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Essays on sickness absence from work

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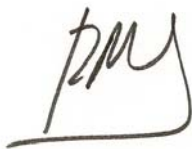
El Doctor Roberto Bande Ramudo, profesor contratado doctor de la Universidad de Santiago de Compostela en el departamento de Fundamentos del Análisis Económico,

informa que:

- La memoria titulada “Essays on sickness absence from work” elaborada por D.^a Elva López Mourelo cumple con los requisitos para optar al título de Doctora en Economía.

- El Capítulo 2 fue elaborado conjuntamente con el Doctor Alfonso Alba Ramírez y D.^a Elva López Mourelo contribuyó con un mínimo del 50% del trabajo realizado.

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Roberto Bande Ramudo



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PREFACE

This thesis examines absence from work due to sickness in Spain. The first chapter reviews the current state of knowledge related to theory, as well as empirical evidence relating to sickness absence in an economic context. The economic literature has stressed that labour supply factors such as gender and age are important in determining sickness absence, but, according to the empirical evidence, the effect of these two variables is uncertain. Chapters 2 and 3 aim to shed light on this debate by providing empirical evidence regarding the effect of gender and age, respectively, on sickness absence from work. Finally, Chapter 4 examines the contribution of government intervention in occupational health and safety (OSH) in giving rise to spatial differences in the incidence of workplace accidents.

In particular, Chapter 2 focuses on explaining gender differences in work absence behaviour. The data come from the 2006 wave of the *Continuous Sample of Working Histories*, which was expanded with information on all sick leave spells covered by the Spanish sickness insurance scheme for the period 2005-2006. The empirical analysis in this chapter is divided into two parts. First, competing risk models are used to measure the time from the start of an employment contract to the first sickness absence spell in relation to each worker's characteristics. Second, a single event duration model is estimated to examine how these characteristics affect the time to return to activity after a period of sick leave. The results reveal that both incidence and duration of sick leave are higher for women than for men. More specifically, the presence of children under 3 years old in the household is one of the most important variables explaining the differences in sickness absence between women and men.

Chapter 3 examines the impact of worker's age on the consequences of occupational injuries. Using data from the *Spanish Statistics on Accidents at Work* for 2004-2010, a multinomial model is estimated in order to analyse the impact of the age on the probability of suffering a severe or fatal accident. Further, a duration model is used to assess the effect of worker's age on the length of sick leave caused by occupational injuries. The analysis shows that the probability of suffering a severe or fatal accident, as well as the duration of the sick leave, increases with the worker's age once personal, job, and accident characteristics are controlled for. From a policy perspective, the results point out the importance of a proper match between the capabilities of the worker and the demands of the job. Therefore, decisions about delaying the retirement age require additional measures, such as the occupational reallocation of these older workers to tasks with lower incidence rates, in order to minimise these effects.

Finally, Chapter 4 analyses the regional distribution of the incidence of workplace accidents in Spain, as well as its dynamics over the last two decades. It also analyses the contribution of socioeconomic factors and government prevention measures in giving rise to spatial differences in the incidence of workplace accidents. The results call for a modification of the legal framework as regards the intensity of inspection and sanction regimes, given that such changes would reduce the magnitude of regional disparities.



CHAPTER 1

Sickness absence from work: Theoretical issues and previous literature from an economic perspective

1. Introduction

The analysis of sickness absence from work has been carried out within several different scientific disciplines such as medicine, psychology, sociology, etc. Thus, economics has also contributed to the study of absenteeism due to sickness. The purpose of this chapter is to review the current state of knowledge and issues related to theory and empirical evidence of sickness absence from work according to an economic perspective.

Traditionally, economic theories on sickness absence are usually rooted in the perception of humans as individuals who make rational choices and, therefore, seek to maximise their welfare or utility. Section 2 describes how, facing a choice between labour supply and leisure, individuals maximize their utility given budget and time constraints. However, several factors have an impact on this decision. Economic literature has highlighted that characteristics of the worker, such as health, gender and age, can influence his or her valuation of free time and consumption (Section 3). Likewise, empirical work has stressed the crucial role played by flexible working arrangements in the determination of absence decisions (Section 4). Salary levels also influence absence, but Section 5 illustrates that the direction of this association is uncertain. In most countries, the government and/or the employers provide employees with insurance against the loss of income due to sickness. A central theme in economic research concerns the negative effects of such insurance systems, especially when moral hazard arises (Section 6). As Section 7 shows, workers not only face costs in terms of forgone income, which depend on the generosity of the insurance system, but also the possibility of sanctions by employers, ranging from slow career progression to dismissal. Labour demand factors also play a crucial role. The costlier absence is to employers, the more likely they are to respond. As Section 8 suggests, if absence is clearly connected with the working environment or the type of contract, the employer may attempt to improve it. Finally, Section 9 presents issues for future research and introduces the rest of the thesis.

2. The income-leisure choice framework

Economic theories on sickness absence have generally been analysed within the traditional income-leisure choice model (Allen, 1981; Leigh, 1985). Within this framework, individuals are assumed to maximize utility, which is a function of two components: consumption (which requires work) and leisure. Thus, an individual has a utility function of the form:

$$U = U(x, l) \quad (1)$$

where x is a vector of consumption goods and l is leisure time.

The budget constraint of the worker is represented by:

$$x \leq R + wh \quad (2)$$

where R is non-labour income, w is real wage and h is actual hours worked.

Workers also face a time constraint, which assumes that total hours are the sum of leisure time (l) and actual hours worked (h):

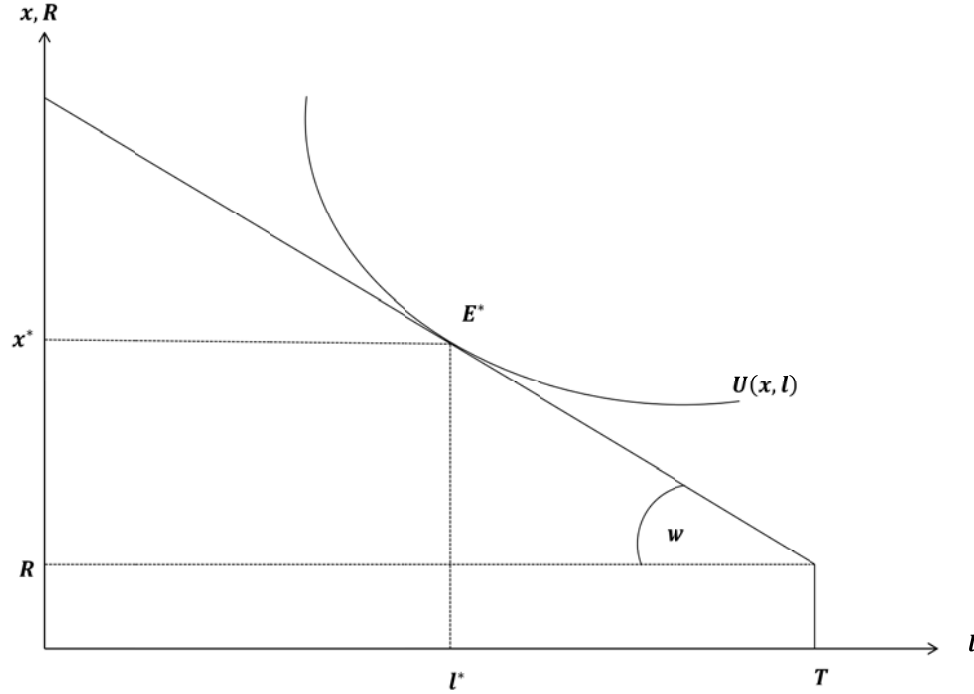
$$T = h + l \quad (3)$$

The individual's problem is to maximise equation (1) subject to constraints (2) and (3). Assuming positive but declining marginal utilities, the first-order equilibrium condition is:

$$\frac{\partial U(x, l) / \partial l}{\partial U(x, l) / \partial x} = \frac{u_l(x^*, l^*)}{u_x(x^*, l^*)} = w \quad (4)$$

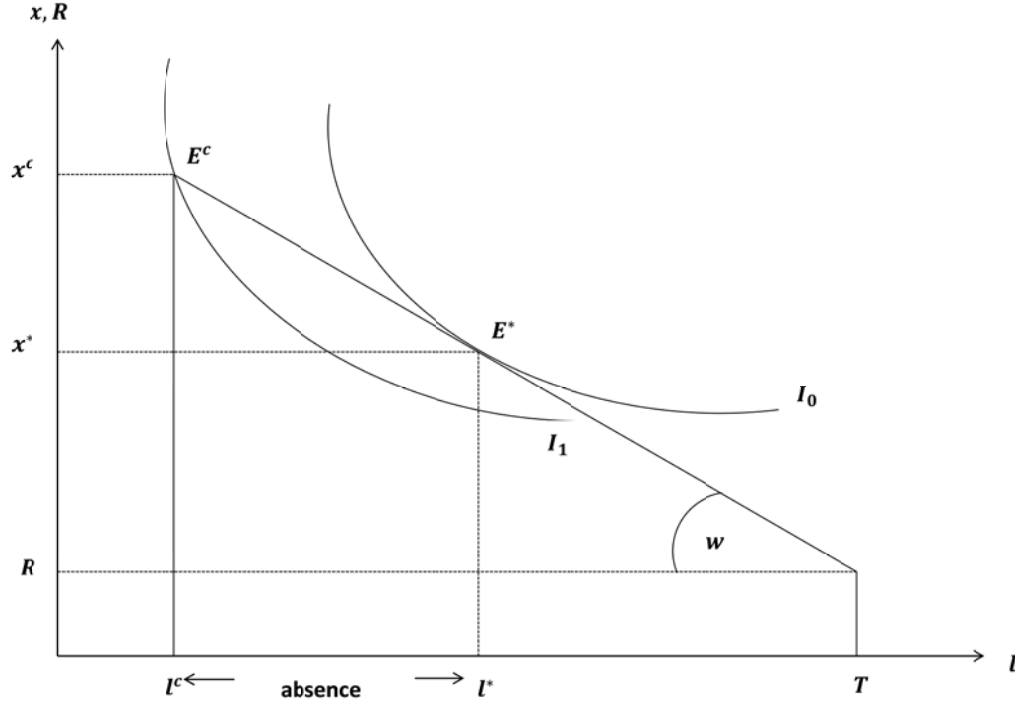
so that the marginal rate of substitution between consumption and leisure equals the economic rate of substitution (w). Graphically, the individual maximises utility by moving to the point on the budget constraint that is tangential to his or her indifference curve. Thus, equilibrium appears as $E^* = (x^*, l^*)$, where both $l^* = T - h^*$ and h^* represent the individual's optimal labour supply decision (see Figure 1.1).

Figure 1.1 Income-leisure choice model equilibrium



Within this framework, the temptation to be absent is determined by the difference between the marginal rate of substitution between consumption and leisure and the real wage rate. This arises because official hours of work are assumed to be predetermined and, as a result, the contractual hours (h^c) exceed the desired hours of work h^* . Figure 1.2 shows the individual's budget constraint if the employment contract specifies working hours $[T, E^c, l^c]$. Moreover, Figure 1.2 also shows the individual's indifference curves (I_k). Thus, if the individual had not a contractual constraint, his or her equilibrium would appear as $E^* = (x^*, l^*)$. Nevertheless, the contractual constraint moves the individual to $E^c = (x^c, l^c)$, where $l^c = T - h^c$. At E^c the individual's marginal rate of substitution between income and leisure, that is the slope of his/her indifference curve, exceeds the individual's economic rate of substitution between income and leisure, that is the slope of his/her budget constraint (w). This would tempt the individual to take absence ($l^a = l^* - l^c$) in order to move towards the maximising equilibrium (Brown and Sessions, 1996).

Figure 1.2 Income-leisure choice model with contractual hours and absence decision



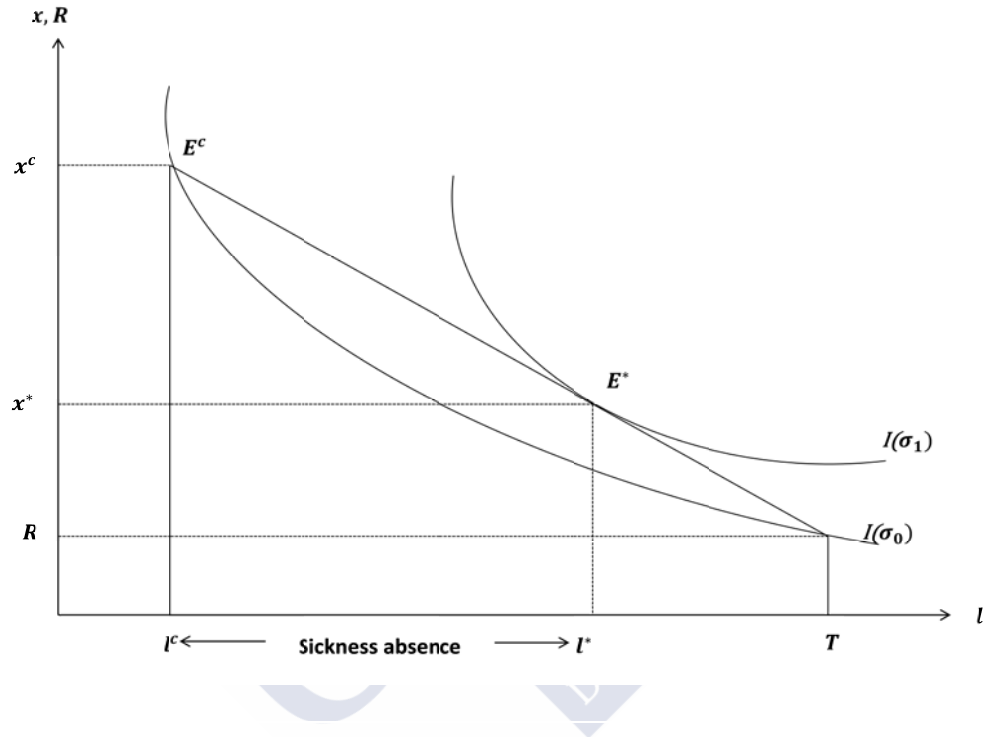
So far, this discussion has assumed that absenteeism on behalf of the individual is to some extent voluntary, and that therefore absenteeism arises not because the individual is unable to work, but he or she chooses not to do so. However, it should be noted that absenteeism could be either voluntary or involuntary due to, for instance, a sickness. Modelling sickness absence demands the incorporation of sickness into the individual's utility functions. Following Barmby et al. (1994) an index of sickness, σ , may be incorporated into the utility function. The index is assumed to be a random variable with a probability density function $f(\sigma)$. Thus, higher values of σ are associated with higher levels of sickness experienced by the individual. Utility is expressed as a function of consumption, leisure and the individual's level of sickness:

$$U = U(x, l, \sigma) \quad (5)$$

where x is a vector of consumption goods, l is leisure time and σ represents the level of sickness for this particular individual. Moreover, it is assumed that $U_\sigma < 0$, $U_{x\sigma} < 0$ and $U_{l\sigma} > 0$. Therefore, as σ rises, the individual places more value on leisure relative to consumption and his/her indifference curves become steeper. This rise in the marginal rate of substitution increases the likelihood of absence.

Figure 1.3 shows the indifference curve $I(\sigma_0)$ when the level of sickness is such that the individual is indifferent between absence and attendance. The slope of the indifference curve is determined by the value of σ which determines whether an individual attends or not. If $\sigma_1 > \sigma_0$, then the individual maximises utility by absenting himself/herself from work. In this case, the slope of the indifference curve $I(\sigma_1)$ is steeper than that of $I(\sigma_0)$.

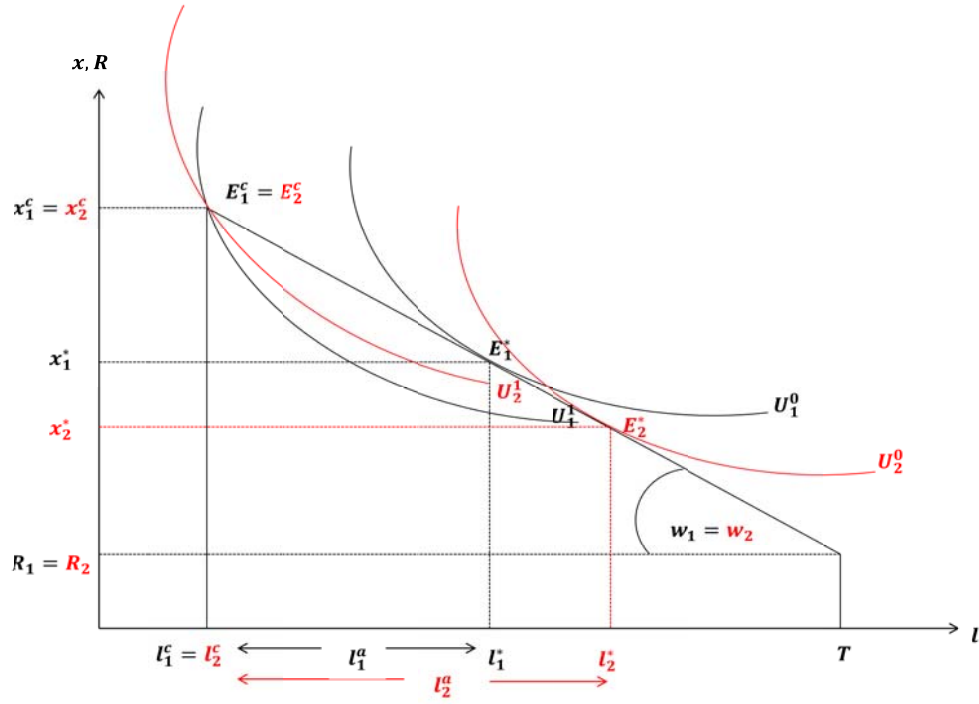
Figure 1.3 Health status and absence decision



3. The impact of labour supply characteristics on sickness absence

Theoretical analyses of sickness absence mostly focus on labour supply characteristics. Indeed, characteristics of the worker can influence his or her valuation of free time and consumption. Thus, different people may have different preferences of leisure and consumption and, therefore, different utility functions. Figure 1.4 depicts two individuals with the same budget constraint $[T, E^c, l^c]$ but different preferences over leisure and consumption – U_1 for worker 1 and U_2 for worker 2. Actual labour market decisions by workers can be depicted by the point of tangency between the budget constraint and the indifference curve. In Figure 1.4, the tangency between the budget constraint and worker 1's indifference curve (U_1^0) represents worker 1's optimal income-leisure choice. Likewise, worker 2 maximises expected utility at the tangency between the budget constraint and U_2^0 . Hence, workers 1 and 2 maximise their utility at points l_1^* and l_2^* , respectively. However, if both workers had the same number of contractual hours (l^c), worker 2 would be more tempted to take sickness absence than worker 1 to move towards the maximising equilibrium ($l_2^a > l_1^a$).

