	-0.0519	-0.25	0.0875	1.37
Age 60 (dummy)	0.0911	0.62	0.9595	15.84
Age 65 (dummy)	-0.3682	-0.84	2.5122	41.29
Age (in years)	-0.2501	-4.23	0.3805	19.53
Unemployment = 24 months (dummy)	0.4462	2.36	0.3456	5.40
* With Unempl. Benefits (dummy)	0.3859	1.26	1.6661	18.26
* With Unempl. Benefits & qualified (dummy)	1.5108	5.10	0.2320	2.67
Ln(Unemployment Duration)	-0.7235	-12.58	0.5004	15.63
Regional employment growth rate	-0.0567	-2.13	-0.0102	-1.27
*with Un. Benefits (dummy)	0.0688	2.17	0.0095	0.85
Qualified worker (dummy)	0.1259	1.18	-0.4238	-10.32
Constant Term	-3.6229	-4.10	-12.5615	-22.04

Notes: Likelihood function -145,838.64. Number of observations: 1,071,224. The estimated equations include a time trend, dummies both for firm size and for other characteristics of the firm and the previous job.

5.2 Transitions from unemployment

In this section, we focus on assessing the impact of the economic incentives offered by the unemployment/pension system on the labour transitions of the unemployed. Specifically, we explore the variation of behaviour with current income, the level of pension rights and its dynamics, and the importance of accumulated life-cycle wealth. We also control for age, for the duration of the unemployment spell, for the duration in previous employment and for some of the characteristics of the worker position (level of qualification, type of firm, sector of activity, etc). Finally, we also control for the stage of the business cycle during the unemployment spell and for regional, time and individual fixed effects. Table 4 reproduces a selection of the most important estimation results. They can be easily summarized: incentives matters. The amount of income available during the unemployment spell, the opportunity cost of the forgone pension and the erosion of accrued pension rights are all key predictors of a transition out of unemployment. Other variables such as age, spell duration or the skill level of the worker also have a relevant impact. We shall now review those findings in detail.

Current income is one of the key variables reflecting the economic incentives experienced by the unemployed. In our specification, we estimate the coefficients of three dummy variables (rows 1 to 3 in table 4) associated with the perception of truncated (from above) contributive unemployment benefits (Truncated Unempl. Benefits), contributive benefits below the maximum (Un-truncated Unempl. Benefits), or the common unemployment subsidy (Unemployment Subsidy). The variables are, therefore, arranged in a decreasing order of income, being those unemployed without benefits the reference group. We also measure the marginal effect on behaviour of

Figure 4: U-E transition (by Unempl. duration), after age 60: the effect of Unemployment Benefits

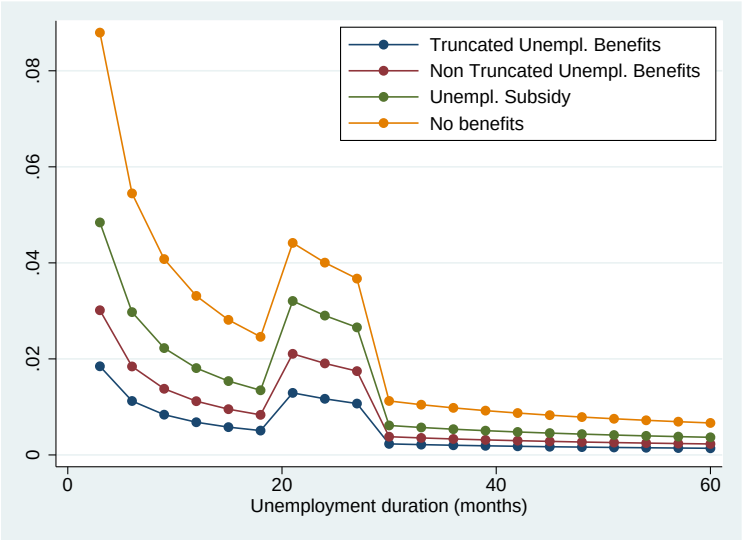
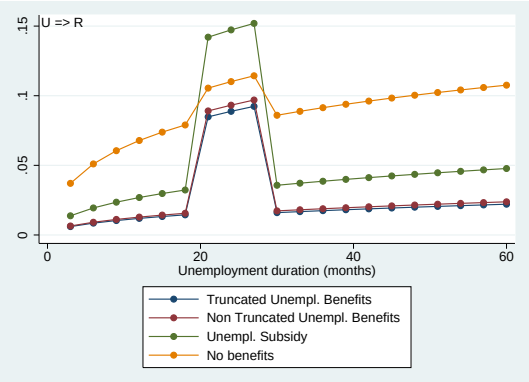
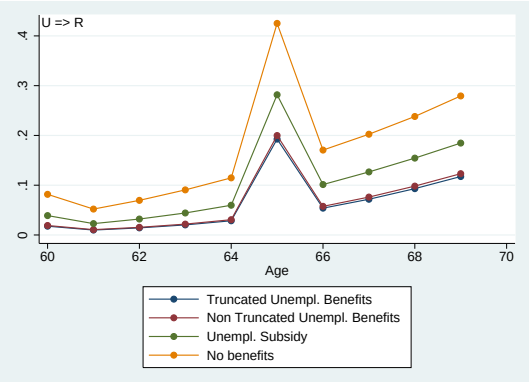


Figure 5: U-R transition (by Unempl. duration and age): the effect of Unemployment Benefits





an additional unit of income (on those whose benefit is within the legislated ceiling and floor). The inclusion of several interaction terms, however, makes a direct interpretation of the coefficients difficult. Instead, we resort to figures 4 and 5 to illustrate the findings related to these marginal effects. The results can be summarized as follows:

- As predicted by the theory of section 2, we find a very clear, inverse relation between the disposable income of the unemployed and the probability of a subsequent change in the labour state (ie, both in the transition $U \rightarrow E$ and $U \rightarrow R$). The monotonicity emerges in both the comparison across income groups and in the marginal effects.

- Perfect monotonicity is violated in the retirement transition of the unemployed with a duration of between 20 and 30 months: the retirement hazard in that case peaks among those drawing the unemployment subsidy (left panel of figure 5). This effect may be a behavioural reaction to the fact that, in Spain, the size of the benefit decreases with the duration of the unemployment spell. When the benefit is downgraded from "Prestación contributiva" to "Subsidio" (typically after around 24 months on the jobless roll), the drop in income is especially acute (from 60% of previous wages to 75% of the minimum wage). This drop may rationalize the high rate of retirement among workers with a subsidy.

We document some of the **direct effects of duration**, regardless of its impact on disposable income. They can be appreciated in the discontinuities in the hazard rates of the unemployed without benefits in figures 4 and 5. More generally, the effects reveal themselves in the duration regressors in table 4 (lines 8 to 5 from the bottom of the table). Longer durations imply a continuous depreciation of the labour capabilities, resulting in continuously lower reentry rates and higher retirement rates. At the same time, crossing the two-years threshold leads to a discontinuous jump in retirement but, also, to higher reentry rates. This clearly points towards a strategic use of the unemployment benefits by workers and maybe, also, by employers.