Figure 1.4 Sickness absence decision with different preferences



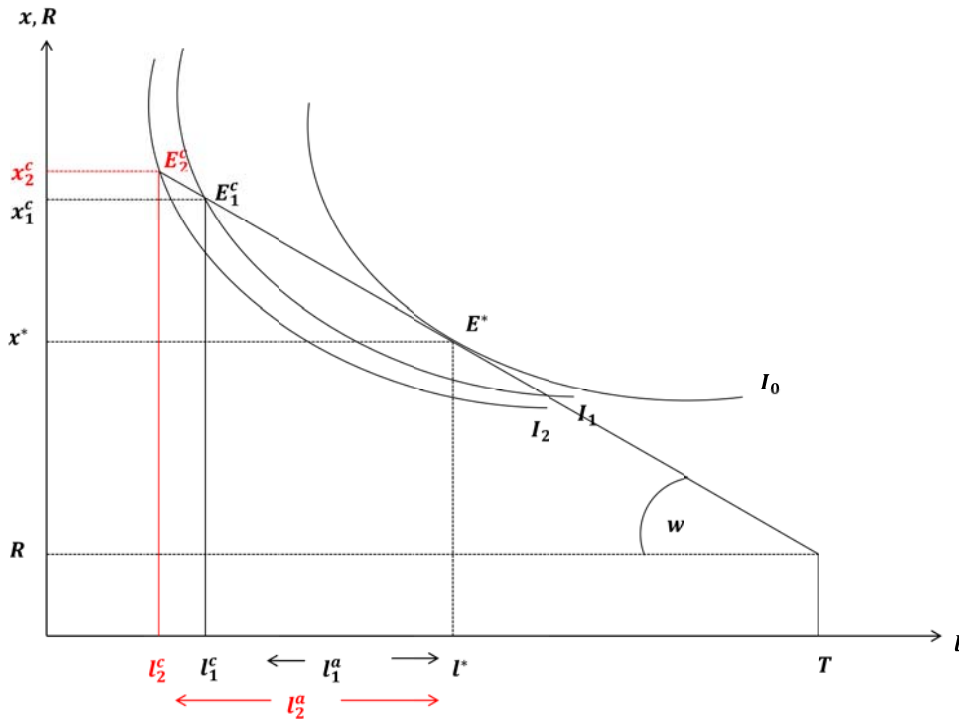
The economic literature has also stressed that variables such as gender and age are important in determining sickness absence. A common finding in many of the studies on sickness absence has been that females exhibit higher absence rates than males (Leigh, 1983; Paringer, 1983; Vistnes, 1997). A common explanation of this gender difference in sickness absence is that women are exposed to the “double burden” of combining paid work with family obligations to a greater extent than men (Mastekaasa, 2000). Thus, women are still more likely to assume responsibility for the children in the household and hence may be absent from work in order to gain a greater degree of flexibility. Nevertheless, empirical evidence on the relationship between dependants and sickness absence has yielded mixed results. While Leigh (1983) and Vistnes (1997) found that the presence of children younger than six increased female absenteeism, Paringer (1983) found that women with dependants were less likely to be absent.

The other factor that has been suggested to be associated with sickness absence is the worker’s age. Interestingly, there is also debate in the literature about the effect of age on absenteeism. Indeed, Allen (1981) suggested that the probability of absence for workers 55 and over is significantly below that of younger workers; Leigh (1983) found that age had no significant effect on explaining absenteeism for either gender; and Paringer (1983), in contrast, found a positive relationship between age and absenteeism that was greater for males. Dionne and Dostie (2007) suggested that age was related to a lower absence at an increasing rate, arguing that this pattern is usually explained by the hypothesis that older workers expect longer unemployment spells if fired and are therefore careful not to engage in behaviour that might lead to job loss.

4. Working time and sickness absence

In the simplest form of the income-leisure model, sickness absence would increase as the contracted working time increases. Figure 1.5 shows the individual's budget constraint if the employment contract specifies longer working hours $[T, E_2^c, l_2^c]$. The increase in contractual hours moves the individual from E_1^c to E_2^c , where $l_2^a > l_1^a$. At E_2^c the difference between the individual's marginal rate and his or her economic rate of substitution between income and leisure is higher than in E_1^c . As a result, the increase in contractual hours increases the temptation to be absent ($l_2^a > l_1^a$) in order to move towards the maximising equilibrium (E^*).

Figure 1.5 Sickness absence decision with different contractual hours



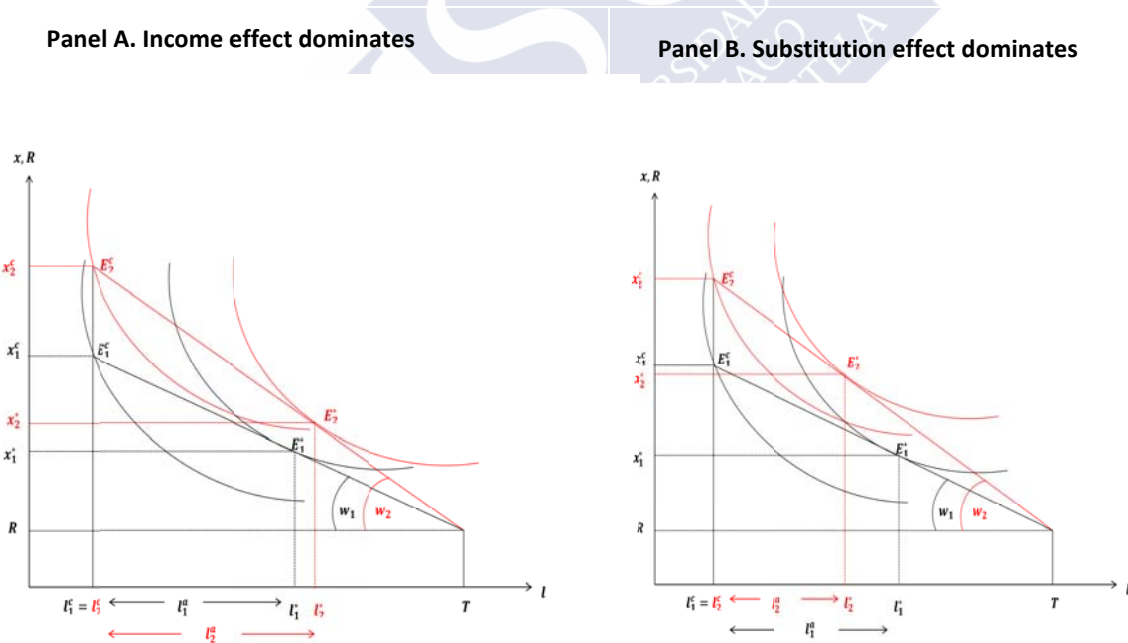
It is apparent from the above analysis that more flexibility – measured, for instance, by the share of part-time employment and flexible working time arrangements– may help to reduce sickness absence. Indeed, empirical work has stressed the crucial role played by flexibility in the determination of absence decisions. For instance, Barmby et al. (2004) suggested that more flexible work arrangements reduce the impact of long working hours on sickness absence. In this vein, Dionne and Dostie (2007), using detailed data on the scheduling of the work week, found that workers who worked at home or worked on a reduced work week had a lower incidence of absenteeism.

5. The role of salaries: income versus substitution effect

Salary levels also influence sickness absence, but, according to the labour supply model, the effect of the wage on absence is uncertain. Salaries have both a positive income effect and a negative substitution effect on absence. The income effect means that higher (lower) salaries increase (decrease) the tendency to be absent if leisure is a normal good, since higher (lower) salaries make it possible for a person to achieve a given level of consumption through a lower (higher) amount of work. On the other hand, the substitution effect occurs since higher (lower) wages mean that the economic loss during absence also increases (decreases) and, therefore, serve to decrease (increase) the tendency to be absent.

The effect of an increase in wages on the individual's absence decision is illustrated in Figure 1.6. In particular, Panel A depicts a situation where income effect is higher than substitution effect. In this case, despite economic loss during absence has increased, the individual desires more hours of sickness absence because he or she hits his or her target income faster. On the other hand, Panel B shows a situation where substitution effect dominates. Thus, the opportunity cost of sickness absence is high in such way that the individual is willing to work more because the return to work effort is higher.

Figure 1.6 Increase in wages and sickness absence decision



Therefore, from the labour supply model, the effect of the wage on absence is ambiguous with conflicting income and substitution effects. As a result, the empirical evidence also provides contradictory results. For instance, Drago and Wooden (1992) found a significant negative relationship between salaries and absence, as well as Chaudhury and Ng (1992), Ercolani (2006) and Dione and Dostie (2007). This contrasts with the results of Leigh (1991), which indicated that wages are not statistically significant predictors of absence.

Further, as Johansson and Palme (1996) indicate, omitting the risk at the workplace may lead to biased estimates of the relationship between wages and absence. Indeed, when people accept a job, they not only accept a wage and a contracted number of work hours, but also a number of non-wage characteristics such as a higher level of risk at the workplace. The worker may accept these risks if he or she is rewarded by a higher wage. Thus, the compensating wage differential hypothesis predicts a positive relationship between wage rates and absence. This is because workers who choose a higher risk level at the workplace and receive, as a result, a compensating wage, are likely to have a higher rate of work absence for two reasons. First, the worker will try to minimize the exposure time to risk and hence he or she has greater incentives to be absent¹. Secondly, workers who are exposed to higher risks also have a higher probability of being absent due to work-related illnesses or injuries.

Empirical estimates of compensating differentials relied on a standard wage equation in which the wage rate is regressed on the fatality risk and a set of demographic and job characteristics of the worker – the so-called hedonic wage equation. This trade-off that workers make between job risks and additional pay has been interpreted as the value of a statistical life (VSL). Thus, the VSL is defined as the amount that the worker is willing to receive for accepting a job with a risk of death. Since Thaler and Rosen (1976) published the first estimation of the VSL based on the hedonic wage methodology, a wide body of literature has found a positive relationship between job risk and wage (Marin and Psacharopoulos, 1982; Viscusi, 1993; Albert and Malo, 1995; Viscusi and Aldy, 2003).

6. Sickness insurance system and moral hazard

The labour supply model can be expanded on building in compensation during absence. Such compensation can be seen as a form of insurance, which means that the employee does not have to bear the entire cost of absence. In most countries, the government and/or the employer provides employees with insurance against the loss of income owing to sickness. The effect of a simple sick pay scheme on the individual's absence decision is illustrated in Figure 1.7.

According to Brown and Sessions (1996), if we assume that the individual receives sick pay at the rate $s < w$ when he or she is on sick leave, then the individual faces two budget constraints: the conventional wage line increasing from right to left and then new sick pay line increasing from left to right. If the individual is on sick leave, then he or she moves to E_1 , where $x^s - R$ is the sick payment. If the individual takes only a portion of his or her total time allocation as absence, then he or she moves along the budget constraint $[T, E_1, E^c, l^c]$, with slope $w - s$ (Figure 1.7-Panel A).

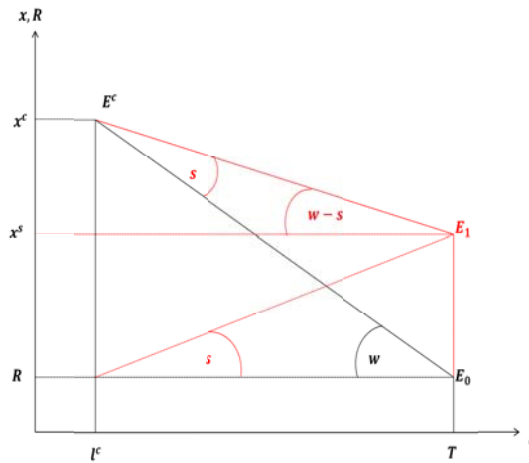
Figure 1.7 shows how the provision of sick pay raises the incentive of the worker to be absent. With the introduction of a sick pay scheme at the rate $s < w$ the budget constraint of the individual will pivot at E^c to become $[T, E_1, E^c, l^c]$. The introduction of a sick payment creates

¹ The fact that risk-seekers may select themselves into risky occupations may partially reduce this effect (Viscusi, 1998).

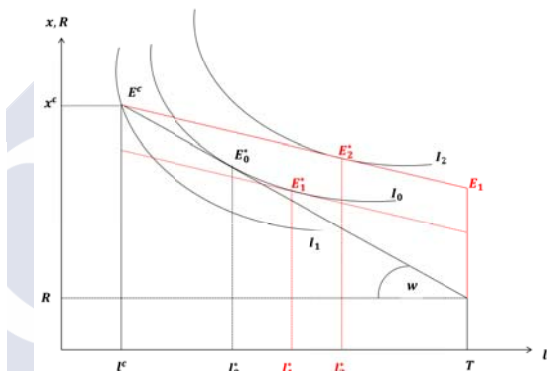
an income and a substitution effect. Thus, the movement from E_0^* to E_1^* represents the substitution effect, which serves to increase absenteeism, whilst the movement from E_1^* to E_2^* represents the income effect, which gives a further impetus to be absent on account of the assumed normality of leisure (Figure 1.7-Panel B).

Figure 1.7 Impact of sick-pay scheme on sickness absence decision

Panel A. The budget constraint with sick-pay



Panel B. Sick-pay and sickness absence decision



A central theme in economic research concerns the negative effect of insurance systems, notably the risk of moral hazard. Moral hazard is a term used to describe the phenomenon that arises when employees change their behaviour as an effect of the insurance system – i.e. more favourable systems yield higher absence and vice versa. Thus, the incentives from the insurance scheme may have a strong impact on absence behaviour, leading to question whether generous insurance not only compensates for sickness and disability but also induces such outcomes. In fact, some countries such as Sweden and Germany have made changes in their sick payment schemes to reduce the economic compensation during sick leaves (Johansson and Palme, 2005; Ziebarth and Karlsson, 2010).

Although there is a large body of literature on sickness absence, only a handful of studies have empirically analysed the relationship between absence behaviour and sick leave benefits. Interestingly, all of them find that employees adapt their absence behaviour to increases and decreases in benefit levels, therefore providing empirical evidence of strong moral hazard effects of the sickness insurance scheme. For instance, Johansson and Palme (2002, 2005) evaluated the Swedish sick pay reform of 1991 and found that both the incidence and the duration of absence decreased when the cost of absence increased. Likewise, Henrekson and Persson (2004) used long-time series data –from 1955 to 1999– for Sweden taking advantage of several legislative changes in the compensation levels to show a strong effect of changes in sick payment levels on sick leave behaviour. Outside the Swedish context, two studies examine legislative changes in the sickness benefit levels in Germany. In particular, Ziebarth and Karlsson (2010) found that the

German reform in 1996² increased the overall share of private sector employees without any absence days between 6 and 8 per cent. Similarly, Puhani and Sonderhof (2010) estimated that the reduction in sick pay from 100 to 80 per cent of the wage decreased absence days by about 2 days per annum on average – i.e. one per cent of annual working days in Germany.

Likewise, several empirical studies have analysed the effects of changes in insurance compensation on workplace accident rates or on recovery time (Butler and Worral, 1983; Johnson and Ondrich, 1990; Bolduc et al., 2002; and Boden and Ruser, 2003). Most of the extant literature agrees that workers respond to economic incentives provided by workers' compensation payments. In fact, several studies from the United States have shown that increases in the workers' compensation insurance in the 80s were accompanied by an increase in work-related illnesses or injuries claims (Meyer et al. 1995; Butler et al., 1996). As Butler et al. (1998) indicated, these additional claims would be due to moral hazard since, in the absence of moral hazard, a change in benefits would not cause a systematic change in the claims. Indeed, using data from the National Council on Compensation Insurance available for 15 states from 1980 to 1989, Butler et al. (1996) found evidence that moral hazard response explains most of the 30 per cent of the increase in the proportion of soft tissue injuries during the 1980s.

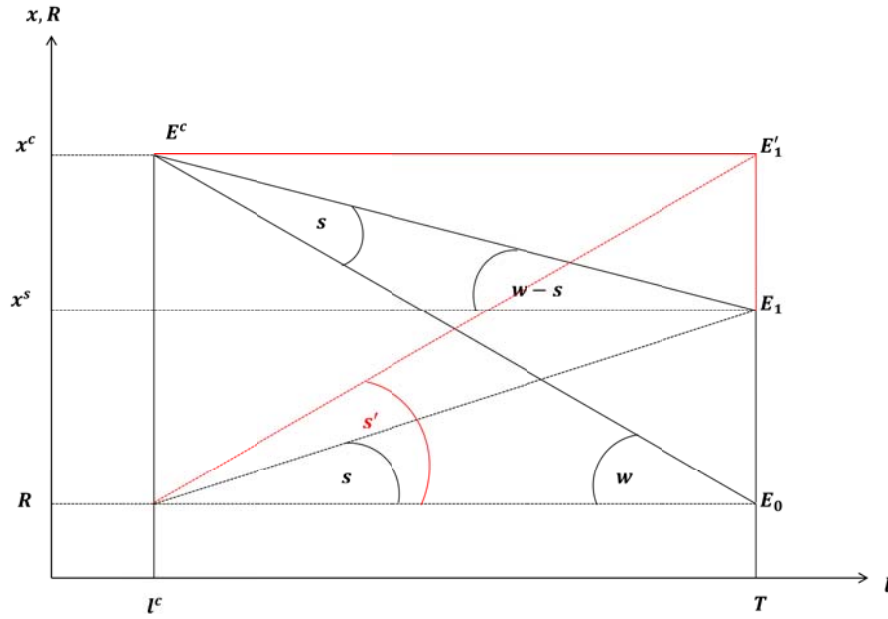
In this vein, characteristics of labour market institutions can also lead to moral hazard behaviour by workers. For instance, Frick and Malo (2008) analysed the impact of institutions such as job protection legislation and sickness benefit systems on individual absenteeism. Using data for 14 European countries, they found that employment protection does not influence the number of absence days while sickness benefits increase absenteeism. Likewise, the economic literature has analysed the link between sickness or workers' compensation insurance and unemployment insurance. In particular, Lusinyan and Bonato (2007) stressed that the Swedish case is a good example of how the interaction of sickness insurance with unemployment insurance creates a perverse incentive for the unemployed to be listed as sick. Likewise, Fortin et al. (1999) showed, using data on more than 30,000 workers in the Canadian construction industry for the period 1976-1986, that a reduction in the unemployment insurance replacement ratio is associated with an increase in the duration of claims due to severe accidents that are difficult to diagnose. Moreover, they also found that the duration of spells is much higher when an accident occurs in December, a month which corresponds to the beginning of the lay-off season in the construction sector.

7. Non-economic or more long-term costs of absence

The model depicted in last section assumes that the individual receives a sick pay at the rate $s < w$, i.e. below his or her salary. Figure 1.8 plots this scenario where, assuming $w = s$, the individual's budget would be given by a rectangle $[T, E'_1, E^c, l_c]$ and, under standard convex preferences, the worker would have an incentive to absent himself/herself fully (Brown and Sessions, 1996).

² The German Employment Promotion Act, which went into effect October 1, 1996, reduced the sick pay employees are entitled to claim from 100 to 80 per cent of gross wages during the first six weeks per sickness episode (see Ziebarth and Karlsson (2010) for more details).

Figure 1.8 The budget constraint with 100 per cent compensation for sickness



In systems where sick pay is 100 per cent of the worker's salary (e.g. the Norwegian sickness insurance scheme³), one could expect that the employee would be absent all time according to this simplified model. Nevertheless, a prediction of 100 per cent absence is obviously unreasonable and hence economic models also have built in non-economic or more long-term costs of absence for the employee. Thus, in their decisions about absence, workers face costs in terms of income, which depend on the generosity of the insurance system, but also the possibility of sanctions by the employers, ranging from slow career progression to dismissal (Lusinyan and Bonato, 2007). Thus, rational worker behaviour could explain why workers take sick leave more frequently after the end of their probationary period, when full employment protection is provided (Ichino and Riphahn, 2005; Lindbeck et al., 2006).

Further, this concern about job loss could explain why sickness absence tends to be negatively correlated with the unemployment rate, a phenomenon that is confirmed in several studies (Leigh, 1985; Drago and Wooden, 1992; Askildsen et al., 2005). Pro-cyclical absence rate can be due to a fear of unemployment during a period of weak labour market conditions in such a way that unemployment could function as a "discipline device" on the shirking behaviour of workers (Shapiro and Stiglitz, 1984). Nevertheless, some empirical evidence suggests that, besides an eventual disciplining effect of the unemployment rate on the sick-leave rate, a labour force composition effect may also play a role. Thus, a pro-cyclical pattern of the aggregate absence rate would emerge if workers with low absence rates are more likely to be retained during economic recessions and more absence-prone workers are more likely to be laid off (Leigh, 1985; Askildsen et al., 2005). A different interpretation is that major changes in the rules of the sickness insurance

³ All employees in Norway who have been with the same employer for at least four weeks are covered by sickness insurance. Once this requirement is fulfilled, daily cash benefits in the case of sickness equal 100 per cent of pensionable income and are paid from the first day of sickness for a period of 260 days.

system tend to coincide in time with economic recessions. As Henrekson and Persson (2004) indicates, the deep Swedish recession at the beginning of the 1990s, which caused unemployment to rise sharply and public-sector finances to deteriorate, forced the government to cut down on various welfare schemes, including sickness insurance.

Likewise, it has been argued that workplace accident rates also exhibit a pro-cyclical nature. There are two explanations to this fact. Terrés de Ercilla et al. (2004) and Martín-Román (2006) argue that during economic upturns workers increase their effort level, which makes them less cautious regarding job safety. This fact would increase the total number of accidents as well as the incidence. On the other hand, Boone and van Ours (2006) argue that during the upturns workers are more likely to report job accidents because it would be easier to find a new job if they are fired for absenteeism. This increases reporting rates, and therefore incidence indexes.

8. Labour demand considerations: costs to employers

So far, this review has interpreted sickness absence exclusively from a labour supply perspective. However, just focusing on the behaviour of workers is only half the story and, therefore, the exclusion of labour demand considerations would lead to a poorly specified model. Indeed, as with all economic behaviour, it is the mutual interaction of supply and demand that is relevant. Nevertheless, to our knowledge, there is only one study that analyses work absence within a model that combines labour supply and labour demand, namely Lusinyan and Bonato (2007). Thus, following these authors, labour demand aspects could be incorporated in the analysis.

So far, we have taken into consideration the worker's maximization problem given by:

$$\max U = U(x, l) \quad (6)$$

subject to:

$$x = R + P(l^a, v)w(l^c - \beta l^a) + [1 - P(l^a, v)][B + G] \quad (7)$$

$$T = l^c + l^a + h \quad (8)$$

where x is a vector of consumption goods; l is leisure time; R is non-labour income; w is real wage; l^c is contractual hours of work; l^a is absence hours due to sickness; β is the inverse of the sickness benefit replacement rate (ratio of sick pay to wage) such that $\beta \in [0, 1]$, with $\beta = 0$ corresponding to the case when sickness absence is fully compensated (100 per cent replacement rate) and $\beta = 1$ when there is no compensation. B is unemployment benefits; G is firing-related entitlements and $P(l^a, v)$ is the probability of keeping the job –i.e. the inverse of the penalty for being absent. $P(l^a, v)$ is a function of absence behaviour (l^a) and some business cycle characteristics (v).

Further, the firm chooses its desired input of hours of work maximising its profit function given by:

$$\Pi = Y - P(l^a, v)w(l^c - \theta\beta l^a) - [1 - P(l^a, v)]G \quad (9)$$

where

$$Y = Ak^{1-\alpha}(l^c - l^a)^\alpha \quad (10)$$

is the production function, which depends on actual hours worked, $(l^c - l^a)$, with the labour share being α . Moreover, θ indicates if the sick pay is paid by the firm ($\theta = 1$) or by the government ($\theta = 1/\beta$). From the first-order conditions of the optimization problems in equations (6)-(8) and (9)-(10) with respect to the absence hours (l^a), the optimal wages for the worker and the firm are respectively:

$$w^W = \frac{P_{l^a}(B+G) - \frac{U_l}{U_x}}{P_{l^a}(l^c - \beta l^a) - P\theta\beta} \quad (11)$$

and

$$w^F = \frac{Y_a - P_{l^a}G}{P_{l^a}(l^c - \theta\beta l^a) - P\theta\beta} \quad (12)$$

In terms of the above model, the market mechanism will determine not only the observed absence, but also the system of absence control employed by the firm. As a result, observed variations in absence may be due to the behaviour of both the firm's management, as well as its employees. Thus, a firm that faces high absence rates will likely respond with control mechanisms such as monitoring, fines, threats of dismissal, or increasing contractual flexibility. Likewise, if absence is clearly connected with the working environment, the employer may attempt to improve it. In fact, a number of studies show that firms that take a more proactive stance toward the development of comprehensive workplace risk prevention are more likely to have lower absence rates due to workplace accidents or occupational diseases (see *inter alia* Viscussì, 1979; McCaffrey, 1983; Curington, 1986; Gray and Scholz, 1993)

There is extensive literature providing empirical evidence for the significance of contract type for absence decisions. Indeed, a number of studies have focused on the effect of temporary contracts on job accidents. Amuedo-Dorantes (2002) and Hernanz and Toharia (2006) find that fixed-term workers show a greater probability of having an accident due to the type of job they are undertaking, but not due to the fixed-term characteristic of their contract. Guadalupe (2003), on the contrary, finds that there exists a systematic difference between the accident rates of temporary and permanent workers which is not due to a composition effect. Finally, García-Serrano et al. (2010) find that after controlling for a set of personal and professional characteristics, those workers working through a Temporary Help Agency (THAs) show lower probabilities of suffering from a severe accident, and exhibit a smaller duration of absence compared to their counterparts on non-THA temporary and open-ended contracts.

9. Moving forward

Until very recently, sickness absence has received less attention than other areas of labour economics. However, there has been an upsurge of research both theoretical and empirical on the factors determining worker absenteeism. Given the socioeconomic costs of sickness absence, further research in this area is expected in the near future.

As this chapter has shown, the traditional approach to explaining absenteeism is based on the conventional income-leisure choice model, where the difference between the number of contractual working hours and the number of desired working hours by workers at the going wages provides the motivation for absence. This traditional approach interprets sickness absence exclusively from a labour supply perspective. However, the exclusion of labour demand considerations leads to a poorly specified model. Indeed, the costlier absence is to employers, the more likely they are to respond. Though some progress has been made in incorporating demand side aspects to the analysis, this approach is still somewhat underdeveloped. Labour market institutions also play a crucial role: job security provisions and unemployment insurance reduce the expected cost of absenteeism to workers either by making it more difficult to sanction or by reducing the effective cost of the sanction. Only a reduced number of recently published studies look at the impact of the institutional framework on sickness absenteeism behaviour. Therefore, there are many avenues of research on worker absenteeism left to explore.

This thesis aims to contribute to this growing body of knowledge on sickness absenteeism. As Section 2 of this chapter illustrated, the economic literature has stressed that labour supply factors such as gender and age are important in determining sickness absence, but, according to the empirical evidence, the effect of these two variables is uncertain. Chapter 2 and 3 aim to shed light on this debate by providing empirical evidence regarding the effect of gender and age, respectively, on sickness absence from work. In particular, Chapter 2 focuses on explaining gender differences in the incidence of sickness absence, as well as in the duration of sick leave, while Chapter 3 examines the impact of worker's age on the consequences of occupational injuries. Furthermore, Sections 6, 7 and 8 of this chapter have described how demand side aspects, macroeconomic factors and labour market institutions also affect sickness absence. In this vein, Chapter 4 examines the contribution of socioeconomic factors and government intervention in occupational health and safety (OSH) in giving rise to spatial differences in the incidence of workplace accidents.

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CHAPTER 2

Sickness absence from work in Spain: Are there gender differences?

1. Introduction

Like most European countries, Spain's public sickness insurance scheme is a major component of its social security system. In 2012, expenditure on public sickness benefits amounted to around 6 billion Euros, which accounted for 0.55 per cent of GDP⁴. But the cost of sick leave is larger than the amount paid to the sick worker while he or she is absent from work; production losses and health care outlays are also socioeconomic costs of sickness absence. Furthermore, we should bear in mind that some temporary sick or injured workers could become permanently disabled and hence leave the labour force. But surprisingly and despite its relevance for public policy, there appears to be a dearth of empirical consensus regarding the determinants of incidence and duration of absence from work due to illness.

This chapter aims to shed light on gender differences in the incidence and duration of sickness absence. Previous studies have shown that, on average, women are more prone to be absent from work than men (Leigh, 1983; Paringer, 1983; Vistnes, 1997; Ichino and Moretti, 2009). One of the most plausible explanations for this fact is that women to a greater extent than men are exposed to the "double burden" of combining paid work with family responsibilities (Mastekaasa, 2000). However, there is not agreement in the literature on how this double burden—in particular, the presence of children in the household—affects the incidence and duration of sickness absence among women. While some studies found that the presence of children increased female absenteeism (Leigh, 1983; Scott and McClellan, 1990; Vistnes, 1997), others found that women with dependants were less likely to be absent (Paringer, 1983; VandenHeuvel and Wooden, 1995).

In this chapter we take another look at gender differences in absenteeism, but we also add to the literature in several respects. First, unlike many previous studies we have distinguished between sickness absence due to common illness or non-work-related injury and occupational disease or work-related injury. Second, the empirical analysis in this study uses data on absence spells from work that are strictly certified by a physician, based on evidence of injury or illness. Other important advantages of the present data include: 1) the dataset is designed to be representative of the whole universe of workers and employers in Spain; 2) the database generates matched employer-employee information, so the analysis makes use of variables related to both the worker's (labour supply) and the employer's (labour demand) characteristics; 3) the matched

⁴ In 2006, the year for which this study was carried out, expenditure on public sickness benefits amounted to around 8 billion Euros, which accounted for 0.8 per cent of GDP.

nature of the data and the fact that, for each individual in the sample, only one spell of employment with a specific employer is considered allows us to take into account unobserved firm heterogeneity; and 4) the longitudinal nature of the data (individuals are followed from the beginning of the employment relationship until the first sick leave spell starts and ends) allows us to take into account unobserved worker heterogeneity.

We examine microdata from a sample of 294,316 individuals obtained from the 2006 wave of the Continuous Sample of Working Histories (CSWH), which was expanded with information on all sick leave spells covered by the Spanish sickness insurance scheme for the period 2005-2006. Thus, our research on the topic has been encouraged by the availability of data that take into account institutional settings and include labour supply and demand variables.

The empirical analysis in this chapter is divided in two parts. First, we use a competing risk model approach to measure the time from the start of an employment contract to the first sickness absence spell in relation to each worker's characteristics, i.e. we model the incidence of worker absence spells. Second, we estimate a single event duration model to examine how the worker's characteristics affect the time to return to activity after a period of sick leave. We find that the presence of children under 3 years old in the household is one of the most important variables explaining the differences in sickness absence between women and men. Indeed, when there are children under 3 years in the household, the probability of sick leave due to common illness or injury for open-ended workers aged 25 to 39 within first 400 days of employment is roughly 10 per cent for men, but increases to 15 per cent in the case of women. Furthermore, we find that 8 per cent of the open-ended male workers aged 25 to 39 with children less than 3 years old return to work after a sick leave spell due to common illness or injury before the 5th day, while this percentage decreases to less than 6 per cent in the case of women.

The chapter is organized as follows. In Section 2, we briefly describe the statutory sickness insurance system in Spain. Section 3 presents the data and how the sample was selected. Section 4 presents empirical evidence on gender differences in the probability of sickness absence. Finally, Section 5 examines gender differences in the time to return to work after a period of sick leave. Conclusions are presented in Section 6.

2. The Spanish sickness insurance scheme

Spain has a compulsory sickness insurance scheme, which replaces lost earnings resulting from temporary health problems that prevented the insured worker from doing his or her regular job. The Spanish sickness insurance distinguishes between common disease or non-work-related injury and work-related injury or occupational disease. Indeed, sickness benefit in the case of non-work-related illness or accident and occupational sickness or injury differ with respect to their requirements; the recognition and duration of the right to sickness benefit; the entity in charge of the payment; and the amount of the compensation. Figure 2.1 summarizes the main characteristics of the Spanish compulsory sickness insurance and distinguishes between common diseases or non-work-related injury and work-related injury or occupational disease.

Figure 2.1 Main characteristics of the Spanish compulsory sickness insurance scheme

Common illness or non-work-related injury															
Days of sick leave	1	2	3	4	5	6	7	...	15	16	...	20	21	...	365
Who pays?	Employer									INSS or MATEPSS					
Amount paid	60% of worker's daily contribution base												75%		
Medical confirmation report	X			(Every 7 days from the 4th)											

Work-related injury or occupational disease															
Days of sick leave	1	2	3	4	5	6	7	...	15	16	...	20	21	...	365
Who pays?	INSS or MATEPSS														
Amount paid	75% of worker's daily contribution base														
Medical confirmation report							X		(Every 7 days from the 7th)						

Note: According to its initials in Spanish, INSS is the National Institute of the Social Security and MATEPSS is the Social Security Mutual Society for Work-Related Injuries and Occupational Diseases.

Source: Own elaboration based on Ministry of Labour and Social Security.

In Spain, all workers are entitled to benefits during sickness. Although no prior contribution periods are required in the case of occupational sickness or accident (regardless of being work-related or not), the worker must have contributed for at least 180 days within the previous 5 years in the case of common diseases.

According to the Spanish system, absence from work due to sickness or injury requires certification by a physician. If an employee falls ill due to a common illness or non-work-related accident, the certificate needs to be reissued the 4th day of sick leave and every 7 days thereafter. On the other hand, in the case of occupational disease or injury, a medical confirmation report is required as of the 7th day in a spell and every 7 days thereafter.

Benefit is calculated as a percentage of the worker's daily contribution base in the month prior to the start date of sick leave. People who are sick due to a common illness or non-work-related accident are entitled to 60 per cent of the daily contribution base from day 4 to day 20, inclusive, and to 75 per cent from the 21st day on. During the first 3 days, the worker is not entitled to sickness insurance payments or salary, unless a relevant collective agreement establishes a workers' compensation or equivalent. In the case of work-related injury or occupational disease, the compensation level is 75 per cent from the day after the worker is on leave from work and throughout the sickness spell⁵, and is paid the first day by the employer as a normal working day.

⁵ In the case of work-related injury or occupational disease, the replacement level is calculated as a percentage of the worker's daily contribution base for professional contingencies in the previous month and the daily contributions for overtime in the last 12 months.

In the case of common illness or non-work-related accident, the employer is required to pay from day 4 to day 15, both inclusive; beyond that time, the National Institute of the Social Security (i.e., the public health insurance system) compensates absences for up to a year. If the cause of sickness is a work-related accident or an occupational injury, sickness compensation is provided by National Institute of the Social Security (INSS, according to its initials in Spanish)⁶ for a maximum period of one year. Thus, the maximum period of duration of sick leave is 365 days, regardless of the cause. This period could be extended by 180 days when it is believed that the worker could be discharged from medical care during this time. Nevertheless, when the sick leave ends at the absolute maximum period of 545 days, the condition of the disabled individual must be examined within a maximum period of 3 months in order to determine their degree of permanent disability. In any case, the worker must return to work the day after medical discharge.

It is important to note that some employees are subject to more generous sick pay rules as per collective bargaining agreements. For example, some workers are covered by collective bargaining contracts that guarantee them sick pay of 100 per cent of their wage during the first three days in the case of a non-work-related illness or injury. Moreover, there are special schemes for public-sector workers, domestic employees, self-employed workers, coal miners, and maritime workers.

In the context of this study, it is important to mention that there are other social security provisions and benefits related to sick leave, namely maternity leave, risk pregnancy benefits, and risk during breastfeeding benefits. In Spain, women who have covered a minimum contribution period⁷ are entitled to paid maternity leave. In general, the maternity leave period will have an uninterrupted duration of 16 weeks, of which 6 weeks must be taken immediately after the child's birth. Maternity benefits are 100 per cent of the worker's daily contribution base. Likewise, women who are unable to work due to either risk during pregnancy or when breastfeeding a child under 9 months old are entitled to 100 per cent of the worker's daily contribution base from the first day in the spell. In both cases, there is not required minimum contribution period.

Our data on sick leave do not include information on either of these other situations. Since a woman who is unable to work may choose the best way to protect herself and the child, there may be a substitution among schemes in certain cases. This is important to bear in mind when interpreting the results of this study since the existence of these three schemes mentioned above reduces the probability that many of our recorded absence spells are directly related to child births.

⁶ Actually, payment is the responsibility of the National Institute of the Social Security or the Social Security Mutual Society for Work-Related Injuries and Occupational Diseases (MATEPSS, according to its initials in Spanish), depending on which is the competent Managing Body.

⁷ The minimum contribution period depends on worker's age. Thus, there is not required minimum contribution period for workers aged 21 or less. Nevertheless, workers aged 21 to 26 must have contributed for at least 90 days within the previous 7 years or 180 days over the entire working life. Finally, workers aged 27 or more must have contributed for at least 180 days within the previous 7 years or 360 days over the entire working life.

3. Data

The individual data used in this study are obtained from the 2006 wave of the Continuous Sample of Working Histories (CSWH, *Muestra Continua de Vidas Laborales* in Spanish), which contains a sample of approximately 4 per cent of all those individuals who have been affiliated to the Spanish Social Security during the reference year (1,170,895 observations in 2006). The CSWH consists of data extracted from administrative records from the Social Security, the Municipal Registry of Inhabitants and the Spanish Tax Agency⁸.

The CSWH provides information on personal characteristics of each individual in the sample – such as gender, age, nationality and place of birth, as well as some additional information about the composition of his or her household, such as the number of children and their dates of birth. Moreover, the CSWH also contains information related to the professional characteristics of the individual, such as length of the employment period, type of contract, occupation, type of working day (part-time versus full-time) and monthly earnings. Finally, the CSWH provides information on employer’s characteristics, such as industry, sector (public versus private), and the number of workers in the firm. Therefore, the CSWH provides information on aspects of both labour supply and labour demand.

To be able to observe the worker’s sick leave behaviour, the database was expanded with sick leave spell data for the period 2005-2006 from administrative records from Spanish Social Security System. Thus, this unique dataset contains information about all sick leave spells covered by the Spanish sickness insurance scheme. For each individual in the sample, we know the number of sick leave spells, the dates of entry and exit in sick leave, the type of sickness or injury (common or non-work-related versus occupational or work-related) and the entity responsible for the payment (National Institute of the Social Security or the Social Security Mutual Society for Work-Related Injuries and Occupational Diseases).

Regarding the sample selection we perform for our analysis, we focus, for each individual, on the longest employment spell that started in 2005 within the Social Security General Regime. Focusing on a single spell of employment with a specific firm allows us to reduce the heterogeneity associated with the labour demand side. More importantly, however, job duration plays a crucial role in identifying the factors associated with the incidence of sick leave. Self-employed workers are excluded from the sample because they are likely to have different incentives and possibilities to use (or not use) sick leave compensated by the Social Security system. The final sample consists of 294,316 individuals (161,218 male and 133,098 female), where 58,055 of them experienced at least one sickness absence spell during 2005-2006.

Individuals are followed from their entry into employment until their first sick leave event, the end of the contract, or upon censoring (right censoring occurs when the study period ends on the last of December 2006.) The duration of the spells is measured in days. Background variables such as gender, age and place of birth, as well as information about the composition of the household are registered at the beginning of the spell. Spell characteristics are reported in Table

⁸ For a more detailed description about CSWH, see Durán (2007).

2.1. We see that out of 294,316 individuals, 43,017 experienced a sick leave due to common illness or non-work-related injury (14.6 per cent), 15,038 experienced a sick leave due to occupational illness or work-related injury (5.1 per cent), 180,972 experienced an exit due to the end of their contract (61.5 per cent) and the remaining 55,289 (18.8 per cent) were lost to follow-up before any sick leave or end of contract. As Table 2.1 shows, 17.3 per cent of the spells in sick leave due to non-work-related illness or accident last less than 4 days, 55.2 per cent terminate in the following 26 days, and 27.5 per cent last more than 30 days. In the case of sick leave spells due to occupational disease or injury, 8.3 per cent last less than 4 days, 73.3 per cent end from day 4 to day 30, and 18.3 per cent last more than a month. However, there are differences across genders. Indeed, women have longer sick leave spells than men. In particular, the average number of non-working days due to common illness or non-work-related injury among women is 6.3 days higher than for men. Regarding occupational diseases or injuries, the average duration of the sick leave is also longer for women, but the difference is only in 0.8 days.