The potential income obtained in case of retirement (ie, the **pension level**) is another key incentive variable for the unemployed. According to our basic model in section 2, higher pension benefits increase the opportunity cost of staying unemployed and the implicit reservation wage applied to the job offers received. Three regressors (lines 5 to 8 from the top in table 4) capture these effects in our econometric model: a dummy for minimum pensions and two continuous variables reflecting the two main components of the pension formula: the size of the pension rights ("base reguladora") and the replacement rate resulting from the age and number of contributed years when the individual retires (see Appendix A for details). Note that, as we are including a specific `age` variable in the model, our `replacement rate` variable isolates the effect of longer contributive careers on behaviour. Our three pension-level variables do not interact with another regressor, making the analysis of the resulting effects quite straightforward:

- Bigger accrued pension rights are associated with lower reentry rates and higher retirement rates, as expected. The quantitative importance of the effects is remarkably large.[27] We find them to be *systematically larger* than those associated with the variation in disposable income described above.

  Potential pensions also increases with gains in replacement rates. They arise from either delays in the retirement age or as a result of longer contributive records. The former effect is captured by the variable `age`, which has the expected signs: the older the unemployed, the lower the incidence of reemployment and the larger the incidence of retirement. Obviously, larger pension income is not the only element underlying this regularity.[28] Table 4 shows a strong positive impact due to the latter effect on both retirement and employment. The impact on retirement is consistent with the opportunity cost interpretation above, while the impact on reemployment demands some additional explanation. Our conjecture is that this coefficient is reflecting unobserved factors correlated with a strong attachment to the labour market (revealing themselves

[27] We compute the income-elasticity of reemployment and retirement behaviour, in accordance with our estimations. Space constraints make it impossible to reproduce these results here, but they are available from the authors upon request.

[28] Health, social customs and ad-hoc rules in collective agreements must also be contributing to this outcome.

in longer working careers, a strong individual propensity to work and good perceived qualities by employers).

- Finally, being eligible for minimum pensions is estimated to clearly increase the retirement hazard. This effect has been discussed at length elsewhere in the literature (eg. Jiménez-Martín and Sánchez-Martín (2007)). We also detect a significant negative effect in the reemployment hazard that has received less attention in previous empirical analysis.

The **curvature of the life-cycle profile of labour income** has important incentive implications within the context of the Spanish pension rules. If the growth rate of the individual real earnings is negative when the worker approaches retirement, accrued pension rights can start to decrease. More precisely, individual pension rights, $\overline{w}(\tau)$, (described in section 2), would suffer a reduction in value if retirement is delayed. Under those circumstances, the value of the future pension continuously depreciates if the individual stays unemployed. This depreciation takes the form of a discrete drop when the duration of the unemployment spell is so long that the *contributive* unemployment benefit is substituted with the (much smaller) *subsidy*. In our analysis, these effects are captured by the regressor `Change in pension rights` (row 9 in table 4) and its interactions. The main findings can be interpreted directly from the estimated coefficients, as follows:

- For the unemployed with less than two years on the jobless roll the data coincide closely with the theoretical prediction, and we see a negative link between retirement and the change in pension rights. This factor seems to make an specially important contribution to early retirement at 60. Besides, we also find a negative link with reemployment, implying that workers with decreasing pension rights are more likely to reenter in the labour force. We find an exception to this in the group of jobless workers that are not currently drawing unemployment benefits. It may be argued that an indirect signaling mechanism may be operating in this case: the signal value of an increasing labour income profile may lead to better job offers if it is interpreted as an indication of quality by the hiring corporations.

- For the long term unemployed, we find a very weak (but significant) impact on the reentry rates and an insignificant effect on retirement. The reentry rate increases with the slope of the labour income profile, which again hints at some kind of signalling or even strategic effect.

Age is found to be an extremely important predictor of retirement behaviour. This comes as no surprise. In theory, age is correlated with retirement for biological reasons (changes in health, in the relative value of leisure or in the capacity to undertake physically demanding jobs) and, more importantly, due to its interaction with pension regulation. For instance, a peak in retirement at the Early Retirement Age (60 in Spain) has long been rationalized as the optimal response to credit constraints[29]. The mirror effect on job reentry should be a discrete drop in the observed transitions back into employment. Secondly, early retirement penalties are progressively reduced as the worker approaches the normal retirement age of 65. We may, therefore, expect a positive trend in retirement in the 60/65 age range (and the opposite in reemployment). Finally, 65 is not only the "legal" retirement age: numerous collective agreements still contain explicit incentives to retire at that particular age. It is also a "reasonable" retirement age according to commonly accepted social norms.

Our econometric estimations (a continuous age variable and dummies for the ages of 60, 61 and 65, confirm all of the aforementioned effects. Note that controlling for unobserved heterogeneity has a major impact on the evaluation of the quantitative impact of reaching the age of 65 on retirement. On top of the independent age-effect described above, the age 65 peak is also the result of a composition effect in a population of heterogeneous agents. This is clearly revealed in figure 3 and further discussed in section 5.1.

According to standard theory, **Life-cycle wealth** affects behaviour by changing the relative valuation of leisure and income. When leisure is a normal good, an increase in life-cycle wealth decreases the marginal utility of income and favors a greater consumption of leisure. This naturally leads to earlier retirement and lower reentry rates into employment. In our estimation (table 4), the coefficient on

[29] With the extra contribution of an insufficient amount of accumulated liquid wealth earlier in the life-cycle. See eg. Borsch-Supan (2000) or Jiménez-Martín and Sánchez-Martín (2007)

(our proxy of) life-cycle wealth is only weakly significant, suggesting that the quantitative importance of this process is small.

Finally, the sensitivity of labour behaviour to the **business cycle** is analyzed by exploring its responsiveness to changes in the growth rate of local employment. The estimated results (rows 3 and 4 starting from the bottom in table 4) reveal a surprising lack of correlation: retirement coefficients are statistically insignificant, while the reentry ones are significant but only marginally so. For the unemployed currently receiving benefits, the reentry rates are estimated to react positively during cyclical expansions, while the opposite pattern emerges for the unemployed with no income support. Theoretically, this may imply that the reservation wages grow faster during expansions than the wages actually offered. We nonetheless find the result puzzling and plan to address it in more detail in future research.