Table 2.1 Spell characteristics

	Total	Women	Men
Employment spell characteristics:			
Mean duration (days)	249.3	239.9	257.0
Proportion of spells ending in:			
Sick leave due to common illness or non-work-related injury	14.6%	16.5%	13.0%
Sick leave due to occupational illness or work-related injury	5.1%	2.7%	7.1%
End of contract	61.5%	63.3%	60.0%
Censored	18.8%	17.4%	19.9%
Sick leave spell characteristics:			
<i>Sick leave due to common illness or non-work-related injury</i>			
Mean duration (days)	44.0	47.1	40.8
Proportion of spells lasting:			
Less than 4 days	17.3%	16.9%	17.7%
From 4 to 30 days	55.2%	53.4%	57.2%
More than 30 days	27.5%	29.7%	25.1%
Censored	0.17%	0.17%	0.16%
<i>Sick leave due to occupational illness or work-related injury</i>			
Mean duration (days)	24.3	24.9	24.1
Proportion of spells lasting:			
Less than 4 days	8.3%	5.3%	9.3%
From 4 to 30 days	73.3%	74.5%	73.0%
More than 30 days	18.3%	20.2%	17.7%
Censored	0.03%	0.00%	0.04%

Source: Own elaboration based on CSWH.

4. Does being a woman increase the risk of sickness absence?

4.1. Empirical strategy

We are interested in measuring the time from the beginning of a job to the first spell of sickness absence and the type of sickness absence in relation to factors, such as being a woman. However, instead of a sick leave spell, we could observe the end of the contract. Thus, the end of the contract acts as a competing event that impedes the occurrence of the event of interest, i.e. sickness absence. This must not be confused with the usual right-censoring found in survival data, since, while subjects lost to follow-up are still at risk of sick leave, the end of a contract is a permanent condition that prevents future sick leave spells.

Another important feature of our empirical strategy is the distinction between common disease or non-work-related injury and occupational illness or work-related injury. We explore empirically the different causes of sick leave in a dependent competing risk framework. When analysing the probability of sick leave due to common illness or non-work-related accident, the end of contract and sick leave due to occupational disease or injury will act as competing events. By contrast, when the probability of failure towards sick leave due to occupational disease or injury is the event of interest, end of contract and sick leave due to common illness or injury will be treated as competing events.

In our analysis, we are interested in estimating the cumulative incidence function for failure from each cause conditional on the covariates. In a competing risk setting⁹, cumulative incidence for a particular cause of failure is the probability of experiencing this cause of failure until time t , in the presence of all the other possible causes. Thus, the cumulative incidence for the failure type k is estimated as follows:

$$F_k(t) = \sum_{i|t_i \leq t} \lambda_k(t_i) S(t_{i-1}) \quad (1)$$

where $\lambda_k(t_i)$ is the cause-specific hazard function defined as:

$$\lambda_k(t_i) = \frac{d_{ki}}{n_i} \quad (2)$$

i.e., the proportion of subjects at risk that fail due to cause k ; and $S(t_{i-1})$ is the survival function defined as:

$$S(t) = \prod_{i|t_i \leq t} \left(1 - \sum_{k=1}^K \frac{d_{ki}}{n_i}\right) = \prod_{i|t_i \leq t} (1 - \sum_{k=1}^K \lambda_k(t_i)) \quad (3)$$

i.e., the probability of being event-free at t_i .

⁹ The Kaplan-Meier (KM) method has been a widely used tool for estimating cumulative incidence function. However, as Gooley et al. (1999) stressed, in a competing risk framework, the KM estimates are biased. Indeed, KM overestimates the true failure probability because it assumes that all events are independent and hence, censors events other than the event of interest.

The proportional hazards model based on the method of Fine and Gray (1999) provides a useful alternative to Cox regression (Cox, 1972) for survival data in the presence of competing risks. This method makes use of the hazard of subdistribution, which is a function of the cumulative incidence for the corresponding cause of failure and can be defined as:

$$\lambda_k(t, X) = \lim_{\Delta t \rightarrow 0} \frac{\text{Prob}(t \leq T < t + \Delta t, \varepsilon = k | T \geq t \cup (T \leq t \cap \varepsilon \neq j), X)}{\Delta t} = \frac{\frac{dF_k(t, X)}{dt}}{(1 - F_k(t, X))} = -\frac{d \log(1 - F_k(t, X))}{dt} \quad (4)$$

where T is the failure time; $\varepsilon \in (1, \dots, K)$ is the cause of failure (for which the K causes are assumed to be observable) and X is a $p \times 1$ bounded time-independent covariate vector.

This hazard function permits the calculation of the conditional probability that a subject with covariates X fails in the interval $(t + \Delta t)$ due to cause k -th, given that the subject was at risk just before time t_i ; but also conditional to subjects who have failed from other causes before time t , who are not really at risk at that time.

Furthermore, Fine and Gray (1999) imposed a proportional hazards assumption on the subdistribution hazards:

$$\bar{\lambda}_k(t|X) = \bar{\lambda}_{k,0}(t) \exp\{X^T(t)\beta_0\} \quad (5)$$

Therefore, the cumulative incidence function has the form:

$$F_k(t|X) = 1 - \exp\left[-\int_0^t \lambda_{k,0}(s) \exp\{X^T(s)\beta_0\} ds\right] \quad (6)$$

According to Fine and Gray (1999), the partial likelihood function is:

$$\mathcal{L}(\beta) = \prod_{i=1}^n \left[\frac{\lambda_{k,0}(T_i) \exp\{X_i^T(T_i)\beta\} \Delta T_i}{\sum_{j \in R_i} \lambda_{k,0}(T_i) \exp\{X_j^T(T_i)\beta\} \Delta T_i} \right]^{I(\varepsilon_i=i)} = \prod_{i=1}^n \left[\frac{\exp\{X_i^T(T_i)\beta\}}{\sum_{j \in R_i} \exp\{X_j^T(T_i)\beta\}} \right]^{I(\varepsilon_i=i)} \quad (7)$$

and the logarithm of partial likelihood is

$$\log\{\mathcal{L}(\beta)\} = \sum_{i=1}^n I(\varepsilon_i = i) \times (X_i^T(T_i)\beta - \log[\sum_{j \in R_i} \exp\{X_j^T(T_i)\beta\}]) \quad (8)$$

We obtain $\hat{\beta}$ by maximising $\log\{\mathcal{L}(\beta)\}$.

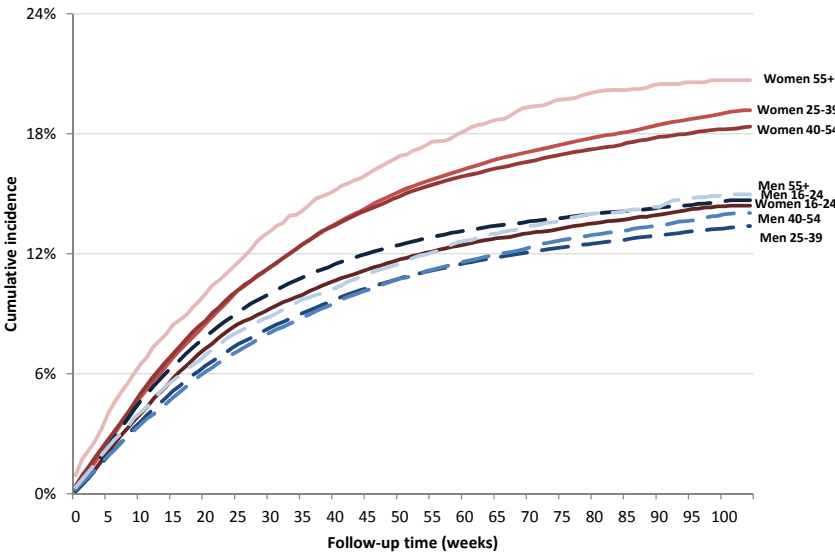
4.2. Descriptive analysis

The descriptive analysis shows clear patterns in the data. A first glance at the data can be made using cumulative incidence curves of sickness absence. Figure 2.2 illustrates that there are strong differences in the cumulative incidences of each type of sickness absence. Indeed, the probability of sick leave due to common illness or non-work-related injury is always higher than that of sick leave due to occupational disease or injury. Looking at the graph, we immediately notice that being a woman increases the odds of sick leave due to common illness or non-work-related injury, but that men have a higher incidence of sickness absence due to occupational disease or

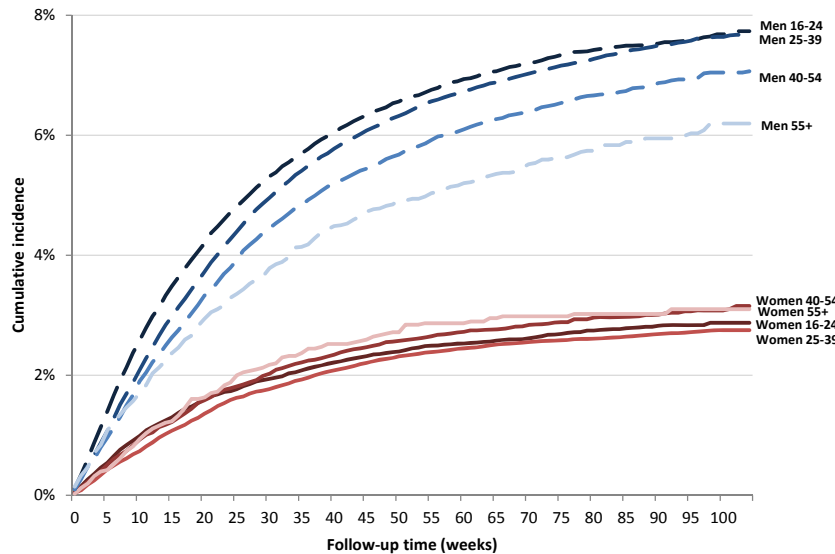
injury. Moreover, age also seems to play a crucial role explaining sickness absence. In fact, in Figure 2.2-Panel A, we observe that women older than 55 years have the highest incidence of sickness absence due to common illness or injury, followed by women aged 25 to 39. The high incidence of sick leave due to common illness or injury among women aged 25 to 39 may likely be due to the fact that this group accounts for most of the women with family responsibilities. On the other hand, age has the opposite effect on sick leave due to occupational disease or injury. Indeed, the youngest men (16-39) have the highest incidence of this type of sickness absence.

Figure 2.2 Cumulative incidence curves of sickness absence by cause, gender and age

Panel A. Sickness absence due to common illness or non-work-related injury



Panel B. Sickness absence due to occupational illness or work-related injury

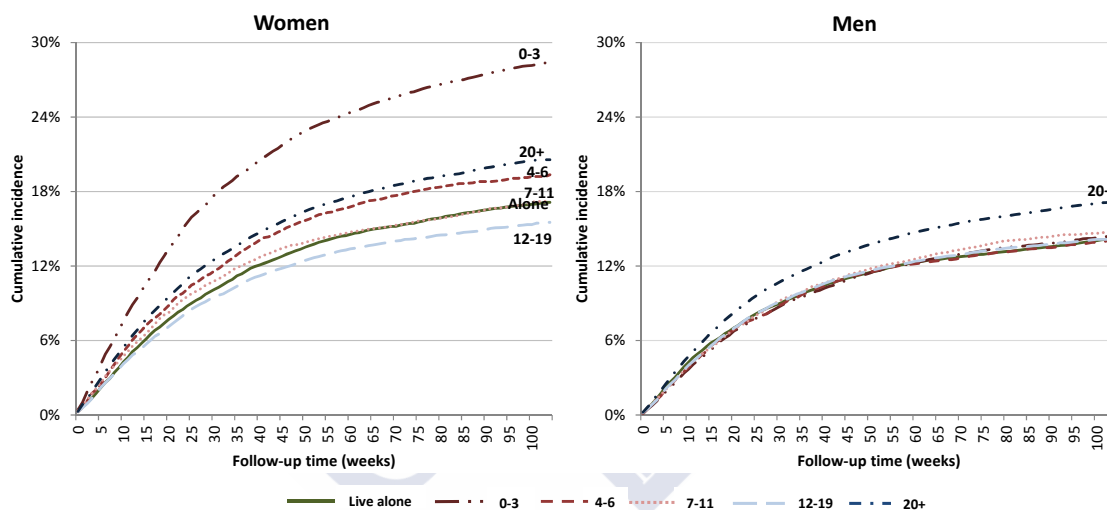


Source: Own elaboration based on CSWH.

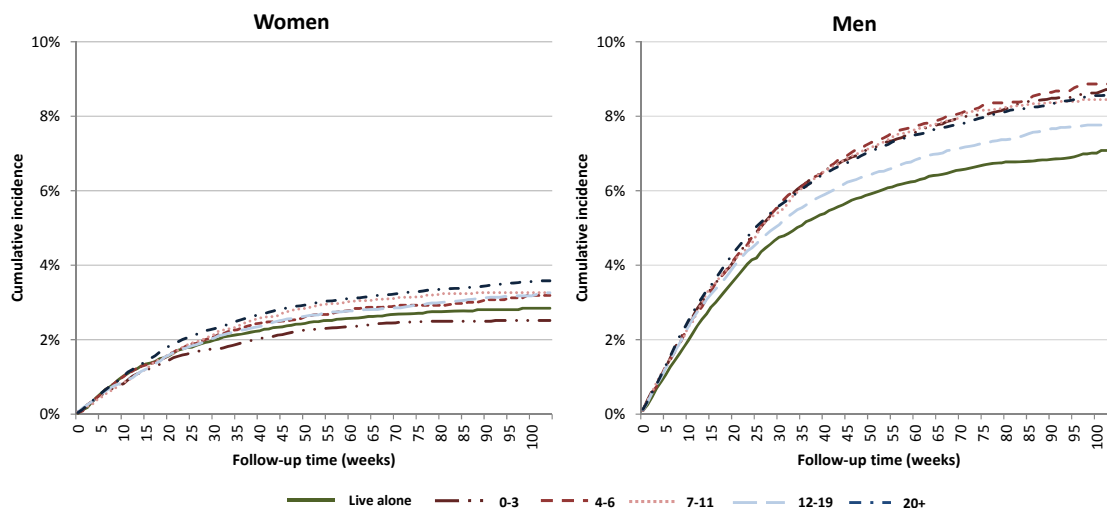
Figure 2.3 depicts how the incidence of sick leave varies according to the age of the youngest person in the household. In fact, the presence of children under 3 years old is strongly correlated with female sick leave due to common disease or non-work-related injury. The relationship appears to be the opposite for the incidence of sick leave of men, namely, the presence of younger children reduces the probability of absence from work due to common illness or non-work-related injury. In fact, among men, those who live in households where the youngest person is older than 20 have the highest probability of sick leave due to common disease or non-work-related injury (Figure 2.3-Panel A). By contrast, for both women and men, the presence of children under 3 years old does not seem to have an impact on the incidence of sick leave due to occupational sickness or injury (Figure 2.3-Panel B).

Figure 2.3 Cumulative incidence curves of sickness absence by cause, gender and group of age of the youngest person in the household

Panel A. Sickness absence due to common illness or non-work-related injury



Panel B. Sickness absence due to occupational illness or work-related injury

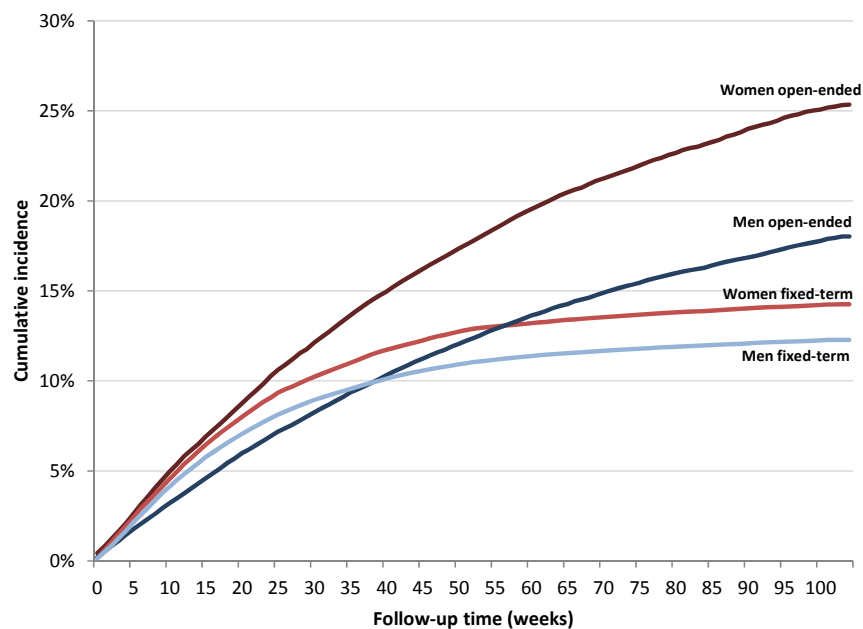


Source: Own elaboration based on CSWH.

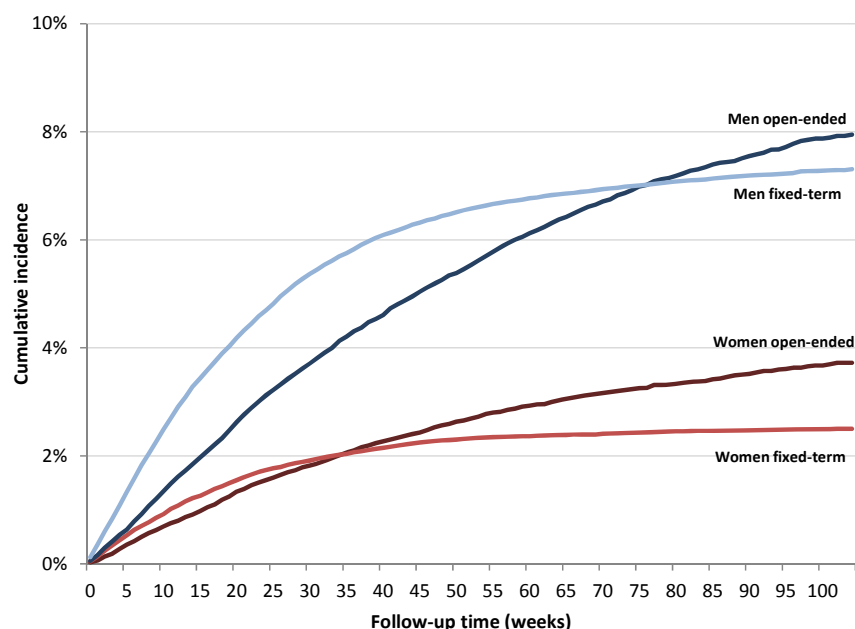
Figure 2.4 shows that, until a certain time of job tenure, the probability of sickness absence is higher in the case of fixed-term contracts and, from that moment on, the likelihood of sickness absence is greater in workers with open-ended contracts. After a year on the job, the probability of sickness absence of a fixed-term employee does not increase much because most temporary workers do not preserve their job under a fixed-term contract over a year. The exception is female sickness absence due to common illness or injury. In this case, we observe that the probability of absence is clearly higher in women with an open-ended contract than in the case of their counterparts with a fixed-term contract, regardless of the time that the worker has been in the job. This indicates that accounting for the type of contract is crucial when analysing the incidence of sick leave in Spain. For this reason, as we explain below, we estimate the cumulative incidence function according to the type of contract held by the worker. Indeed, the relationship between sickness absence and the type of contract is a question that extends beyond the scope of this study, but it does appear to deserve a study in its own right.

Figure 2.4 Cumulative incidence curves of sickness absence by cause, gender and type of contract

Panel A. Sickness absence due to common illness or non-work-related injury



Panel B. Sickness absence due to occupational illness or work-related injury



Source: Own elaboration based on CSWH.

4.3. Econometric analysis

This section summarizes the main results of the econometric analysis carried out. An aggregate analysis is useful for the knowledge of general determinants of sickness absence, but it could hide particularities of determined groups. For this reason, we have estimated the model for different classifications. First, we have split up the workers between fixed-term and open-ended employees. Secondly, for each group, we have made the regressions for the total sample, as well as separately for male and female workers. As we show below, the outcomes confirm the relevance of these differentiations and therefore permit us to know the particular characteristics associated with the highest probability of occurrence of sickness absence.