Table 5: Exit from employment, after the age of 60. Model with unobserved heterogeneity control

	to Unemployment		to Retirement	
	Coef.	t Stat.	Coef.	t Stat.
Wage (level in €)	0.0669	2.47	-0.0515	-1.28
Entitled to Maximum pension (dummy)	-1.1380	-1.55	-0.6596	-1.90
Entitled to Minimum pension (dummy)	0.3747	4.59	0.2373	1.92
* Qualified worker	0.0632	0.67	-0.0723	-0.43
Un-truncated pension rights (in 1,000 €)	0.1086	7.93	0.1590	10.12
* Age	-0.0118	-6.90	-0.0124	-7.88
Replacement rate	0.0195	5.51	0.0440	7.87
Change in pension rights (in 1,000 €)	0.0269	0.38	-0.1404	-1.75
* Age 65 (dummy)	0.1454	1.11	-0.1818	-4.73
* Age	0.0041	0.45	0.0267	3.18
Life-cycle Wealth	-0.0421	-0.79	-0.1461	-1.97
Age 60 (dummy)	-0.0517	-0.91	1.9405	18.56
Age 62 (dummy)	0.1458	2.89	-0.5354	-5.25
Age 63 (dummy)	0.4767	8.31	-0.9186	-11.21
Age 65 (dummy)	-0.2797	-1.02	2.4982	30.96
Age (in years)	0.0622	2.14	1.1639	37.60
Ln(Employment Duration)	-0.3416	-20.13	-0.1692	-6.15
Regional employment growth rate	0.0035	0.36	0.0195	1.31
* Qualified worker	-0.0236	-1.83	-0.0544	-2.92
Qualified worker (dummy)	-0.4613	-7.68	-0.2298	-2.75
Constant Term	-4.5966	-10.31	-17.2405	-26.21

Notes: Likelihood function -145,838.64. Number of observations: 1,071,224. We have included a time trend, firm size dummies and other firm and job characteristics in these equations.

5.3 Transitions from employment

The exit from employment to both unemployment and retirement is estimated with the sample of employment spells described previously and using the same discrete time, quarterly duration model. The model specification is also very much like the one described in the previous section. Note however, that there are some differences in the theoretical foundations underpining the empirical model. On the one hand, the transition from employment into retirement is conceptually similar to the voluntary actions of the unemployed previously analyzed. In that case, the background theory is the same combination of economic incentives (current income, opportunity cost, life-cycle wealth, etc) and individual value of leisure (broadly understood) reviewed in section 2. Unsurprisingly, the resulting

regression specification (Table 5) parallels that estimated in section 5.3 (Table 4). On the other hand, the interests of the employing corporations play a far more important role in the transition into unemployment of the individuals in our sample. Firings and dismissals are clearly beyond the sphere of control of the individual, responding to the firms' need for adjustment to changes in the competitive environment, the business cycle or the technical conditions of production. Deriving an explicit theory of optimal corporate decisions exceeds our ambitions in this paper, but our empirical model does uncover several important predictors of the firing decisions made by firms. This probably reflects the existence of strategic interactions between the firms and the workers when deciding the timing of the exit. For example, companies may choose the age of exit in such a way that the individuals can go into retirement without suffering permanent drops in their pensions (ie, taking advantage of the *contributive* unemployment scheme).[30]

The overall picture emerging from Table 5 is not very different from our conclusions in the previous section: behaviour is highly influenced by the economic incentives faced by the individual. The size of the transition flows from employment are much smaller than from unemployment (section 3.2), but the determinants of these flows are, once again, strongly correlated with the economic opportunities available for the agents. Furthermore, corporations do seem to coordinate the timing of their firings with the provisions of the unemployment rules. The next paragraphs review in detail the determinants of the transitions into retirement and into unemployment.

Direct **transitions from employment into retirement** are far less common in our sample than those involving unemployment, but the sensitivity to economic incentives is remarkably similar:

- The marginal effect of an additional unit of **labour income** (variable `wage` in row 1 of table 5) is estimated to have a negative impact on retirement (as predicted by theory), although the effect is not very significant. This is not very different from what we estimated for the unemployed. At the same time, the regression results provide some other indirect evidence supporting an important role for the size of job earnings. First, the broad classification implied by the dummies on minimum/maximum pension does hint at a monotone negative relation between earnings and retirement (see below). Secondly, life-cycle wealth has a negative impact on retirement (in contrast with the findings for the unemployed). This may also be capturing a stronger attachment to the labour market by high income workers. The estimation results provide some extra indirect evidence of the importance of other job characteristics. Qualified and stable occupations in particular (with the latter measured by the duration in the current employment spell) are associated with a significantly smaller incidence of voluntary retirement.

- The opportunity cost implied by the **pension** available in the case of retirement has a stronger quantitative effect. As with the unemployed, we report two independent contributors to the final size of the old-age pension: accrued pension rights and its replacement rate. The former (`Un-truncated pension rights` in table 5) has a strong effect, although its influence decreases with age. The latter (`replacement rates`) is correlated with age and with the length of the contributive career. Both coefficients are positive and clearly significant. Finally, we include specific dummies to control for the impact of minimum and maximum pensions. The theory predicts an unequivocal negative effect of minimum pension on employment and a more mixed effect for maximum pension.[31] The empirical results confirm that minimum pensions push low-qualified workers out of employment, while maximum pensions have the opposite effect (which probably reflects more general advantages of high-earnings jobs).

[30] Logically, this is assuming that the firing responds to a long-term planning rather than to a quick adjustment forced by unexpected shocks. Note also that after the changes in the pension law introduced in 2002, all future transitions into retirement prior to the Normal Retirement Age will necessarily involve a six-month spell of unemployment (or participating in some of the new, ad-hoc programs of "partial retirement"). Section 6 offers a first look at the effect of the 2002 reform using a difference-in-difference approach. Understanding the interactions between firms and workers, in any case, will be increasingly important in the future.

[31] Minimum pensions have three effects, all aligned with earlier retirement: they increase income in retirement, increase life-cycle wealth and eliminate the possibility of increasing the future pension by staying employed. Maximum pensions foster earlier retirement by preventing future pension gains, but the other two effects work in the opposite direction (they reduce both income in retirement and life-cycle wealth).

- The **curvature of the life-cycle profile of labour income** also shows the expected negative correlation predicted by the theory (workers with a decreasing income profile tend to retire more to avoid the depreciation of their accrued pension rights). The effect is more important at earlier ages, with the exception of the normal retirement age of 65.
- **Age** effects are very strong and remarkably similar to those found for the unemployed. Our discussion there still applies to the employed, with the additional observation that age is likely to have an important role in the coordination of the actions of employees and employers. The latter are likely to choose the key legal ages (60 and 65) to fire workers bound for a direct transition into retirement. For most workers, however, a long stay in the unemployment program is more likely. In that case, the key ages for dismissal are 58-59 and 62-63, two years in advance of the legal ages. This conjecture is robustly confirmed in Table 5 and also in Table A.3 in the Appendix. The probability of being separated from the job is considerably higher at these ages as the worker may combine two years of unemployment benefits and the exit to retirement after their exhaustion.
- **Business cycle** effects: as with the unemployed, we do not find a strong behavioural reaction to the changes in the growth rate of the local labour market. Only qualified workers reveal an appreciable pro-cyclical reaction to the stage of the business cycle (they retire less when local employment rates improves).

Turning to the estimated determinants of the **transitions into unemployment**, we find they reveal some of the logic behind the workforce adjustment by companies. On average, more expensive workers are fired in greater numbers, but this finding must be carefully qualified. Note first that the risk of redundancy is clearly smaller for qualified workers. Secondly, low income workers (entitled to minimum pensions) follow the opposite tendency, with an appreciably larger firing risk. Finally, the stability of the job (which is a combination of the intrinsic characteristics of the position and of the worker) is a very strong (negative) predictor of the risk of exiting the firm into unemployment. Besides, the estimation results confirm a general tendency to fire older workers rather than their younger counterparts.

A particularly significant pattern is the strong peaks in firing found two-years in advance of key legal retirement ages. Clearly, companies take into account the two-year protection offered by the public unemployment insurance when deciding the timing of their redundancies. Finally, we find a surprisingly small cyclical correlation of the flows from employment into unemployment. The estimated coefficients suggest a higher firing rate of qualified workers during recessions, but the effects are only marginally significant.

Overall, our findings confirm the general pattern uncovered in the previous sections: economic incentives matter a lot. The intensity of the dynamics out of employment is smaller (especially into retirement), but the logic behind them seems to sit comfortably with the prediction of basic economic theory.

6 Policy evaluation

6.1 Evaluation of the changes in early retirement introduced in the 2002 pension reform

In 2002, Spain introduced a package of legislative changes affecting the details of the contributive pension system. The modifications ranged from relatively minor changes in the pension formula to a quite substantial reformulation of the pathway into retirement *before* the normal retirement age. In the pre-2002 system, the pension benefit was first available at the age of 60 (with substantial early-retirement penalties). After 2002, the early retirement age was delayed to 61 and was made available only to those workers with at least 6 months on the unemployment rolls.[32] Assuming a rational

[32]The purpose of the reform was to eliminate the possibility of a voluntary early withdrawal from the workforce. On the face of it, policy-makers were not contemplating the possibility of an strategic use of the unemployment benefit by companies

reaction by workers and corporations, we may conjecture that these changes would (i) increase the intensity of retirement flows of unemployed workers ($U \rightarrow R$) at the age of 61; and (ii) increase the flow of transitions from employment into unemployment ($E \rightarrow U$) at the age of 59.[33] This latter behavioural change reflects the strategic use of the unemployment scheme by private agents in the economy: companies would fire two years in advance of the new early retirement age in the confidence that, in the meantime, their workers will be well protected by the generous contributive unemployment benefit.

In this section, we use our econometric model to evaluate the behavioural reaction to an institutional reform undertaken in Spain in 2002. We proceed in three steps: first, we identify the parameters of the model that (according to the theory) should be affected by the reform. We then estimate the interaction-dummies for those parameters to isolate the behaviour in the post-reform part of the sample (2002/2008). Finally we check for any significant changes in the affected parameters. This is equivalent to a *difference-in-difference* approach for the evaluation of the impact of the reform.

Table 6: Double difference test for the 2002 reform

Exit from Employment, to unemployment,	without unobserved het. controls		With het. controls	
	Coef.	T Stat.	Coef.	T Stat.
Age 58 (dummy)	0.2292	5.62	0.2341	5.72
Age 59 (dummy)	-0.0368	-0.67	-0.0280	-0.51
Years 2002-2008 (dummy)	-0.3962	-10.66	-0.3905	-10.42
2002-2008 × Age 58	*0.3260*	*5.60*	*0.3262*	*5.58*
2002-2008 × Age 59	*0.5228*	*7.09*	*0.5182*	*6.99*

Table 7: A triple difference test for the 2002 reform

Exit from Unemployment, After age 60	to employment		to retirement	
	Coef.	T Stat.	Coef.	T Stat.
Without unobserved heterogeneity controls				
Age 61 (dummy)	-0.7252	-2.10	0.6632	2.88
Years 2002-2008 (dummy)	-0.3520	-1.31	0.4246	3.23
* Age 61	0.5132	1.27	-0.4936	-1.49
Unempl. $>$ 6 months (dummy)	0.2362	1.12	0.9026	8.89
* Age 61	-0.0423	-0.12	-0.7108	-3.03
* Year 2002-2008	0.0635	0.30	-0.3170	-2.58
Age 61 × 2002-2008 × Unempl. $>$ 6 months	*-0.2001*	*-0.42*	*1.0080*	*2.96*
With unobserved heterogeneity controls				
Age 61 (dummy)	-0.7330	-2.12	0.6231	2.61
Years 2002-2008 (dummy)	-0.3358	-1.24	0.2759	1.90
* Age 61	0.5343	1.31	-0.3717	-1.08
Unemplemployment $>$ 6 months (dummy)	0.1779	0.84	0.3748	3.27
* Age 61	0.0072	0.02	-0.3701	-1.52
* Year 2002-2008	0.0661	0.31	-0.1594	-1.19
Age 61 × 2002-2008 × Unemployment $>$ 6 months	*-0.2568*	*-0.54*	*0.6674*	*1.88*

Notes: Likelihood function for the model with unobserved heterogeneity, -145,715.11. Number of observations: 1,071,224. We have included a time trend, firm size dummies and other firm and job characteristics in these equations.

and workers.

[33]Note that, by making a direct transition from employment into retirement impossible, the reform should result in larger ($E \rightarrow U$) flows and a higher incidence of unemployment at all ages preceding the normal retirement age.

Table 6 presents the results of this policy evaluation over the transitions from employment to unemployment before the age of 60. It displays the estimation results when employed workers are allowed to have different exit rates to unemployment at ages 58 and 59 (in order to test for the strategic use of Unemployment Benefits before the age of 61). We present results with and without control for unobserved heterogeneity. The effect of the reform is captured by the interaction dummies, showing a large increase in firing rates both at 58 and, especially, at 59 after the reform was implemented, that is, after 2002. In this particular case, the control of unobserved heterogeneity does not significantly affect the key coefficients representing the reform, evidencing that the reform affects all types of workers.

Similarly, Table 7 shows the estimated change in the retirement behaviour of the unemployed after 61. Again we show results without (top panel) and with controls (bottom panel) for unobserved heterogeneity. The importance of unobserved heterogeneity is much more evident in this case, since its consideration reduces both the size and the significance of most of the coefficients. The impact of the reform is captured by a triple interaction term (in the last row of the table), defined by the simultaneous coincidence of being 61 years old, having an unemployment duration of 6 months or more and being unemployed after 2002. [34] When unobserved heterogeneity is not taken into account the estimated effect is large and very significant: the exit to retirement more than doubled after 2002 for the average worker when compared on a like-to-like basis before 2002. When unobserved heterogeneity is taken into account the estimated effect is still large and significant at 10 percent. The comparison of the two coefficients reveals that an important fraction of the effect (more than one third) is explained by the presence in the sample of unemployed workers more prone to take the retirement option.

6.2 Reform analysis

As a second illustration of the sensitivity of individual behaviour to economic incentives, this section simulates the consequences of a joint reform of pension and unemployment rules. [35] We consider a rather extreme *thought experiment* combining changes in the generosity of unemployment benefits and changes in the way the pension rights (of the unemployed) are updated. The design of the reform is intended to emphasize the interaction of pension and unemployment rules in the shaping of the labour behaviour of older unemployed workers.