The explanatory variables in the empirical analysis include several individual's personal and job characteristics:

■ Gender and age

As discussed in Chapter 1, the economic literature has stressed that variables such as gender and age are important in determining sickness absence. However, while a common finding in many of the studies on sickness absence is that females exhibit higher absence rates than males (Leigh, 1983; Paringer, 1983; Vistnes, 1997), there is a debate in the literature about the effect of age on absenteeism. Indeed, some studies suggest that sickness absence increases with age (Paringer, 1983; Dionne and Dostie, 2007) and others, in contrast, find a negative relationship between both variables (Allen, 1981).

To isolate the importance of worker's gender and age as factors to explain sickness absence, we consider the interaction of both variables in the estimation of models for the total sample. The interactions are captured with the inclusion of seven dummy variables: women aged 16-24, women aged 25-39, women aged 40-54, women aged 55 or more, men aged 16-24, men aged 40-54 and men aged 55 or more. The omitted category for comparisons is men aged 25-39.

Nevertheless, when we do the estimation for both women and men separately, we introduce nine dummy variables of group of age: aged 16-19, aged 20-24, aged 25-29, aged 30-34, aged 40-44, aged 45-49, aged 50-54, aged 55-59 and aged 60-64. The omitted category in this case is aged 35-39¹⁰.

■ *Family responsibilities*

The aim of this research is to study differences in sickness absence across genders. For this reason, it is important to have a measure of the household composition of the worker. We use as measure of family responsibilities the age of the youngest person who lives with the worker. We include five binary variables: workers who live alone, workers whose youngest household member is under 3 years old, workers whose youngest household member is aged 4 to 6, workers whose youngest household member is aged 7 to 11, and workers whose youngest household member is aged 12 to 19. The comparison category is those workers whose youngest cohabitant is aged 20 or more.

With the aim of capturing possible differences between male and female in sickness absence which are linked directly with the presence of children in the household, we create the next two dummy variables: males aged 25-39 whose youngest household member is under 3 years old and females aged 25-39 whose youngest household member is under 3 years old.

■ *Health*

A deterioration in an individual's overall health status is expected to increase the probability of sickness absence. Indeed, the estimation of those authors who introduce health variables in their absence models (Allen, 1981; Leigh, 1983; Paringer, 1983) show that these variables have usually been the most important variables in explaining absenteeism. We use the level of disability of the worker as a proxy of the health status. We have added two dummy variables: people with a level of disability between 33 and 64 per cent and people with a level of disability of 65 per cent or more. The comparison category is those workers without a disability.

■ *Social Security contribution group*

In our database, we do not have available information about education level and occupation. Rather, we use the Social Security contribution group as a proxy for both. The contribution group is created on the basis of professional category and the education level attained. We have

¹⁰ While we introduce nine dummy variables of group of age when we do the estimation for both women and men separately, we only take into account four groups of age when we estimate the model for the total sample. The reason for consider fewer groups of age in the estimation for the total sample is that the interaction of gender and age divided in nine intervals would lead to some categories with only a few number of observations and, therefore, with a high probability of being insignificant.

created ten dummy variables, one for each one of the Social Security contribution groups: engineers and other university graduates, engineering technicians and other skilled workers, administrative chiefs and managers, assistants and other semi-skilled workers, skilled clerks, assistant clerks, skilled labourers, semi-skilled labourers, and unskilled labourers. The omitted category for comparison is skilled clerks.

■ *Firm size*

With regard to how the firm size influences sickness absence, Vistnes (1997) suggests that workers in larger firms feel a sense of alienation and may be more likely to be absent from work than workers in small firms. There are more personal employer-employee relationships in a small business that could promote a higher identification with the goals of the company and could thereby reduce the workers' absenteeism. However, the impact of firm size on sickness absence due to occupational diseases or work-related injuries could be completely different. Small companies usually have a lower number of resources to use in training and labour security. On the other hand, the law establishes how employees have to participate in the decisions of prevention of workplace risks. This legislation does not include firms with less than six employees. We have created six dummy variables to describe the size of the company: 0-50 employees, 51-100 employees, 101-300 employees, 301-600 employees, 601-1,000 employees and more than 5,000 employees. The group of reference is 1,001-5,000 employees.

■ *Earnings*¹¹

As indicated in Chapter 1, the impact of wages on absenteeism is ambiguous due to the income and substitution effects. When the paid sick leave represents 100 per cent of the wage, the substitution effect disappears and, so, the effect of wage on sick leave is positive. However, in the Spanish system the paid sick leave does not represent 100 per cent of the wage (as described in Section 2). In order to study whether the income or substitution effect has a higher impact, we have introduced a dummy variable for each one of the five salary quintiles with quintile 3 as the omitted category.

■ *Working hours*

Empirical work has stressed the crucial role played by working time flexibility – measured, for instance, by the share of part-time employment – in the determination of absence decisions. For example, Dionne and Dostie (2007) found that workers who worked on a reduced work week had a lower incidence of absenteeism. Moreover, when the number of weekly hours of work is high, the probability of work and family conflict will be higher. For this reason, it is necessary to take into account the differences between workers in the number of working hours. So, when we study the probability of sick leave appears, we introduce a binary variable that is coded 1 if the worker has part-time work.

■ *Labour-market experience*

¹¹ The variable earnings used in this analysis is the workers' contribution base, which generally corresponds to real monthly wages without overtime.

There are two sets of variables to account for the previous experience of the worker. To study sick leave, the first set of variables was obtained by dividing actual experience (days worked) by potential experience (days since the date of first job) up to the first day of the job in question. There are three qualitative cases: 1) The job studied is the first one (the ratio of actual to potential experience does not apply); 2) the job that precedes the one studied is too short to be considered but is close to the one studied; and 3) the prior job is short and ended more than three years before the one studied. Five additional cases are based on intervals of the percentage calculated as indicated: 4) 1-25; 5) 26-50; 6) 51-75; 7) 76-100; 8) 101-200+. The omitted case is 76-100.

The second set is simply the number of contracts that the worker had held before the job in our analysis: 0-10 (omitted); 11-20; and 21 or more.

We have also introduced a set of control variables such as worker's place of birth, the region where the worker lives, the economic activity and the legal form of the company, and the day and month of entry into employment.

Table 2.2 presents the competing risk regression results separated by type of contract and cause of sick leave. The values in the table represent the change in the odds of being absent from work due to sickness for a one-unit change in the explanatory variable. A value below 1 means that the likelihood of sickness absence is lower than that of a worker in the comparison group with all other factors held constant. A value above 1 means that the likelihood of sickness absence of workers who fall into that category is higher than those in the comparison group with all other factors held constant. The greater the difference between the indicated value and 1 is, the stronger the effect of the variable. Estimates that reach a significant probability level are denoted by asterisks; the standard errors are shown in parentheses. As evidenced by the large values on the likelihood ratio tests (as shown on the bottom of the tables), the overall explanatory power of the models is highly significant. The first four columns are estimates based on the full sample, the following four columns offer the results for female workers, and the last four columns for male workers. To preserve space, Table 2.2 reports the results involving only our main variables of interest (the full results are shown in Table A2.1 of the Appendix).

Considering the separate analyses of sickness absence by cause, we can quickly observe that the effects of worker's characteristics do indeed vary significantly between sick leave due to common illness or injury and sick leave due to occupational disease or accident. Thus, the general finding in the literature suggesting that women are more prone to absence (Leigh, 1983; Paringer, 1983; Vistnes, 1997) only holds for sick leave due to common illness or injury. In fact, women have lower risk of sick leave due to occupational disease or injury than men.

In the case of sick leave due to common illness or injury, differences in the type of contract are found to influence sickness absence behaviour of women in particular. Indeed, the risk of sickness absence due to common illness or injury of a woman with an open-ended contract is about four times higher than that of a woman with a fixed-term contract. We also find that the effects of age on sickness absence vary significantly between women and men. While we observe a U-shaped relationship of age with sickness absence due to common illness or injury in the case

of women with open-ended contract (a result consistent with Allen (1984) and Leigh (1991)), the risk of sick leave decreases with the worker's age for men, regardless of the type of contract.



Table 2.2 Estimation results of competing risk models on the probability of suffering a sickness absence. Main variables

	Total				Women				Men			
	Fixed-term contract		Open-ended contract		Fixed-term contract		Open-ended contract		Fixed-term contract		Open-ended contract	
	Common	Occupational	Common	Occupational	Common	Occupational	Common	Occupational	Common	Occupational	Common	Occupational
Gender and age (ref. Men aged 25-39)												
Women aged 16-24	1.18 (0.03)**	0.68 (0.03)**	1.72 (0.06)**	0.88 (0.06)								
Women aged 25-39	1.21 (0.03)**	0.66 (0.03)**	1.43 (0.04)**	0.66 (0.04)**								
Women aged 40-54	1.17 (0.03)**	0.62 (0.03)**	1.58 (0.05)**	0.61 (0.04)**								
Women aged 55 or more	1.12 (0.07)	0.61 (0.09)**	1.93 (0.11)**	0.62 (0.08)**								
Men aged 16-24	1.21 (0.03)**	1.08 (0.03)**	1.45 (0.05)**	1.29 (0.06)**								
Men aged 40-54	0.90 (0.02)**	0.86 (0.03)**	1.00 (0.03)	0.76 (0.04)**								
Men aged 55 or more	1.03 (0.05)	0.76 (0.05)**	1.11 (0.06)	0.80 (0.07)*								
Age of the youngest cohabitant (ref. Aged 20 or more)												
Missing	1.01 (0.04)	1.02 (0.05)	0.90 (0.05)	1.05 (0.09)	1.09 (0.07)	0.84 (0.12)	0.99 (0.08)	1.08 (0.20)	0.97 (0.05)	1.05 (0.06)	0.85 (0.07)	1.05 (0.11)
Live alone	1.05 (0.02)*	1.02 (0.03)	1.03 (0.03)	1.06 (0.05)	1.05 (0.03)	1.09 (0.08)	1.03 (0.04)	1.05 (0.10)	1.05 (0.03)	1.00 (0.04)	1.02 (0.04)	1.08 (0.06)
Aged 0-3	1.37 (0.05)**	1.13 (0.06)*	1.35 (0.06)**	1.01 (0.09)	1.85 (0.05)**	0.91 (0.07)	1.87 (0.06)**	0.90 (0.09)	1.08 (0.03)**	1.13 (0.04)**	1.09 (0.04)*	1.07 (0.06)
Aged 4-6	1.14 (0.03)**	1.08 (0.05)	1.15 (0.04)**	1.17 (0.07)*	1.23 (0.05)**	1.03 (0.09)	1.27 (0.06)**	1.08 (0.13)	1.08 (0.04)	1.08 (0.05)	0.98 (0.06)	1.22 (0.09)*
Aged 7-11	1.09 (0.03)**	1.17 (0.04)**	1.10 (0.03)**	1.08 (0.06)	1.09 (0.04)*	1.13 (0.09)	1.13 (0.05)**	1.17 (0.13)	1.12 (0.04)**	1.17 (0.05)**	1.04 (0.05)	1.06 (0.08)
Aged 12-19	1.01 (0.02)	1.05 (0.03)	1.09 (0.03)**	1.21 (0.05)**	0.99 (0.03)	1.02 (0.06)	1.13 (0.04)**	1.26 (0.10)**	1.04 (0.03)	1.03 (0.04)	1.01 (0.04)	1.20 (0.07)**
People aged 25-39 with children aged under 3												
Female	1.35 (0.06)**	0.73 (0.07)**	1.44 (0.08)**	0.83 (0.11)								
Male	0.79 (0.04)**	1.01 (0.07)	0.83 (0.05)**	1.09 (0.12)								

Degree of disability (ref. No disability)												
From 33% to 64%	1.95 (0.09)**	1.32 (0.11)**	1.87 (0.11)**	1.27 (0.15)*	2.14 (0.17)**	1.73 (0.32)**	2.10 (0.19)**	1.23 (0.29)	1.86 (0.10)**	1.28 (0.12)**	1.71 (0.13)**	1.31 (0.18)*
65% or more	2.59 (0.29)**	0.91 (0.29)	1.80 (0.27)**	0.73 (0.33)	2.59 (0.44)**	0.40 (0.40)	1.51 (0.37)	1.26 (0.91)	2.58 (0.37)**	1.12 (0.38)	2.05 (0.38)**	0.63 (0.37)
Social Security contribution group (ref. Skilled clerks)												
Engineers and other university graduates	0.80 (0.04)**	0.49 (0.08)**	0.61 (0.03)**	0.41 (0.06)**	0.87 (0.05)*	0.41 (0.10)**	0.67 (0.04)**	0.80 (0.16)	0.69 (0.06)**	0.69 (0.14)	0.57 (0.04)**	0.29 (0.06)**
Engineering technicians and other skilled workers	1.00 (0.05)	0.70 (0.09)**	0.81 (0.04)**	0.54 (0.08)**	1.03 (0.05)	0.69 (0.11)*	0.83 (0.05)**	0.73 (0.15)	0.89 (0.08)	0.77 (0.15)	0.83 (0.07)*	0.41 (0.10)**
Administrative chiefs and managers	0.60 (0.05)**	0.93 (0.14)	0.72 (0.04)**	0.64 (0.09)**	0.62 (0.07)**	0.63 (0.19)	0.65 (0.05)**	0.44 (0.13)**	0.60 (0.07)**	1.33 (0.24)	0.79 (0.06)**	0.83 (0.13)
Assistants and other semi-skilled workers	0.80 (0.05)**	1.24 (0.15)	0.86 (0.05)**	1.19 (0.15)	0.83 (0.06)*	0.90 (0.18)	0.91 (0.07)	0.73 (0.17)	0.77 (0.08)**	1.70 (0.27)**	0.85 (0.06)*	1.61 (0.24)**
Semi-skilled clerks	1.03 (0.05)	1.70 (0.16)**	1.16 (0.07)**	1.88 (0.18)**	1.01 (0.05)	1.44 (0.18)**	1.18 (0.08)*	1.37 (0.20)*	1.07 (0.09)	2.04 (0.28)**	1.18 (0.09)*	2.42 (0.32)**
Assistant clerks	1.05 (0.04)	0.91 (0.08)	0.97 (0.03)	1.06 (0.09)	1.00 (0.04)	0.79 (0.08)*	0.95 (0.04)	0.87 (0.09)	1.11 (0.08)	0.95 (0.13)	1.00 (0.07)	1.14 (0.16)
Skilled labourers	1.10 (0.04)**	2.28 (0.16)**	1.18 (0.04)**	2.73 (0.19)**	1.01 (0.05)	1.47 (0.16)**	1.13 (0.06)*	1.66 (0.19)**	1.17 (0.07)*	3.01 (0.32)**	1.21 (0.06)**	3.47 (0.34)**
Semi-skilled labourers	1.16 (0.04)**	2.19 (0.16)**	1.30 (0.05)**	2.49 (0.19)**	1.05 (0.04)	1.51 (0.15)**	1.16 (0.06)**	1.67 (0.19)**	1.26 (0.08)**	2.95 (0.32)**	1.46 (0.08)**	3.23 (0.34)**
Unskilled labourers	1.16 (0.04)**	2.28 (0.16)**	1.28 (0.05)**	2.87 (0.21)**	1.03 (0.04)	1.72 (0.16)**	1.14 (0.05)**	1.85 (0.20)**	1.27 (0.08)**	2.96 (0.32)**	1.38 (0.08)**	3.73 (0.39)**
Wage quintile (ref. Quintile 3)												
Quintile 1	1.09 (0.03)**	0.99 (0.04)	0.92 (0.03)**	0.73 (0.04)**	1.11 (0.04)**	1.08 (0.08)	0.95 (0.04)	0.76 (0.07)**	1.08 (0.04)*	0.99 (0.05)	0.83 (0.05)**	0.66 (0.06)**
Quintile 2	1.09 (0.02)**	0.96 (0.03)	1.06 (0.03)*	0.92 (0.04)	1.17 (0.04)**	1.24 (0.08)**	1.08 (0.04)*	0.93 (0.07)	1.03 (0.03)	0.88 (0.03)**	1.04 (0.04)	0.89 (0.05)*
Quintile 4	0.95 (0.02)**	1.02 (0.03)	1.07 (0.03)*	1.01 (0.04)	0.94 (0.03)	1.03 (0.08)	1.02 (0.04)	0.85 (0.08)	0.96 (0.02)	1.02 (0.03)	1.10 (0.04)*	1.07 (0.05)
Quintile 5	0.88 (0.02)**	0.93 (0.03)*	1.03 (0.03)	0.89 (0.05)*	0.85 (0.03)**	0.79 (0.08)*	0.99 (0.04)	0.53 (0.06)**	0.90 (0.03)**	0.96 (0.04)	1.06 (0.04)	1.02 (0.06)
Number of observations	206,068		87,991		91,389		41,570		114,679		46,421	
Log-likelihood value	-315,081.8	-122,399.6	-183,624.4	-51,163.1	-140,908.2	-24,953.6	-95,285.1	-14,196.0	-155,753.3	-91,869.3	-76,761.1	-33,999.0

Notes: Standard Errors in parentheses. Significance levels: *significant at 5 per cent; **significant at 1 per cent.

Regarding sick leave due to occupational disease or accident, although differences in the risk of sickness absence by type of contract are less pronounced, workers with an open-ended contract have a higher risk of sickness absence. This finding is in greater agreement with García-Serrano et al. (2010), than with Guadalupe (2003). Furthermore, we observe that the probability of sick leave due to occupational accident or illness decreases with the worker's age, regardless of gender and type of contract. Thus, open-ended employees aged 16-24 are the workers with the highest risk of sick leave due to occupational disease or injury.

One of the largest effects we found for female sickness absence due to common illness or injury is the presence of children in the household. In fact, the presence of children under 3 years old increases the risk of female sickness absence in more than 85 per cent, regardless of the type of contract. However, the presence of children younger than 3 years old does not have a significant impact on female sickness absence due to occupational disease or accident. We can affirm that this result is in contradiction with the role conflict or overload theories (Verbrugge, 1983; Arber et al., 1985), which affirm that the presence of family responsibilities has a negative impact on women's health. If this hypothesis were true, it would be expected that the presence of children in the household would also have an impact on the probability of sick leave due to occupational illness or injury.

While the presence of children under 3 in the household has a substantial impact on the average probability of women being absent from work, the effect of this presence is barely significant for men, suggesting little substitution across the sexes in caring for children. Further, when we consider only individuals aged 25 to 39, women whose youngest child is younger than 3 are between 35 to 44 per cent –depending on they held a fixed-term or an open-ended contract, respectively– more likely to be absent. By contrast, men aged 25 to 39 with children aged under 3 are about 20 per cent less likely to be sickness absent, regardless of the type of contract.

With respect to the measure of health status, disability significantly increases the probability of sickness absence for both sexes, though more so for women than for men. In addition, a disability also increases more the likelihood of sickness absence due to common illness or injury than as a result of occupational disease or accident.

Regarding the Social Security contribution group, we observe that high-skilled workers are less likely to be absent due to common illness or injury than their low-skilled counterparts. This gap remains in the results from the separate analyses of absence by gender, although this is less accentuated among women. This highest probability of low-skilled workers to be absent due to common illness or injury could be due to a number of factors. First, we could conclude that high-skilled workers usually have leading positions in the firm, which may make them feel a greater sense of alienation than their counterparts in non-leading positions. However, the results could also reflect differences in sickness absences explained by different socioeconomic statuses. In fact, the Social Security contribution group is closely related to socioeconomic status, and there is a large body of evidence showing that lower socioeconomic status is associated with higher mortality and sickness absence (Diderichsen, 1990; North et al., 1993).

Nevertheless, where there is a dramatic difference between high- and low-skilled workers is in the probability of sickness absence due to occupational disease or illness, particularly for men. In

fact, overall low-skilled workers are twice as likely to be on sick leave due to occupational disease or illness. This likelihood increases to close to 400 per cent for open-ended male workers. These results suggest that low-skilled workers are most at risk from suffering an occupational injury or accident compared to their high-skilled counterparts.

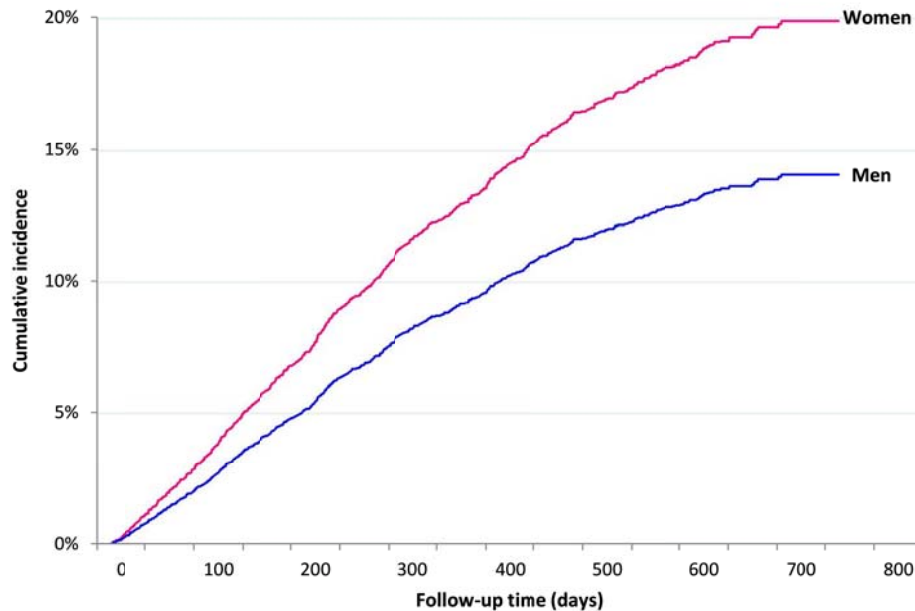
Based on the results of the competing risk regression, predicted cumulative incidence curves can be obtained. According to Fine and Gray (1999), in order to predict cumulative incidence at time t for an individual with covariates $X = x_0$, we estimate the cumulative subdistribution hazard by:

$$\hat{\lambda}_k(t, x_0) = \int_0^t \exp\{x_0^T(u)\hat{\beta}\} d\hat{\lambda}_{k,0}(u) \quad (9)$$

where $\hat{\beta}$ are the relative risk estimates in Table A2.1 and $\hat{\lambda}_{k,0}(t)$ the baseline hazard rate for the study population.

As stated above, the presence of children under 3 years in the household is one of the most important variables explaining the differences in sickness absence between women and men. Figure 2.5 shows the predicted occurrence of sick leave due to common illness or non-work-related injury for open-ended workers aged 25 to 39 whose youngest child is under 3 years old. When there are children under 3 years in the household, the probability of sick leave due to common illness or injury within 400 days is roughly 10 per cent for men, but increases to 15 per cent in the case of women.

Figure 2.5 Estimated cumulative sub-hazard function of sick leave due to common disease or non-work-related injury for open-ended workers aged 25 to 39 with children under 3 years



5. Gender differences in the duration of sick leave

Another important aspect of this study in addition to the incidence of sickness absence is its duration. Under some probability of sickness absence, if the average duration of these periods is higher or lower, their quantitative impact and their consequences on public policies for reducing the problem will be different. In the previous section, we observed that some workers' characteristics have an impact on the probability of sickness absence. If the workers who are more prone to suffer a sickness absence also have a higher duration of absence, we can assert that the relevance of the problem multiplies. So, an exhaustive analysis of the relevance of sickness absence needs to take into account both its incidence and its duration. In order to explore this issue, we examine here the time to return to activity after a period of sick leave.

In the first step, a preliminary descriptive analysis of the sick leave spells is produced using hazard functions. The hazard ratio, or the probability of failure at a certain time, is the conditional probability of returning to job after sick leave at that time, given that an individual has not had this event just prior to that time. Figure 2.6 and Figure 2.7 plot these hazard rates, taking into account different worker's characteristics.

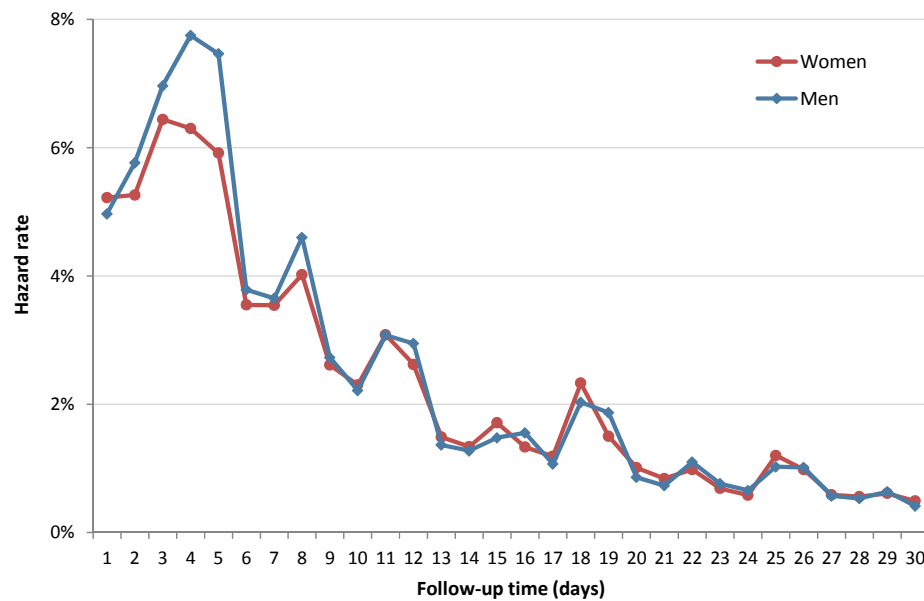
Looking at Figure 2.6, we can observe that institutional settings play a crucial role on the duration of sickness absence. In fact, Figure 2.6 reveals that many exits from activity occur at seven-day intervals (starting on 5th day in the case of sick leave due to common illness or injury and on 8th day in the case of sick leave due to occupational disease or accident), corresponding to the day after the medical certificate needs to be reissued. On the other hand, most sick leave spells end within the first 10 days, as overall sick leave spells due to occupational disease or injury are typically longer. Given the shapes of these estimated baseline hazards, it seems clear that fitting a Weibull hazard would be appropriate¹².

Further, Figure 2.6 shows that there are differences across causes of sickness absence, and also between women and men. In fact, for each moment in time, the hazard rate of return to work after sick leave is higher for men than for women, especially in the case of sickness absence due to common illness or injury. This means that the duration of sick leave spells, in general, is longer for women.

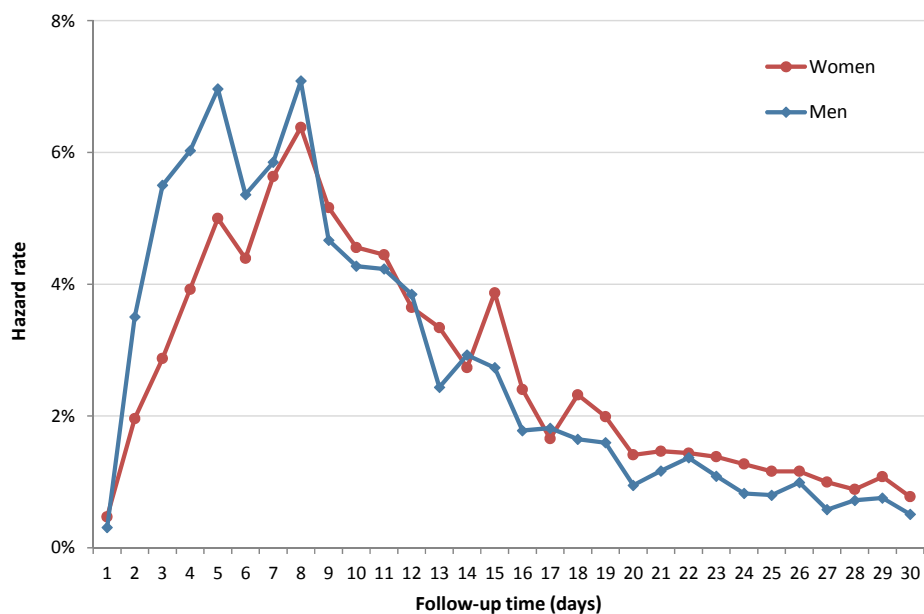
¹² The Weibull distribution is suitable for modelling data with monotone hazard rates that either increase or decrease exponentially with time.

Figure 2.6 Hazard rates of returning to work by cause of sick leave and gender

Panel A. Sickness absence due to common illness or non-work-related injury



Panel B. Sickness absence due to occupational illness or work-related injury

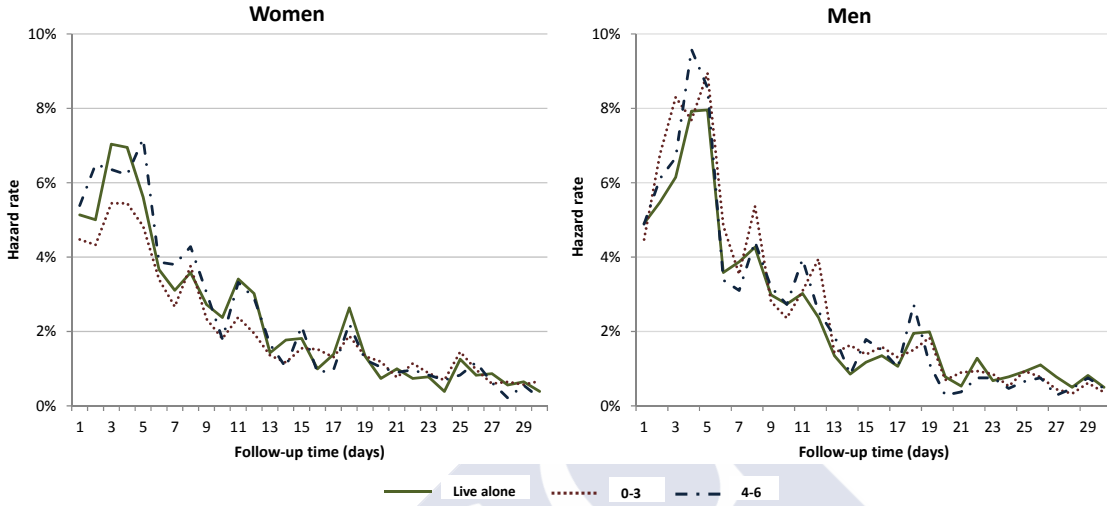


Source: Own elaboration based on CSWH.

As regards how family responsibilities can affect the sickness absence duration, we also observe important differences across genders. Figure 2.7 depicts that for men the presence of children reduces the duration of sickness absences due to common illness or injury in comparison with men who live alone. In the case of women, while the presence of children between ages 4 and 6

reduces the duration of sickness absence, the presence of children aged between 0 and 3 increases it.

Figure 2.7 Hazard rates of returning to work after sick leave due to common illness or non-work-related injury by gender and age group of the youngest person in the household



Source: Own elaboration based on CSWH.

5.1. Empirical Strategy

This study applies a duration model to estimate the hazard of ending the spell of sickness absence. Specifically, we study how a set of covariates has an impact on the probability of returning to the workplace when a worker has a sickness absence.

We express the hazard rate as a function of both time and the explanatory variables, following the proportional hazard model:

$$\lambda(t, X) = \lambda_0(t) \exp(x\beta) \quad (10)$$

where $\lambda_0(t)$ is the baseline hazard. We choose the Weibull model, where the baseline hazard is:

$$\lambda_0 = pt^{p-1} \exp(\beta_0) \quad (11)$$

So, the hazard function in the Weibull model can be expressed as following:

$$\lambda(t, X) = pt^{p-1} \exp(\beta_0 + x\beta) \quad (12)$$

Now, we introduce the unobserved heterogeneity in the model ("frailty"). The frailty hazard rate may be written as:

$$\lambda(t, X|v) = \lambda(t, X) \cdot v = \lambda_0(t) \exp(x\beta) \cdot v = \lambda_0(t) \exp(x\beta + u) \quad (13)$$

Where v is a random variable of positive values, with the mean normalised to one and finite variance σ^2 ; $\lambda_0(t)$ is the baseline hazard function; and $u \equiv \ln(v)$ is a random variable with a mean of zero. A crucial assumption in these models is that v is distributed independently of X and t .

Taking this into account, the frailty hazard function in the Weibull model is:

$$\lambda(t, X|v) = pt^{p-1} \exp(\beta_0 + x\beta + u) \quad (14)$$

As Allison (1982) indicated, the problem in these models is that T is not observed for the censored cases. However, the method of maximum likelihood allows the full use of the information available for these cases. The general likelihood equation for censored data is:

$$\mathcal{L} = \prod_{i=1}^n [f(t_i)]^{\delta_i} [1 - F(t_i)]^{1-\delta_i} \quad (15)$$

In this likelihood equation, we observe that each individual contributes with the density function if the duration is complete and with the survival function (1 minus the cumulative distribution function) if the duration is censored. Because the function depends on the vector of covariates, we can express the earlier equation as:

$$\mathcal{L} = \prod_{i=1}^n [\lambda(t_i, x_i|v)]^{\delta_i} [1 - F(t_i, x_i|v)]^{1-\delta_i} \quad (16)$$

Taking that into account, the survival function can be expressed as:

$$S(t, X|v) = \exp\left(-\int_0^t \lambda(s, x_i|v) ds\right) = \exp\left(-v \int_0^t \lambda(s, x_i) ds\right) \quad (17)$$

We can observe that, as the hazard is a function of the frailties, so too is the survival function conditional on both the covariates and the frailty term.

To derive the expected value of the survival function, we need to specify a probability distribution for v_i [$g(v)$]. We consider that frailty follows a Gamma distribution. Now, the expected survival function can be derived from the hazard rate as follows:

$$S(t) = E[S(t, X|v)] = E\left[\exp\left(-v \int_0^t \lambda(s, x_i) ds\right)\right] = L\left[\exp\left(\int_0^t \lambda(s, x_i) ds\right)\right] \quad (18)$$

where L is the Laplace transformation. The use of the Laplace transformation is required to integrate out the distribution of the unobserved frailty.

So, the cumulative distribution function is:

$$F(t_i, x_i|v) = 1 - S(t) = 1 - L\left[\exp\left(\int_0^t \lambda(s, x_i) ds\right)\right] \quad (19)$$

This allows the likelihood function to be expressed entirely in terms of the frailty hazard rate:

$$\mathcal{L} = \prod_{i=1}^n [\lambda(t_i, x_i|v)]^{\delta_i} L\left[\exp\left(\int_0^t \lambda(s, x_i) ds\right)\right] \quad (20)$$

Finally, we obtain the estimated parameters maximising $\mathcal{L}$.

As before, we have estimated the model for the total sample, as well as for women and men separately. Basically, we have included the same explanatory variables as those in the model for analysing the probability of sick leave. Nevertheless, instead of controlling for the day of the week and the month of entry into employment, we have introduced dummy variables for each day of the week and month in which the sick leave spell starts. Moreover, we have also controlled for the tenure in employment before the sick leave event, as well as the entity in charge of the payment (i.e. National Institute of the Social Security or the Social Security Mutual Society for Work-Related Injuries and Occupational Diseases).

5.2. Summary of results

The regression results for the total sample and for men and women separately, can be found in Table 2.3. This table contains the estimated hazard ratios. Hazard ratios at each survival time are related to absolute differences in characteristics:

$$\frac{h(t, X_1)}{h(t, X_2)} = \exp[\beta'(X_1 - X_2)] \quad (21)$$

Hazard ratios are interpreted as follows. A value below (above) 1 means that the likelihood of transit from sick leave back to work is lower (higher) than that of a worker in the comparison group with all others covariates held constant.

In this section, we present the main results. As in the previous section, we will focus exclusively on the main variables affecting gender differences on sick leave duration, and omit the effects of other explanatory variables. The full estimation results for all variables are available in Table A2.2 of the Appendix.

From the estimation results, we find that overall sick leave spells due to occupational disease or injury are longer than those due to common illness or accident for women, but not so for men. However, sick leave spells due to common illness or injury for older women (40 years old or more) are longer than those due to occupational disease or work-related accident.

Our empirical results further suggest that the duration of sick leave increases clearly with age. The hazard rate of return to the workplace after sick leave is higher for younger workers than for older ones. Older workers remain absent from work more days for every type of cause, common or occupational.

As for the probability of incidence, the presence of children under 3 years old in the household is very significant for explaining the duration of the sickness absence due to common disease or accident, but not for occupational contingency. We find that the presence of children under 3 years old in the household prolongs the duration of sick leave spells due to common illness or injury in the case of women. However, the relationship is the opposite for men; namely, the presence of younger children has a large and significant effect on men's hazard rate of return to the workplace after sick leave. In the case of people aged 25 to 39, while the presence of children reduces the duration of sick leave spells due to common illness or injury by 34 per cent for men, it increases the time away from work by 35 per cent in the case of women.