We proceed in two steps. First, we modify the treatment of the pension rights of the unemployed throughout the duration of the unemployment spell. In the current system (see section 2 or table A1 in appendix A.1), the pensionable income acknowledged by the pension authority for the updating of the worker's pension rights is the full wage enjoyed in the preceding employment spell (up to a legislated maximum). This favorable treatment lasts for up to a maximum of two years, with the minimum wage replacing the previous wage thereafter. In contrast, in our reformed system the minimum wage will be used for the updating during the first year of unemployment and a zero will be included for longer durations. This harsh reform makes the unemployment route into retirement appreciably costlier: on average, the drop in accrued pension rights associated with one extra year unemployed accelerates from -€1,464 to -€2,703 in our sample. The average level of the accrued pension rights also falls appreciably (from €11,351 to €11,088 , that is a 2.32% drop). The behavioural consequences predicted by our model after this institutional change are presented in Table 8. They are surprisingly small: unemployed workers reemploy at a slightly larger rate (around 3% higher) and also retire slightly more at 60, the early retirement age. The explanation can be found by inspecting our estimation results in table 4: the only groups that show a high sensitivity to changes in pension rights are the short-term unemployed and the unemployed without benefits. The reform has some effect on the former but hardly any on the latter.

A more comprehensive reform would also modify the amount of cash income provided to the unemployed. Intuition (and the estimation results in table 4) suggests that workers would be more

[34] We do not model the additional requirement of having contributed for at least 30 years because in our sample above 97% of the unemployed workers meet the criteria.

[35] The standard caveats associated with the use of reduced-form models for policy evaluation should be applied to our results. Clearly, a more structural econometric approach would be better suited to this endeavour. In any case, we believe our findings are a good illustrative approximation of the results of the reform.

responsive to changes in this dimension. To test this conjecture we consider a second institutional change on top of the modifications in the dynamics of pension rights discussed above. In this second step we make the *contributive* benefits available only during the first year in the program (compared to the two years currently available), followed by the provision of the unemployment *subsidy* if the spell extends between one and two years. Longer durations will not be covered by the unemployment program (compared with the unrestricted provision of the unemployment subsidy until retirement in the current system). Table 9 presents the prediction of our model in this new environment. The behavioural response to the joint reform is significant. The hazard rates corresponding to transitions back into the workforce and transitions out of the labour force (into retirement) record similar increases ranging between 15 and 19%. In the absence of changes in the labour market conditions, these figures reflect an institutionally induced change in the propensity to accept job offers and in the willingness to transit into retirement via unemployment. All in all, our results are a sound confirmation of the power of economic incentives and of the importance of the joint consideration of pension and unemployment rules in policy design (targeted at older workers).

7 Concluding remarks

In this paper we analyze the labour market transitions of workers approaching retirement in Spain, paying special attention to their responsiveness to the financial incentives implicit in public regulations. We study the individual transitions of employees and unemployed workers, assuming retirement to be an absorbing state. We emphasize the importance of the exit route via unemployment, given its large quantitative incidence among Spanish workers (accounting for more than 2/3 of the transitions into retirement) The incidence of this alternative exit route is already large in many European countries, and likely to have an increasing presence after the latest cyclical recession. Note, for example, that Coile and Levine (2009) estimate the increase in retirement attributable to the rising unemployment rate in US to be almost 50 percent larger than the decrease brought about by the associated stock market crash. More generally, the recent macroeconomic developments emphasize the importance (for policy purposes) of getting a better understanding of the dependence of labour decisions on unemployment and pension rules. Pension reforms are being ubiquitously ushered in OECD countries for budgetary reasons, with very little understanding of their labor supply consequences. This investigations contributes to throw some light on this important subject.

Our empirical strategy is based on the joint estimation of two multi-state, discrete time, duration models (for the exit from employment and unemployment). The regressors considered in each model include the disposable income (in the current and alternative labour states), the size of accrued pension rights and their change with the duration of the current spell. These variables are carefully constructed to capture the fundamental economic incentives generated by pension and unemployment rules. The estimation uses a new data set based on administrative records from the Spanish Social Security adminstration (*Muestra Continua de Vidas laborales*). This new database provides the entire labour history of the workers in the sample. Thanks to this feature, we can control for the unobserved heterogeneity in the sample in our estimation exercise.

Our findings contribute to the previous literature in several ways. First, our estimation results clearly reinforce previous evidence on the influence of institutional incentives on individual behaviour. In particular, we find strong cross-effects between the two insurance systems coexisting at older ages: unemployment regulations are extremely important for the timing of retirement, while pension rules have strong effects on the transitions between employment and unemployment. A natural corollary is that the small reentry rates observed in Spain among workers aged 55 or over are, at least in part, a consequence of an institutional design that subsidizes non-participation over the costly alternative of job seeking. The combination of generous Unemployment Benefits (for durations of up to two years), and substantial penalties for early retirement make unemployment a very attractive alternative for a large fraction of the sample. The same effect reveals itself in the high retirement rates observed among unemployed workers once UB benefits are no longer available.

The paper also explores the effects of unobserved heterogeneity in the assessment of the importance of financial incentives. We find that assuming a homogeneous population leads to rather large estimation biases in the key parameters of the model (and, consequently, in the result of policy ex-

Table 8: Reform Analysis (i): change in pension rights (effect measured over quarterly hazard rates)

	Exit from Unemployment					
	to Employment			to Retirement		
Age	baseline	simulated	difference	baseline	simulated	difference
60	0.657	0.678	+3.20%	5.605	5.694	+1.59%
61	0.480	0.495	+3.15%	3.395	3.369	-0.75%
62	0.368	0.380	+3.16%	4.671	4.639	-0.70%
63	0.282	0.291	+3.17%	6.293	6.252	-0.64%
64	0.214	0.221	+3.18%	8.268	8.220	-0.58%
65	0.081	0.084	+3.32%	34.085	33.961	-0.36%
66	0.122	0.126	+3.21%	13.152	13.091	-0.46%
67	0.092	0.095	+3.22%	15.974	15.908	-0.41%
68	0.069	0.071	+3.23%	19.045	18.973	-0.38%

Table 9: Reform Analysis (ii): simultaneous change in pension rights and Unemployment benefits (effect measured over quarterly hazard rates)

	Exit from Unemployment					
	to Employment			to Retirement		
Age	baseline	simulated	difference	baseline	simulated	difference
60	0.657	0.782	+18.95%	5.605	6.568	+17.20%
61	0.480	0.573	+19.37%	3.395	3.958	+16.59%
62	0.368	0.439	+19.16%	4.671	5.396	+15.51%
63	0.282	0.335	+18.91%	6.293	7.188	+14.22%
64	0.214	0.254	+18.66%	8.268	9.325	+12.79%
65	0.081	0.094	+15.18%	34.085	36.831	+8.06%
66	0.122	0.145	+18.23%	13.152	14.468	+10.00%
67	0.092	0.108	+18.04%	15.974	17.404	+8.95%
68	0.069	0.081	+17.76%	19.045	20.620	+8.27%

periments). The sensitivity of behaviour to current disposable income, for instance, is significantly underestimated if the underlying heterogeneity is omitted. More strikingly, unobserved heterogeneity seem to be responsible for more than half the size of the peaks in retirement hazards observed at 60 and 65, for both employed and unemployed workers. The usual interpretation of these peaks as a reaction to the details of the pension rules is, consequently, an overstatement of the sensitivity to incentives.