Table 2.3 Estimation results of models on the duration of sick leave. Main variables

		TOTAL		WOMEN		MEN	
		Common	Occupational	Common	Occupational	Common	Occupational
Gender and age (ref. Men aged 25-39)							
	Women aged 16-24	1.08 (0.05)	0.82 (0.07)*				
	Women aged 25-39	0.70 (0.03)**	0.66 (0.05)**				
	Women aged 40-54	0.38 (0.02)**	0.52 (0.06)**				
	Women aged 55 or more	0.19 (0.02)**	0.33 (0.09)**				
	Men aged 16-24	1.30 (0.05)**	1.31 (0.08)**				
	Men aged 40-54	0.55 (0.03)**	0.70 (0.05)**				
	Men aged 55 or more	0.23 (0.02)**	0.46 (0.06)**				
Age (ref. Aged 35-39)							
	16-19			2.02 (0.17)**	1.20 (0.21)	1.64 (0.14)**	1.83 (0.21)**
	20-24			1.66 (0.10)**	1.28 (0.18)	1.55 (0.10)**	1.62 (0.15)**
	25-29			1.25 (0.07)**	1.05 (0.15)	1.35 (0.08)**	1.36 (0.12)**
	30-34			1.06 (0.06)	1.12 (0.16)	1.24 (0.08)**	1.16 (0.10)
	40-44			0.74 (0.05)**	0.87 (0.14)	0.70 (0.05)**	1.04 (0.11)
	45-49			0.62 (0.05)**	1.01 (0.19)	0.57 (0.05)**	0.69 (0.09)**
	50-54			0.46 (0.04)**	0.61 (0.13)*	0.53 (0.05)**	0.69 (0.09)**
	55-59			0.36 (0.05)**	0.56 (0.16)*	0.27 (0.04)**	0.55 (0.09)**
	60-64			0.27 (0.05)**	0.31 (0.30)	0.19 (0.04)**	0.51 (0.13)*
Age of the youngest cohabitant (ref. Aged 20 or more)							
	Missing	0.87 (0.06)*	1.12 (0.12)	0.87 (0.09)	1.06 (0.22)	0.86 (0.08)	1.17 (0.15)
	Live alone	0.94 (0.04)	0.90 (0.06)	0.92 (0.05)	0.93 (0.12)	0.98 (0.05)	0.89 (0.07)
	Aged 0-3	0.83 (0.05)**	1.21 (0.12)	0.55 (0.03)**	1.05 (0.13)	1.17 (0.06)**	1.08 (0.08)
	Aged 4-6	1.05 (0.05)	1.07 (0.09)	0.97 (0.07)	1.10 (0.17)	1.18 (0.09)*	1.07 (0.11)
	Aged 7-11	0.90 (0.04)*	0.94 (0.07)	0.79 (0.05)**	0.94 (0.13)	1.04 (0.07)	0.93 (0.09)
	Aged 12-19	0.98 (0.04)	1.11 (0.07)	0.94 (0.05)	1.11 (0.13)	0.99 (0.05)	1.07 (0.08)
People aged 25-39 with children aged under 3							
	Female	0.65 (0.05)**	0.88 (0.15)				
	Male	1.34 (0.11)**	0.86 (0.11)				
Degree of disability (ref. No disability)							
	From 33% to 64%	0.48 (0.05)**	0.62 (0.10)**	0.56 (0.09)**	1.19 (0.28)	0.45 (0.07)**	0.54 (0.12)**
	65% or more	0.43 (0.10)**	0.78 (0.53)	0.47 (0.16)*	0.12 (0.25)	0.46 (0.15)*	1.25 (0.91)
Social Security contribution group (ref. Skilled clerks)							
	Engineers and other university graduates	0.72 (0.06)**	0.76 (0.23)	0.68 (0.06)**	1.40 (0.60)	0.85 (0.12)	0.37 (0.14)**
	Engineering technicians and other skilled workers	0.90 (0.06)	1.01 (0.25)	0.84 (0.07)*	1.06 (0.32)	1.00 (0.14)	0.79 (0.32)

Administrative chiefs and managers	0.64 (0.07)**	1.19 (0.28)	0.58 (0.08)**	1.51 (0.55)	0.84 (0.15)	0.90 (0.28)
Assistants and other semi-skilled workers	0.73 (0.07)**	1.34 (0.29)	0.71 (0.08)**	2.04 (0.77)	0.82 (0.14)	0.92 (0.27)
Semi-skilled clerks	0.78 (0.06)**	1.17 (0.18)	0.78 (0.07)**	1.65 (0.32)*	0.84 (0.11)	0.81 (0.19)
Assistant clerks	1.13 (0.07)*	1.12 (0.16)	1.04 (0.06)	1.21 (0.20)	1.22 (0.15)	0.84 (0.21)
Skilled labourers	0.79 (0.05)**	1.43 (0.17)**	0.67 (0.05)**	1.56 (0.27)*	1.01 (0.10)	1.16 (0.22)
Semi-skilled labourers	0.83 (0.05)**	1.46 (0.18)**	0.73 (0.05)**	1.67 (0.26)**	1.08 (0.12)	1.15 (0.23)
Unskilled labourers	0.83 (0.05)**	1.47 (0.18)**	0.67 (0.04)**	1.56 (0.24)**	1.13 (0.12)	1.20 (0.24)
Wage quintile (ref. Quintile 3)						
Quintile 1	0.89 (0.04)**	1.04 (0.08)	0.96 (0.05)	0.93 (0.12)	0.84 (0.06)*	1.13 (0.12)
Quintile 2	0.94 (0.04)	1.08 (0.06)	0.96 (0.05)	1.15 (0.13)	0.95 (0.05)	1.07 (0.08)
Quintile 4	1.07 (0.04)	1.01 (0.06)	1.06 (0.07)	0.94 (0.13)	1.10 (0.06)	1.02 (0.07)
Quintile 5	1.01 (0.05)	1.00 (0.07)	1.08 (0.07)	1.02 (0.18)	0.99 (0.06)	1.00 (0.08)
Number of observations	43,017	15,038	21,988	3,621	21,029	11,417
Log-likelihood value	-74,943.2	-20,833.4	-38,749.3	-4,853.5	-35,976.5	-15,882.4

Notes: Standard Errors in parentheses. Significance levels: *significant at 5 per cent; **significant at 1 per cent.

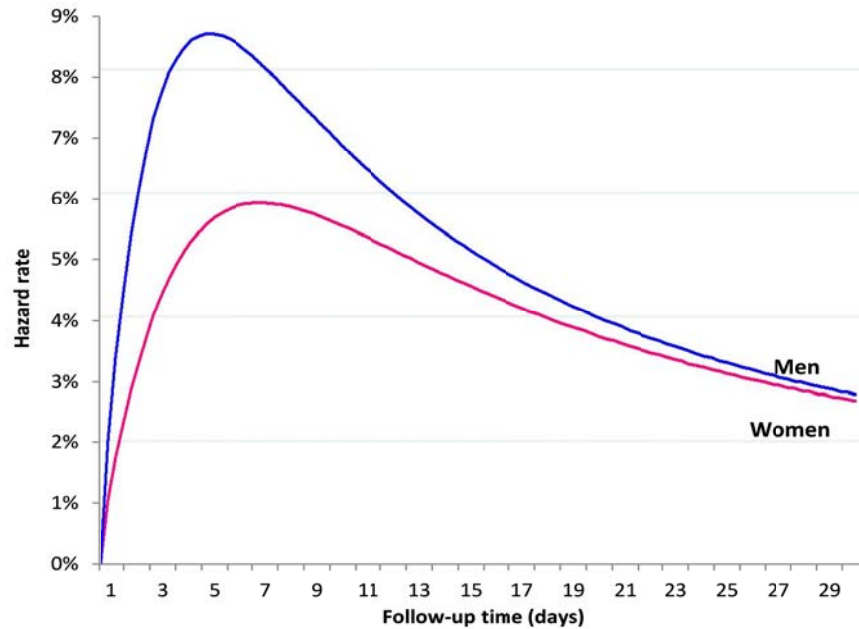
We find, very much as expected, that health status has a large and significant effect on sick leave duration. The larger the worker's degree of disability is, the larger the duration of sick leave spells, especially those due to common illness or accident. This holds for both women and men.

Regarding the Social Security contribution group, we observe that this variable is significant for explaining the duration of sick leave in both the total sample and the female population, but not in the case of men. Thus, high-skilled female workers have shorter sickness absences than their low-skilled counterparts.

Finally, we find that wage levels are relatively unimportant in determining the length of time spent in sick leave for both women and men, and regardless of the cause of sick leave. Wages are only important in encouraging those workers situated in the first wage quintile to remain in sick leave due to common illness or injury for longer periods of time. We can think that substitution effect implies that those workers with higher salaries return to work earlier.

In Figure 2.8 the estimation results have been applied to calculate the risk of return to activity after a sick leave spell for women and men with family responsibilities. The individuals are assumed to be between 25 and 39 years old, have children under 3 years in the household, and hold an open-ended contract. According to the estimation results, the risk of returning to activity before the 5th day of sick leave is clearly higher for men than women. Indeed, we find that after controlling for the other worker's characteristics, 8 per cent of the open-ended male workers aged 25 to 39 with children under 3 years old return to activity after a sick leave spell due to common illness or injury before the 5th day, while this percentage decreases to less than 6 per cent in the case of women. In other words, the presence of young children in the household increases the duration of female sick leave and provokes men to return to activity earlier.

Figure 2.8 Estimated hazard rate of returning to work after sick leave due to common disease or non-work-related injury for open-ended workers aged 25 to 39 with children under 3 years



6. Conclusions

In this chapter we have considered two types of causes for sick leave: common disease or accident and occupational illness or injury. This distinction has revealed essential differences between men and women in the incidence and duration of sick leave in Spain. We find that women have a higher incidence of sick leave due to common disease or accident than men. But the reverse is true when the reason for absence from work is occupational illness or injury.

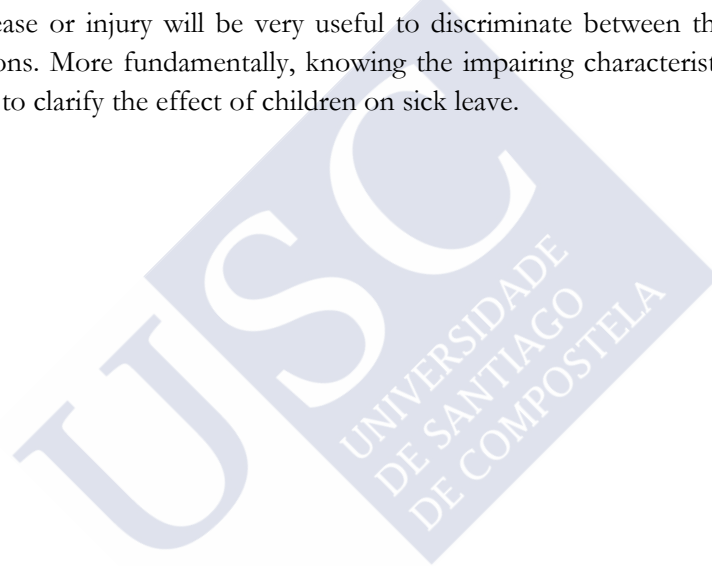
As for duration of sick leave, we find that women take longer than men to return to work from a sick leave absence, regardless of the cause. But the gap is larger when the cause is common illness or accident.

In searching for the causes of the gender gap in sick leave in Spain we have looked at the effect of household composition. Our results indicate that the presence of children under 3 years of age increases the probability of sickness absence due to common illness or accident for women, and reduces it for men. This finding lends support to the hypothesis that small children in the household increase work commitment among men, but reduce work attendance among women. Several explanations are compatible with this result. One is that mothers of young children suffer poor health more often than their counterparts without young children. Another is that the conflict between family needs and work obligations leads women to advantage of sick leave as a means of balancing the two responsibilities. Either of these explanations is plausible in the context of a rigid distribution of gender roles.

However, we conjecture that our empirical evidence lends little support to the view that the presence of children has a negative impact on women's health (Verbrugge, 1983; Arber et al., 1985). Although the presence of children under age 3 increases the probability of sick leave due to common illness or accident, it reduces the probability of absence due to occupational illness or injury. If the presence of children had a negative impact on female health (because of stress, lack of rest, etc.), we would expect women to have a higher probability of sick leave due to occupational illness or injury too.

Moreover, our findings also indicate that the presence of children under age 3 increases the duration of sick leave due to common illness or accident in the case of women and reduce it in the case of men. We do not find that the presence of children is significant in the duration of sick leave due to an occupational disease or work-related accident.

We acknowledge that these results have some caveats. For instance, information on the clinical aspect of the disease or injury will be very useful to discriminate between the health and role conflict explanations. More fundamentally, knowing the impairing characteristics of the disease or injury will help to clarify the effect of children on sick leave.



Appendix

Table A2.1 Estimation results of competing risk models on the probability of suffering a sickness absence. All variables

	Total				Women				Men			
	Fixed-term contract		Open-ended contract		Fixed-term contract		Open-ended contract		Fixed-term contract		Open-ended contract	
	Common	Occupational	Common	Occupational	Common	Occupational	Common	Occupational	Common	Occupational	Common	Occupational
Gender and age (ref. Men aged 25-39)												
Women aged 16-24	1.18 (0.03)**	0.68 (0.03)**	1.72 (0.06)**	0.88 (0.06)								
Women aged 25-39	1.21 (0.03)**	0.66 (0.03)**	1.43 (0.04)**	0.66 (0.04)**								
Women aged 40-54	1.17 (0.03)**	0.62 (0.03)**	1.58 (0.05)**	0.61 (0.04)**								
Women aged 55 or more	1.12 (0.07)	0.61 (0.09)**	1.93 (0.11)**	0.62 (0.08)**								
Men aged 16-24	1.21 (0.03)**	1.08 (0.03)**	1.45 (0.05)**	1.29 (0.06)**								
Men aged 40-54	0.90 (0.02)**	0.86 (0.03)**	1.00 (0.03)	0.76 (0.04)**								
Men aged 55 or more	1.03 (0.05)	0.76 (0.05)**	1.11 (0.06)	0.80 (0.07)*								
Age (ref. Aged 35-39)												
16-19					0.97 (0.05)	0.99 (0.10)	1.50 (0.10)**	1.43 (0.24)*	1.38 (0.06)**	1.34 (0.07)**	1.91 (0.13)**	1.61 (0.15)**
20-24					0.96 (0.04)	1.00 (0.08)	1.12 (0.05)**	1.51 (0.17)**	1.23 (0.04)**	1.15 (0.05)**	1.36 (0.07)**	1.24 (0.08)**
25-29					1.01 (0.03)	0.88 (0.07)	1.00 (0.04)	1.17 (0.12)	1.08 (0.04)*	1.17 (0.05)**	1.01 (0.05)	1.10 (0.07)
30-34					1.04 (0.04)	0.92 (0.07)	1.05 (0.04)	1.12 (0.12)	1.03 (0.04)	1.11 (0.05)*	0.99 (0.04)	0.96 (0.06)
40-44					0.93 (0.04)	0.87 (0.08)	1.03 (0.05)	1.03 (0.12)	0.95 (0.04)	0.93 (0.05)	0.99 (0.05)	0.81 (0.06)**
45-49					1.05 (0.05)	0.88 (0.09)	1.16 (0.06)**	0.99 (0.13)	0.87 (0.04)**	0.97 (0.05)	1.08 (0.06)	0.69 (0.06)**
50-54					1.09 (0.06)	0.91 (0.12)	1.14 (0.07)*	1.24 (0.17)	1.01 (0.05)	0.90 (0.06)	1.02 (0.06)	0.81 (0.08)*

	55-59					0.98 (0.08)	0.93 (0.16)	1.31 (0.08)**	1.38 (0.21)*	1.09 (0.06)	0.82 (0.07)*	1.09 (0.08)	0.80 (0.09)*
	60-64					0.86 (0.12)	0.71 (0.24)	1.54 (0.15)**	0.43 (0.17)*	1.02 (0.09)	0.83 (0.10)	1.26 (0.13)*	0.81 (0.14)
Age of the youngest cohabitant (ref. Aged 20 or more)													
	Missing	1.01 (0.04)	1.02 (0.05)	0.90 (0.05)	1.05 (0.09)	1.09 (0.07)	0.84 (0.12)	0.99 (0.08)	1.08 (0.20)	0.97 (0.05)	1.05 (0.06)	0.85 (0.07)	1.05 (0.11)
	Live alone	1.05 (0.02)*	1.02 (0.03)	1.03 (0.03)	1.06 (0.05)	1.05 (0.03)	1.09 (0.08)	1.03 (0.04)	1.05 (0.10)	1.05 (0.03)	1.00 (0.04)	1.02 (0.04)	1.08 (0.06)
	Aged 0-3	1.37 (0.05)**	1.13 (0.06)*	1.35 (0.06)**	1.01 (0.09)	1.85 (0.05)**	0.91 (0.07)	1.87 (0.06)**	0.90 (0.09)	1.08 (0.03)**	1.13 (0.04)**	1.09 (0.04)*	1.07 (0.06)
	Aged 4-6	1.14 (0.03)**	1.08 (0.05)	1.15 (0.04)**	1.17 (0.07)*	1.23 (0.05)**	1.03 (0.09)	1.27 (0.06)**	1.08 (0.13)	1.08 (0.04)	1.08 (0.05)	0.98 (0.06)	1.22 (0.09)*
	Aged 7-11	1.09 (0.03)**	1.17 (0.04)**	1.10 (0.03)**	1.08 (0.06)	1.09 (0.04)*	1.13 (0.09)	1.13 (0.05)**	1.17 (0.13)	1.12 (0.04)**	1.17 (0.05)**	1.04 (0.05)	1.06 (0.08)
	Aged 12-19	1.01 (0.02)	1.05 (0.03)	1.09 (0.03)**	1.21 (0.05)**	0.99 (0.03)	1.02 (0.06)	1.13 (0.04)**	1.26 (0.10)**	1.04 (0.03)	1.03 (0.04)	1.01 (0.04)	1.20 (0.07)**
People aged 25-39 with children aged under 3													
	Female	1.35 (0.06)**	0.73 (0.07)**	1.44 (0.08)**	0.83 (0.11)								
	Male	0.79 (0.04)**	1.01 (0.07)	0.83 (0.05)**	1.09 (0.12)								
Place of birth (ref. Spain)													
	EU-15	0.89 (0.04)*	0.98 (0.07)	0.84 (0.05)**	0.90 (0.10)	0.89 (0.06)	0.97 (0.16)	0.90 (0.07)	0.72 (0.16)	0.89 (0.06)	0.99 (0.08)	0.79 (0.07)*	1.00 (0.13)
	Rest of Europe	0.78 (0.04)**	0.79 (0.05)**	0.83 (0.05)**	1.07 (0.10)	0.78 (0.06)**	0.85 (0.14)	0.91 (0.08)	1.38 (0.25)	0.77 (0.05)**	0.79 (0.06)**	0.80 (0.07)*	1.02 (0.11)
	Latin America	0.98 (0.03)	1.07 (0.04)	1.03 (0.04)	1.23 (0.07)**	1.06 (0.04)	1.32 (0.11)**	1.08 (0.05)	1.35 (0.14)**	0.90 (0.04)**	1.01 (0.05)	1.03 (0.05)	1.22 (0.09)**
	Africa	0.76 (0.03)**	0.90 (0.04)*	1.01 (0.06)	1.29 (0.11)**	0.90 (0.07)	1.37 (0.20)*	1.22 (0.12)*	1.31 (0.31)	0.73 (0.03)**	0.86 (0.05)**	0.93 (0.07)	1.28 (0.12)**
	Rest of the world	0.45 (0.05)**	0.51 (0.08)**	0.45 (0.05)**	0.47 (0.09)**	0.44 (0.09)**	0.52 (0.24)	0.32 (0.07)**	0.10 (0.10)*	0.47 (0.06)**	0.52 (0.09)**	0.57 (0.08)**	0.57 (0.11)**
Degree of disability (ref. No disability)													
	From 33% to 64%	1.95 (0.09)**	1.32 (0.11)**	1.87 (0.11)**	1.27 (0.15)*	2.14 (0.17)**	1.73 (0.32)**	2.10 (0.19)**	1.23 (0.29)	1.86 (0.10)**	1.28 (0.12)**	1.71 (0.13)**	1.31 (0.18)*
	65% or more	2.59 (0.29)**	0.91 (0.29)	1.80 (0.27)**	0.73 (0.33)	2.59 (0.44)**	0.40 (0.40)	1.51 (0.37)	1.26 (0.91)	2.58 (0.37)**	1.12 (0.38)	2.05 (0.38)**	0.63 (0.37)
Social Security contribution group (ref. Skilled clerks)													
	Engineers and other university graduates	0.80 (0.04)**	0.49 (0.08)**	0.61 (0.03)**	0.41 (0.06)**	0.87 (0.05)*	0.41 (0.10)**	0.67 (0.04)**	0.80 (0.16)	0.69 (0.06)**	0.69 (0.14)	0.57 (0.04)**	0.29 (0.06)**
	Engineering technicians and other skilled workers	1.00 (0.05)	0.70 (0.09)**	0.81 (0.04)**	0.54 (0.08)**	1.03 (0.05)	0.69 (0.11)*	0.83 (0.05)**	0.73 (0.15)	0.89 (0.08)	0.77 (0.15)	0.83 (0.07)*	0.41 (0.10)**
	Administrative chiefs and managers	0.60 (0.05)**	0.93 (0.14)	0.72 (0.04)**	0.64 (0.09)**	0.62 (0.07)**	0.63 (0.19)	0.65 (0.05)**	0.44 (0.13)**	0.60 (0.07)**	1.33 (0.24)	0.79 (0.06)**	0.83 (0.13)