Finally, we complete our assessment of the importance of the incentive effects with a couple of policy evaluations. First, we use our estimated model to explore the consequences of a reform in the early retirement rules implemented in Spain in 2002. Using a *difference-in-difference* approach we find a sizable increase in the incidence of retirement at the new early retirement age (61) among affected workers. Employers also seem to have reacted strategically to the change (by appreciably increasing the firing rates two-years in advance of the new early retirement age). In a second simulation we evaluate the effects of a thought-experiment involving a firm tightening of pension/unemployment rules. We simulate a shortening of the time that unemployment benefits are available and a reduction in the pace of accrual of pension rights during the unemployment spell. These changes lead to sharp increases in predicted reemployment and retirement hazard rates, with gains ranging between 10 and 20% of the initial hazard, depending on age.

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Appendix

A Spanish Social Protection programs

A.1 Spanish Old-Age pension rules

The public old-age pension system is the largest welfare program in Spain, absorbing almost 40% of the total social protection expenditure (50% when including the disability and survivor programs), and representing around 8% of the GDP in 2009. The system is of the Pay As You Go, Defined Benefit type. It provides five types of contributory pensions (old age, disability, widows and widowers, orphans and other relatives), and is organized around three basic schemes: the General Regime (private sector employees and some public servants), the Central Government civil servants scheme, and some Special Regimes, with the Self-employed Scheme being the most important one. In this paper we deal with the old age pensions paid by the General Regime, accounting for around 74 % of the total.

Financing: The System is financed through contributions from employers and employees. Contributions are a fixed proportion of gross labour income between an upper and a lower limit (contribution bases), which are annually fixed and vary according to the professional category. The current contribution rates are 23.6 and 4.7 %, for employers and employees, respectively.

Pension formula: Eligibility requires a minimum of 15 of contributions and complete withdrawal from the labour force. The initial amount is obtained by multiplying a *benefit base* and a replacement rate. The *benefit base* is a moving average of the individual's contribution bases in the 8 years immediately prior to retirement (15 after the 1997 system). The replacement rate depends on age and the number of years of contributions. An individual receives 100% of the *benefit base* when retiring at the age of 65 (Normal Retirement Age, τ_N) having contributed for more than 35 years. It is possible to start collecting the pension at the Early Retirement Age (ERA, 60 in Spain) under a 40% penalty on the benefit base. This corresponds to an 8% annual penalty for bringing forward the retirement age (7% with 40 years of contribution after 1997).[36] There is also a penalty for insufficient contributions (2 % of the benefit base per year below 35 years) The purchasing power of the initial benefit is kept constant according to the evolution of the CPI.

Minimum and maximum pensions: There are lower and upper limits on the pension benefit. Their values in 2000 were roughly equal to and four times the minimum wage, respectively. The minimum pension varies when there is a dependent spouse and/or with age brackets, since it is higher for individuals over 65. They are compatible with early retirement, as they can be awarded immediately after the ERA. In 1999 almost 35% of pensions were topped up to the guaranteed minimum (23.7% in the General Regime), while the incidence of maximum pensions was much lower. Historically the behaviour of both limits, which are annually fixed by the government, has been very different: while maximum pensions have been kept roughly constant in real terms over the last 15 years, minimum pensions have grown at approximately the same rate as nominal wages. As a result of this policy, the minimum pension (for married individuals aged 65+) is higher than the legislated Minimum Wage since 2000, and their values have continued to diverge ever since.

The 2002 Pension Reform:

The 2002 Pension Reform, passed in 2001, introduced a few changes in the conditions for early and postponed retirement.

Early Retirement The 2002 reform changed the requirements for early retirement as from the age of 61 for those workers that started contributing after January, 1st, 1967 (those who started contributing before that date can still retire at 60):

- Aged 61+
- Having contributed at least 30 years

[36] A further reduction of this penalty for very long contributive careers came into force in 2002.

- Involuntary loss of former job
- Being unemployed for at least for six months

The scale of penalization for early retirement was also changed as a function of the number of years contributed:

years of contribution	penalty
40 +	6 %
38-39	6.5 %
35-37	7 %
31-34	7.5 %
- 30	8 %

Postponing retirement The 2002 reform introduced a premium for postponing retirement beyond 65 for those workers with at least 35 years of contributions:

$$\alpha(\tau) = \Big\{ 1 + .02\,(\tau - 65), \quad \text{if} \quad 65 \leq \tau \quad and \quad a(\tau) \geq 35,$$

where a denotes age and n denotes years of contribution.

Table A1. Stylized version of the Spanish General Regime pension rules, 1997-2002 systems

Provision	**Expression**	**Definitions**
Eligibility	$\tau \geq \tau_m = 60 (61\, after\, 2002) \qquad a(\tau) \geq 15$	τ_m is the early retirement age a(.) denotes years of contributions
Covered wages	$c(t) = min\{cx(t), max\{w(t), cm(t)\}\}$	cx, cm are respectively the Max and Min. covered wage $c(t)$ denotes contributions
Pension rights (Benefit Base)	$\overline{w}(\tau) = (1/R) \sum_{\tau-R}^{\tau} c(t)\, dt$	$\overline{w}(\tau)$ is the benefit base R: length of the averaging period (15 in 2002)
Age Penalty	$\alpha(\tau) = \begin{cases} \alpha_0 & \text{if } \tau < \tau_m \\ \alpha_0 + \alpha_1(\tau - \tau_m) & \text{if } \tau_m \leq \tau \leq \tau_N \\ 1 & \text{otherwise} \end{cases}$	τ_N is the normal retirement age $\alpha_0 = .60$ $\alpha_1 = .08$
History Penalty	$\kappa(a(\tau)) = \begin{cases} \kappa_0 & \text{if } a(\tau) < 15 \\ \kappa_0 + \kappa_1(a(\tau) - a_m) & \text{if } 15 \leq a(\tau) \leq 35 \\ 1 & \text{otherwise} \end{cases}$	$\kappa_0 = .60$ $\kappa_1 = .02$
Pension	$B(t,\tau) = min\{BM(t), max\{\alpha(\tau)\,\kappa(a(\tau))\,\overline{w}(\tau), Bm(t,\tau)\}\}$	$b(t,\tau)$ is the pre-tax pension BM is the maximum pension Bm is the minimum pension
Further assumptions	Maximum contributions and pensions are constant in real terms The minimum pension real growth rate or *generosity* is 0.5 %.	

A.2 Unemployment benefits

Unemployment benefits are generally conditional on previous spells of contributions and are available only for workers in the General Regime of the Spanish Social Security system.[37] The duration of these benefits depends upon the spells of previous contributions. The maximum duration is 24 months,

[37]People enrolled in any of the Special Regimes either have no access to unemployment benefits (self-employed and household employees) or have special unemployment programs (farmers and fishermen).

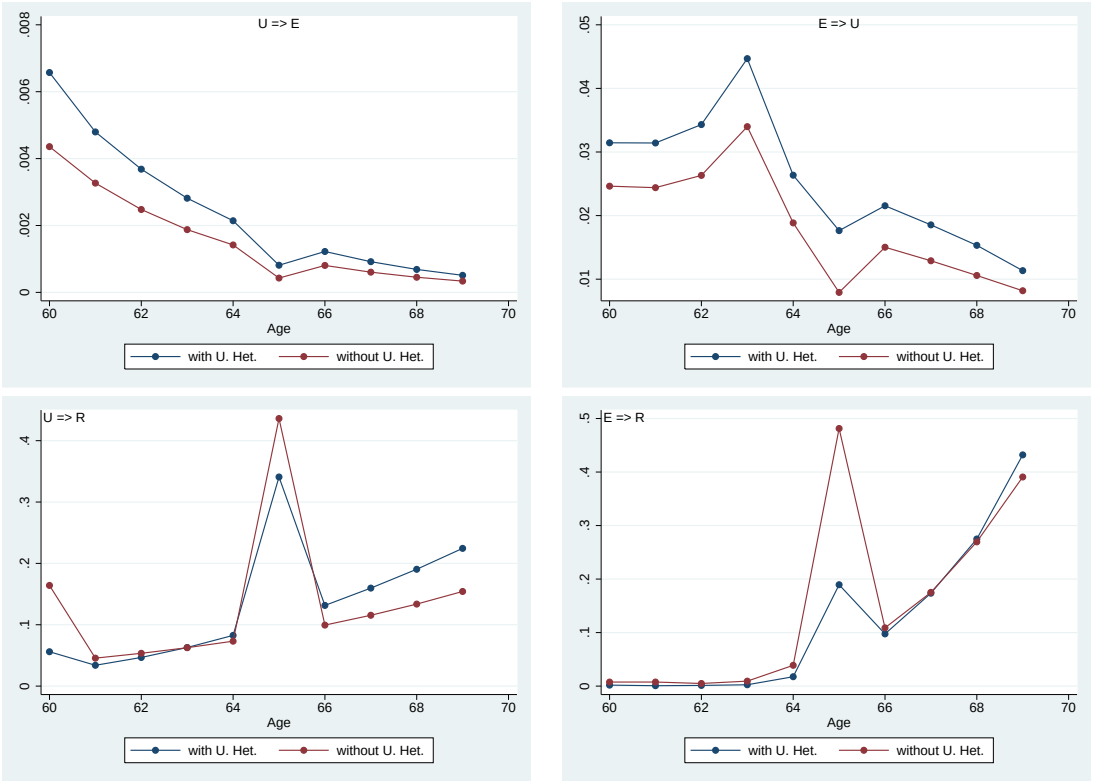
which is achieved after 6 years of contributions. The replacement rate varies with the duration of the spells in two steps: 70% for the first 6 months and 60% for the remainder of the contributory spell, up to 24 months. The benefits have a minimum and maximum amount, both of them varying with the number of dependant children. While unemployed and receiving contributory benefits, workers keep contributing to the pension at the same rate as they were contributing in their prior employment.

There are two continuation programs for those who have exhausted their entitlement to contributory unemployment benefits: one for those aged 45+ (UB45+ program) and the other for those aged 52+ (UB52+ program). The latter is a special subsidy for unemployed people over 52, who lack other income sources, have contributed to unemployment insurance for at least 6 years in their life and, except for age, satisfy all the requirements for an old-age pension. Those in the UB52+ program keep contributing towards the pension but at the minimum contributory base.

B Estimation results with and without Unobserved heterogeneity

The most important contribution this paper makes is the inclusion of unobserved heterogeneity in the examination of the behavioural impact of financial incentives. In this section we check the relevance of this contribution by comparing the estimation results with and without unobserved heterogeneity. This is done by matching Table 4 with Table A5, and Table 5 with Table A6, and by comparing the aggregate hazard predicted by the two models (Figures 6). The comparison of both the estimated coefficients for the set of incentive variables and the graphs suggests that the main consequences of omitting unobserved heterogeneity appear in the exit into retirement, from both unemployment and employment.

Figure 6: Predicted hazards with and without Unobserved heterogeneity control



A priori, one would expect that the omission of one unobserved determinant may artificially

change the estimated effect of the economic incentives. Normally, we would expect the bias to be positive (with the omitted effect being erroneously attributed to the observable incentive variable). The discussion about the causes of early retirement in the Introduction is a clear illustration of such a situation. However, the opposite bias is also possible, when the correct impact of an incentive variable is measured only once, the correct specification is considered. In this case we seem to have both situations:

- Taking proper account of unobservable characteristics we find a clearly diminished impact of the pension level and the dynamics of the pension rights in retirement decisions. Similarly, the effect of life-cycle income reveals a less significant effect in this case. What is really important is that our estimations confirm a very relevant role for economic incentives as explanatory variables for labour transitions, even when composition effects are accounted for (we are comparing similar individuals, not only in terms of their observed characteristics but also controlling for unobserved ones).

- In the exit from employment to retirement, in contrast, we find that the effect of minimum pensions changes from being negative to positive (although not very significant), once unobserved heterogeneity is properly controlled. Thus, those with access to minimum pensions show a slightly larger probability of retiring, comparing individuals with the same value for unobserved heterogeneity. This is a clear confirmation of the theory and previous econometric studies.

- Figure 6 shows how the inclusion of unobserved heterogeneity results in large differences in the average estimated hazard rates into retirement at the age of 60, for unemployed workers, and at age 65, for both employed and unemployed workers. This is a very important new *stylized fact* for this field of the literature: the peaks in the average hazard are substantially smaller (mainly in the exit from employment) once unobserved heterogeneity is controlled for. Hence, the simple empirical hazard rates usually found elsewhere in the literature are largely the result of a composition effect.

  Finally, the same graph shows that unobserved heterogeneity does not change the shape by age of the hazard rates from both unemployment to employment and from employment to unemployment, although the average level of the hazards is slightly larger once unobserved heterogeneity is controlled for.

Overall, our results suggest that the importance of a proper treatment of unobserved heterogeneity cannot be overemphasized, at least in this particular branch of the literature.

Table A2. Initial Conditions

	With Unobs. heterog.		Without Unobs. heterog.	
	Coef.	T Stat.	Coef.	T Stat.
Life-Cycle Income	0.1198	30.18	0.1193	30.34
Age (in years)	-0.2883	-48.62	-0.2830	-48.53
Number of previous unempl. spells	-0.4787	-58.96	-0.4707	-59.11
Part time job (dummy)	1.0768	7.84	1.0573	7.79
Regional employment growth rate	0.0679	15.29	0.0680	15.49
Qualified worker (dummy)	-0.5201	-15.11	-0.5193	-15.28
Constant Term	0.4314	6.40	0.5987	9.49

Notes: Estimation with no unobserved heterogeneity control: Likelihood function -15,473.74. Number of observations: 42,117. We have included a time trend, firm size dummies and other firm and job characteristics in these equations.

Table A3. Exit from Unemployment, before the age of 60

	With Unobs. het.		Without Unobs. het.	
	Coef.	T Stat.	Coef.	T Stat.
With Unempl. Benefits, Un-truncated (dummy)	-0.4435	-3.91	-0.3827	-3.44
With Unempl. Benefits, truncated (dummy)	-2.2183	-19.36	-2.1382	-19.15
Unempl. Subsidy (dummy)	-1.8961	-26.89	-1.8207	-26.55
Unempl. Benefits (level in €)	-0.0015	-9.18	-0.0015	-9.28
% Penalization for early retirement	0.0397	10.88	0.0387	10.81
Change in pension rights (in 1,000 €)	0.3274	11.97	0.3247	12.04
* Unemployment < 24 months (dummy)	-0.1903	-10.43	-0.1869	-10.29
* with no Unempl. Benefits (dummy)	0.0793	3.11	0.0724	2.90
Life-Cycle Income	0.3877	7.41	0.3759	7.36
Age 58 (dummy)	-0.2522	-4.20	-0.2422	-4.06
Age 59 (dummy)	-0.4310	-5.56	-0.4116	-5.35
Age (in years)	-0.1480	-21.76	-0.1431	-21.45
Unemployment = 24 months (dummy)	0.3671	6.03	0.3668	6.06
* With Unempl. Benefits (dummy)	0.7803	9.11	0.7758	9.10
* With Unempl. Benefits & qualified (dummy)	1.2192	15.74	1.2225	15.91
Ln(Unemployment Duration)	-0.5379	-25.37	-0.5570	-26.68
Regional employment growth rate	0.0242	4.75	0.0234	4.65
Qualified worker (dummy)	-0.2146	-5.93	-0.2178	-6.15
Constant Term	-6.8993	-18.76	-6.5780	-18.29

Notes: Estimation with no unobserved heterogeneity control: Likelihood function -21,526.07. Number of observations: 197,342. We have included a time trend, firm size dummies and other firm and job characteristics in these equations.

Table A4. Exit from Employment, before the age of 60

	With Unobs. heterog.		Without Unobs. heterog.	
	Coef.	T Stat.	Coef.	T Stat.
Wage	-0.0697	-4.64	-0.0824	-5.55
% Penalization for early retirement	0.0271	12.07	0.0269	12.11
Change in pension rights (in 1,000 €)	0.0437	3.21	0.0455	3.38
* Qualified worker	-0.0488	-3.02	-0.0487	-3.05
* Age	0.0057	2.01	0.0054	1.91
Life-Cycle Income	-0.7490	-20.02	-0.7319	-19.84
* Qualified worker	0.3181	7.05	0.3421	7.67
Age 58 (dummy)	0.3471	10.01	0.3425	9.91
Age 59 (dummy)	0.1711	3.87	0.1648	3.74
Age (in years)	0.0653	9.96	0.0624	9.58
* Qualified worker	0.0069	1.03	0.0079	1.17
Ln(Empl. Dur.)	-0.5255	-63.98	-0.5312	-65.45
Regional employment growth rate	-0.0334	-7.10	-0.0324	-6.94
* Qualified worker	0.0211	3.33	0.0175	2.79
Qualified worker (dummy)	-0.1354	-3.78	-0.1136	-3.21
Constant Term	-4.8264	-20.82	-4.6644	-20.40

Notes: Estimation with no unobserved heterogeneity control: Likelihood function -55,797.87. Number of observations: 667,085. We have included a time trend, firm size dummies and other firm and job characteristics in these equations.

Table A5. Exit from unemployment, after the age of 60. Model without unobserved heterogeneity control

	to Employment		to Retirement	
	Coef.	T Stat.	Coef.	T Stat.
Truncated Unempl. Benefits (dummy)	-2.0161	-4.88	-1.7849	-9.37
Un-truncated Unempl. Benefits (dummy)	-0.9259	-2.35	-0.2072	-1.33
Unempl. Subsidy (dummy)	-0.9997	-5.23	-0.6246	-10.37
Unempl. Benefits (level in €)	-0.0008	-1.25	-0.0014	-5.30
Entitled to Minimum pension (dummy)	-0.4651	-1.98	0.1410	2.31
Un-truncated pension rights (in 1,000 €)	-0.0332	-1.47	0.0384	14.78
Replacement rate	0.0092	1.64	0.0725	9.58
Change in pension rights (in 1,000 €)	0.3043	3.28	0.3552	10.44
* Age 60 (dummy)	-0.0342	-0.77	-0.2200	-22.55
* Unemployment < 24 months (dummy)	-0.2972	-4.87	-0.1097	-8.28
* with no Unempl. Benefits (dummy)	0.1163	1.55	-0.1144	-4.80
Life-cycle wealth	-0.0684	-0.33	-0.0775	-1.64
Age 60 (dummy)	0.1033	0.70	1.2603	26.45
Age 65 (dummy)	-0.4311	-0.98	2.1134	41.33
Age (in years)	-0.2689	-4.55	0.1671	11.15
Unemployment = 24 months (dummy)	0.4736	2.51	0.5783	11.01
* With Un. Benefits (dummy)	0.3797	1.24	1.2597	16.34
* With Un. Benefits & qualified (dummy)	1.5066	5.11	0.3418	4.44
Ln(Un. Duration)	-0.7814	-13.71	0.1657	7.13
Regional employment growth rate	-0.0535	-2.02	-0.0070	-1.11
*with Un. Benefits (dummy)	0.0666	2.11	0.0310	3.33
Qualified worker (dummy)	0.1256	1.18	-0.5025	-17.31
Constant Term	-2.8254	-3.26	-8.4361	-26.41

Notes: Likelihood function -26,151.45. Number of observations: 69,992. The estimated equations include a time trend, dummies for firm size and for other characteristics of the firm and the previous job.

Table A6. Exit from employment, after the age of 60. Model without unobserved heterogeneity control

	to Unemployment		to Retirement	
	Coef.	t Stat.	Coef.	t Stat.
Wage (level in €)	0.0657	2.48	-0.0667	-2.28
Entitled to Maximum pension (dummy)	-1.2094	-1.65	-1.0262	-3.93
Entitled to Minimum pension (dummy)	0.3484	4.36	-0.2426	-2.42
* Qualified worker	0.0634	0.69	-0.1286	-0.98
Un-truncated pension rights (in 1,000 €)	0.1094	8.08	0.1785	13.22
* Age	-0.0122	-7.17	-0.0168	-13.35
Replacement rate	0.0185	5.32	0.0290	7.00
Change in pension rights (in 1,000 €)	0.0275	0.39	-0.1790	-2.56
* Age 65 (dummy)	0.1400	1.07	-0.1990	-6.29
* Age	0.0038	0.42	0.0308	4.17
Life-cycle Wealth	-0.0693	-1.33	-0.4255	-6.95
Age 60 (dummy)	-0.0671	-1.19	0.5468	6.77
Age 62 (dummy)	0.1523	3.03	-0.9858	-10.26
Age 63 (dummy)	0.4973	8.69	-0.8914	-11.17
Age 65 (dummy)	-0.3143	-1.15	2.7724	47.35
Age (in years)	0.0433	1.50	0.6926	31.44
Ln(Empl. Dur.)	-0.3451	-20.68	-0.1486	-6.40
Regional employment growth rate	0.0028	0.29	0.0156	1.19
* Qualified worker	-0.0226	-1.78	-0.0413	-2.55
Qualified worker (dummy)	-0.4514	-7.66	-0.3488	-4.78
Constant Term	-4.0726	-9.33	-11.6056	-23.42

Notes: Likelihood function -28,327.10. Number of observations: 136,805. We have included a time trend, firm size dummies and other firm and job characteristics in these equations.