Assistants and other semi-skilled workers	0.80 (0.05)**	1.24 (0.15)	0.86 (0.05)**	1.19 (0.15)	0.83 (0.06)*	0.90 (0.18)	0.91 (0.07)	0.73 (0.17)	0.77 (0.08)**	1.70 (0.27)**	0.85 (0.06)*	1.61 (0.24)**
Semi-skilled clerks	1.03 (0.05)	1.70 (0.16)**	1.16 (0.07)**	1.88 (0.18)**	1.01 (0.05)	1.44 (0.18)**	1.18 (0.08)*	1.37 (0.20)*	1.07 (0.09)	2.04 (0.28)**	1.18 (0.09)*	2.42 (0.32)**
Assistant clerks	1.05 (0.04)	0.91 (0.08)	0.97 (0.03)	1.06 (0.09)	1.00 (0.04)	0.79 (0.08)*	0.95 (0.04)	0.87 (0.09)	1.11 (0.08)	0.95 (0.13)	1.00 (0.07)	1.14 (0.16)
Skilled labourers	1.10 (0.04)**	2.28 (0.16)**	1.18 (0.04)**	2.73 (0.19)**	1.01 (0.05)	1.47 (0.16)**	1.13 (0.06)*	1.66 (0.19)**	1.17 (0.07)*	3.01 (0.32)**	1.21 (0.06)**	3.47 (0.34)**
Semi-skilled labourers	1.16 (0.04)**	2.19 (0.16)**	1.30 (0.05)**	2.49 (0.19)**	1.05 (0.04)	1.51 (0.15)**	1.16 (0.06)**	1.67 (0.19)**	1.26 (0.08)**	2.95 (0.32)**	1.46 (0.08)**	3.23 (0.34)**
Unskilled labourers	1.16 (0.04)**	2.28 (0.16)**	1.28 (0.05)**	2.87 (0.21)**	1.03 (0.04)	1.72 (0.16)**	1.14 (0.05)**	1.85 (0.20)**	1.27 (0.08)**	2.96 (0.32)**	1.38 (0.08)**	3.73 (0.39)**
Economic activity (ref. Manufacturing)												
Primary sector	0.66 (0.06)**	0.88 (0.09)	0.82 (0.10)	1.04 (0.13)	0.79 (0.14)	1.11 (0.32)	0.91 (0.18)	1.84 (0.55)*	0.60 (0.06)**	0.83 (0.09)	0.84 (0.11)	0.95 (0.13)
Construction	0.86 (0.02)**	1.14 (0.04)**	1.00 (0.04)	1.21 (0.06)**	0.69 (0.05)**	0.76 (0.12)	1.05 (0.09)	0.67 (0.17)	0.82 (0.02)**	1.06 (0.04)	0.92 (0.04)	1.16 (0.07)**
Wholesale and retail trade	0.93 (0.03)*	0.85 (0.04)**	1.06 (0.04)	0.91 (0.05)	1.01 (0.04)	1.06 (0.09)	1.13 (0.05)**	1.00 (0.10)	0.90 (0.03)**	0.79 (0.04)**	1.00 (0.04)	0.87 (0.05)*
Hotels, restaurants and transport	0.79 (0.02)**	0.67 (0.03)**	0.98 (0.03)	0.84 (0.04)**	0.90 (0.04)*	1.04 (0.09)	0.96 (0.05)	0.73 (0.10)	0.73 (0.03)**	0.57 (0.03)**	0.95 (0.05)	0.83 (0.05)**
Finance and other business activities	0.62 (0.02)**	0.60 (0.03)**	0.97 (0.04)	0.67 (0.04)**	0.72 (0.03)**	0.73 (0.06)**	1.10 (0.05)*	0.75 (0.08)**	0.55 (0.03)**	0.59 (0.03)**	0.85 (0.05)**	0.65 (0.05)**
Other services	0.79 (0.03)**	0.68 (0.04)**	1.24 (0.06)**	0.85 (0.06)*	0.89 (0.04)*	0.90 (0.09)	1.33 (0.07)**	1.02 (0.11)	0.69 (0.03)**	0.57 (0.04)**	1.19 (0.08)**	0.79 (0.07)*
Type of employer (ref. Limited corporation (S.L.))												
Corporation (S.A.)	1.01 (0.02)	1.03 (0.03)	1.09 (0.03)**	1.00 (0.04)	1.01 (0.03)	1.01 (0.06)	1.19 (0.04)**	1.00 (0.07)	1.03 (0.03)	1.05 (0.04)	1.01 (0.04)	1.00 (0.05)
NGO or association	1.06 (0.04)	0.95 (0.06)	1.01 (0.05)	0.64 (0.08)**	1.01 (0.05)	1.04 (0.11)	1.03 (0.06)	0.75 (0.12)	1.15 (0.07)*	0.90 (0.07)	1.01 (0.07)	0.58 (0.09)**
Local government	0.99 (0.04)	0.62 (0.04)**	1.07 (0.14)	1.05 (0.18)	0.97 (0.06)	0.70 (0.08)**	0.93 (0.13)	0.69 (0.23)	1.15 (0.07)*	0.70 (0.06)**	1.33 (0.23)	1.36 (0.25)
Public organization	1.25 (0.06)**	0.65 (0.07)**	1.27 (0.11)**	0.66 (0.11)*	1.19 (0.07)**	0.55 (0.09)**	1.33 (0.12)**	0.84 (0.18)	1.50 (0.12)**	0.81 (0.13)	1.17 (0.13)	0.55 (0.12)**
Central or regional government	1.52 (0.09)**	0.72 (0.11)*	1.06 (0.11)	0.45 (0.10)**	1.40 (0.09)**	0.74 (0.14)	0.91 (0.11)	0.49 (0.14)*	1.98 (0.19)**	0.68 (0.16)	1.40 (0.17)**	0.41 (0.14)*
Other kind of organization	0.90 (0.04)*	0.86 (0.05)*	0.92 (0.05)	0.75 (0.08)**	0.95 (0.06)	0.90 (0.11)	0.99 (0.06)	0.79 (0.12)	0.87 (0.05)*	0.85 (0.06)*	0.84 (0.07)*	0.72 (0.10)*
Physical person	0.77 (0.02)**	0.71 (0.03)**	0.77 (0.03)**	0.65 (0.04)**	0.86 (0.03)**	0.77 (0.07)**	0.77 (0.03)**	0.61 (0.07)**	0.72 (0.02)**	0.70 (0.03)**	0.78 (0.04)**	0.67 (0.05)**
Number employees of the firm (ref. 1,001 – 5,000)												
0-50	0.62 (0.03)**	0.89 (0.07)	0.56 (0.03)**	0.74 (0.07)**	0.59 (0.03)**	0.63 (0.07)**	0.59 (0.04)**	0.49 (0.06)**	0.67 (0.05)**	1.09 (0.11)	0.55 (0.04)**	1.03 (0.14)
51-100	0.74 (0.04)**	1.16 (0.09)	0.68 (0.04)**	0.96 (0.10)	0.73 (0.05)**	0.97 (0.11)	0.72 (0.05)**	0.81 (0.10)	0.78 (0.06)**	1.35 (0.14)**	0.65 (0.05)**	1.20 (0.17)
101-300	0.77 (0.04)**	1.11 (0.09)	0.72 (0.05)**	0.92 (0.09)	0.75 (0.04)**	0.95 (0.10)	0.78 (0.05)**	0.72 (0.09)**	0.80 (0.06)**	1.28 (0.13)*	0.69 (0.06)**	1.20 (0.17)

	301-600	0.85 (0.05)**	1.09 (0.09)	0.83 (0.06)**	1.00 (0.11)	0.89 (0.06)*	1.12 (0.13)	0.91 (0.07)	0.85 (0.12)	0.80 (0.06)**	1.10 (0.12)	0.77 (0.07)**	1.26 (0.19)
	601-1,000	0.95 (0.07)	1.02 (0.10)	0.97 (0.07)	0.99 (0.13)	0.99 (0.07)	0.94 (0.13)	1.02 (0.08)	0.92 (0.14)	0.89 (0.08)	1.10 (0.15)	0.90 (0.09)	1.11 (0.20)
	More than 5,000	0.83 (0.13)	0.66 (0.14)*	0.90 (0.16)	1.02 (0.25)	0.84 (0.11)	0.55 (0.14)*	0.83 (0.15)	0.56 (0.19)	0.78 (0.19)	0.78 (0.18)	1.06 (0.21)	1.62 (0.47)
Wage quintile (ref. Quintile 3)													
	Quintile 1	1.09 (0.03)**	0.99 (0.04)	0.92 (0.03)**	0.73 (0.04)**	1.11 (0.04)**	1.08 (0.08)	0.95 (0.04)	0.76 (0.07)**	1.08 (0.04)*	0.99 (0.05)	0.83 (0.05)**	0.66 (0.06)**
	Quintile 2	1.09 (0.02)**	0.96 (0.03)	1.06 (0.03)*	0.92 (0.04)	1.17 (0.04)**	1.24 (0.08)**	1.08 (0.04)*	0.93 (0.07)	1.03 (0.03)	0.88 (0.03)**	1.04 (0.04)	0.89 (0.05)*
	Quintile 4	0.95 (0.02)**	1.02 (0.03)	1.07 (0.03)*	1.01 (0.04)	0.94 (0.03)	1.03 (0.08)	1.02 (0.04)	0.85 (0.08)	0.96 (0.02)	1.02 (0.03)	1.10 (0.04)*	1.07 (0.05)
	Quintile 5	0.88 (0.02)**	0.93 (0.03)*	1.03 (0.03)	0.89 (0.05)*	0.85 (0.03)**	0.79 (0.08)*	0.99 (0.04)	0.53 (0.06)**	0.90 (0.03)**	0.96 (0.04)	1.06 (0.04)	1.02 (0.06)
Working day (ref. Full-time)													
	Part-time	0.79 (0.02)**	0.56 (0.02)**	0.80 (0.02)**	0.61 (0.03)**	0.83 (0.02)**	0.61 (0.04)**	0.87 (0.03)**	0.65 (0.05)**	0.70 (0.03)**	0.50 (0.03)**	0.66 (0.03)**	0.58 (0.04)**
	Missing			0.75 (0.06)**	0.60 (0.08)**			0.92 (0.08)	0.52 (0.11)**			0.57 (0.06)**	0.63 (0.10)**
Region of residence (ref. Andalucía)													
	Aragón	0.95 (0.05)	1.07 (0.07)	0.76 (0.05)**	0.83 (0.09)	0.84 (0.06)*	0.99 (0.14)	0.69 (0.05)**	0.76 (0.15)	1.05 (0.07)	1.08 (0.08)	0.86 (0.08)	0.83 (0.10)
	Asturias	1.22 (0.06)**	1.00 (0.08)	0.88 (0.07)	1.06 (0.15)	1.01 (0.08)	0.89 (0.14)	0.79 (0.08)*	1.05 (0.27)	1.41 (0.09)**	0.99 (0.09)	0.99 (0.10)	1.01 (0.15)
	Baleares	1.23 (0.05)**	1.20 (0.07)**	0.90 (0.06)	1.05 (0.10)	1.27 (0.08)**	1.11 (0.14)	0.78 (0.07)**	0.96 (0.15)	1.18 (0.07)**	1.23 (0.09)**	1.11 (0.09)	1.10 (0.12)
	Canarias	1.69 (0.05)**	0.87 (0.05)**	1.35 (0.06)**	0.80 (0.07)*	1.60 (0.07)**	0.92 (0.10)	1.23 (0.07)**	0.85 (0.14)	1.77 (0.07)**	0.87 (0.05)*	1.53 (0.10)**	0.78 (0.08)*
	Cantabria	1.36 (0.09)**	0.90 (0.09)	1.16 (0.10)	0.87 (0.14)	1.24 (0.13)*	0.90 (0.18)	1.16 (0.11)	0.90 (0.27)	1.43 (0.11)**	0.88 (0.10)	1.17 (0.15)	0.85 (0.16)
	Castilla y León	0.93 (0.04)	1.08 (0.06)	0.78 (0.04)**	0.97 (0.08)	0.81 (0.05)**	1.02 (0.12)	0.68 (0.05)**	1.05 (0.17)	1.03 (0.05)	1.08 (0.06)	0.89 (0.07)	0.95 (0.10)
	Castilla- La Mancha	1.03 (0.04)	1.31 (0.06)**	0.98 (0.05)	1.03 (0.09)	1.04 (0.07)	1.25 (0.14)*	1.01 (0.07)	0.92 (0.16)	1.02 (0.05)	1.32 (0.07)**	0.94 (0.07)	1.06 (0.11)
	Cataluña	1.30 (0.04)**	1.02 (0.04)	1.00 (0.04)	1.01 (0.06)	1.23 (0.05)**	0.94 (0.07)	0.95 (0.04)	0.89 (0.09)	1.34 (0.05)**	1.05 (0.04)	1.04 (0.05)	1.04 (0.07)
	Valencia	0.93 (0.03)*	1.07 (0.04)	0.81 (0.03)**	0.98 (0.06)	0.89 (0.04)**	0.96 (0.08)	0.80 (0.04)**	0.95 (0.11)	0.96 (0.04)	1.10 (0.05)*	0.83 (0.05)**	0.98 (0.07)
	Extremadura	0.71 (0.05)**	0.84 (0.07)*	0.75 (0.07)**	1.03 (0.14)	0.76 (0.06)**	0.59 (0.11)**	0.77 (0.09)*	0.81 (0.24)	0.69 (0.05)**	0.93 (0.08)	0.73 (0.09)*	1.12 (0.18)
	Galicia	1.08 (0.04)*	1.10 (0.05)*	0.98 (0.07)	0.93 (0.08)	0.93 (0.05)	0.81 (0.09)*	0.93 (0.08)	0.86 (0.14)	1.24 (0.05)**	1.20 (0.06)**	1.01 (0.08)	0.94 (0.10)
	Madrid	1.13 (0.04)**	1.20 (0.05)**	0.86 (0.04)**	1.10 (0.06)	1.08 (0.05)	0.96 (0.08)	0.82 (0.04)**	1.14 (0.12)	1.16 (0.05)**	1.28 (0.05)**	0.91 (0.05)	1.07 (0.07)
	Murcia	1.13 (0.05)**	0.99 (0.06)	0.88 (0.06)	0.89 (0.08)	1.01 (0.06)	1.10 (0.14)	0.91 (0.06)**	0.95 (0.15)	1.24 (0.06)**	0.95 (0.06)	1.08 (0.11)	0.89 (0.10)
	Navarra	1.43	0.86	1.19	0.88	1.29	0.63	1.12	0.74	1.57	0.93	1.29	0.94

	(0.08)**	(0.08)	(0.09)*	(0.14)	(0.11)**	(0.14)*	(0.11)	(0.21)	(0.12)**	(0.10)	(0.13)*	(0.16)
País Vasco	1.26	1.22	1.21	1.22	1.12	0.99	1.17	1.22	1.40	1.26	1.24	1.19
	(0.05)**	(0.06)**	(0.06)**	(0.10)*	(0.06)*	(0.11)	(0.07)*	(0.19)	(0.07)**	(0.08)**	(0.09)**	(0.12)
La Rioja	1.05	0.86	0.89	1.12	1.03	0.53	0.74	1.24	1.08	0.96	1.12	1.02
	(0.10)	(0.13)	(0.10)	(0.18)	(0.13)	(0.21)	(0.10)*	(0.36)	(0.13)	(0.15)	(0.18)	(0.21)
Actual to potential experience ratio (ref. 0.76-1)												
Current job is the first one	0.63	0.66	0.74	0.77	0.58	0.65	0.69	0.74	0.68	0.66	0.75	0.78
	(0.02)**	(0.03)**	(0.03)**	(0.05)**	(0.03)**	(0.07)**	(0.04)**	(0.11)*	(0.03)**	(0.04)**	(0.04)**	(0.06)**
One job before and close to the current one	0.92	0.97	0.91	0.96	0.95	0.89	0.85	0.93	0.87	0.97	0.90	0.92
	(0.03)**	(0.05)	(0.04)*	(0.07)	(0.04)	(0.09)	(0.05)**	(0.13)	(0.04)**	(0.05)	(0.06)	(0.09)
One short job and ended more than 3 years before the current one	0.92	0.93	0.82	0.88	0.93	0.84	0.80	0.83	0.92	0.99	0.90	0.93
	(0.03)*	(0.05)	(0.04)**	(0.08)	(0.04)	(0.09)	(0.05)**	(0.14)	(0.05)	(0.07)	(0.07)	(0.11)
Less than 0.25	0.60	0.60	0.73	1.08	0.59	0.65	0.75	1.12	0.59	0.57	0.67	1.07
	(0.02)**	(0.03)**	(0.04)**	(0.11)	(0.02)**	(0.06)**	(0.05)**	(0.15)	(0.03)**	(0.04)**	(0.08)**	(0.17)
From 0.26 to 0.5	0.93	0.95	0.94	1.04	0.88	0.93	0.92	1.03	1.00	0.97	1.04	1.08
	(0.02)**	(0.03)	(0.03)*	(0.06)	(0.02)**	(0.06)	(0.03)*	(0.09)	(0.03)	(0.04)	(0.06)	(0.09)
From 0.51 to 0.75	1.02	1.00	0.99	1.08	0.95	1.03	0.98	1.05	1.08	0.99	1.03	1.12
	(0.02)	(0.03)	(0.02)	(0.04)*	(0.02)	(0.06)	(0.03)	(0.08)	(0.02)**	(0.03)	(0.03)	(0.05)*
From 1.1 to 2 or more	0.62	0.62	0.95	0.86	0.65	0.59	0.95	0.78	0.61	0.65	0.96	0.90
	(0.02)**	(0.03)**	(0.03)	(0.06)*	(0.03)**	(0.06)**	(0.04)	(0.10)	(0.03)**	(0.04)**	(0.05)	(0.07)
Number of contract signed before current one (ref. from 0 to 10)												
From 11 to 20	1.14	1.15	1.16	1.28	1.15	1.10	1.18	1.34	1.14	1.18	1.16	1.27
	(0.02)**	(0.03)**	(0.02)**	(0.05)**	(0.03)**	(0.06)	(0.03)**	(0.09)**	(0.03)**	(0.04)**	(0.03)**	(0.06)**
More than 20 contracts	1.17	1.17	1.15	1.41	1.16	1.20	1.15	1.31	1.16	1.19	1.20	1.47
	(0.02)**	(0.03)**	(0.03)**	(0.06)**	(0.03)**	(0.08)**	(0.04)**	(0.12)**	(0.03)**	(0.04)**	(0.05)**	(0.08)**
Day of entry into employment (ref. Wednesday)												
Saturday, Sunday and Monday	1.00	1.09	1.03	1.05	0.98	1.00	1.05	1.07	1.00	1.11	1.01	1.05
	(0.02)	(0.03)**	(0.03)	(0.05)	(0.03)	(0.07)	(0.04)	(0.10)	(0.03)	(0.04)**	(0.04)	(0.06)
Tuesday	1.00	1.11	1.02	0.99	1.00	1.17	1.00	0.98	0.98	1.09	1.04	1.00
	(0.02)	(0.04)**	(0.03)	(0.05)	(0.03)	(0.09)*	(0.04)	(0.10)	(0.03)	(0.04)*	(0.05)	(0.06)
Thursday	0.99	1.02	1.02	1.07	1.00	0.91	1.04	1.07	0.99	1.06	0.99	1.06
	(0.02)	(0.04)	(0.03)	(0.06)	(0.03)	(0.07)	(0.05)	(0.12)	(0.03)	(0.04)	(0.05)	(0.07)
Friday	0.93	0.99	1.06	1.01	0.93	0.98	1.07	1.08	0.94	0.99	1.05	0.99
	(0.02)**	(0.04)	(0.04)	(0.06)	(0.03)*	(0.08)	(0.05)	(0.12)	(0.03)	(0.05)	(0.05)	(0.07)
Month of entry into employment (ref. March)												
January	0.95	1.00	0.92	1.14	0.90	0.94	0.93	1.09	0.99	1.01	0.92	1.16
	(0.03)*	(0.05)	(0.04)	(0.08)	(0.04)**	(0.09)	(0.05)	(0.14)	(0.04)	(0.05)	(0.06)	(0.09)
February	0.87	0.97	0.84	1.10	0.85	0.92	0.88	1.02	0.90	0.99	0.82	1.13
	(0.03)**	(0.04)	(0.04)**	(0.07)	(0.03)**	(0.09)	(0.05)*	(0.12)	(0.04)*	(0.05)	(0.05)**	(0.09)
April	0.84	0.97	0.82	0.93	0.77	0.91	0.81	0.92	0.90	0.99	0.85	0.94
	(0.02)**	(0.04)	(0.03)**	(0.06)	(0.03)**	(0.09)	(0.04)**	(0.12)	(0.04)**	(0.05)	(0.05)**	(0.08)
May	0.80	0.91	0.86	0.93	0.74	0.76	0.85	0.95	0.86	0.96	0.87	0.91
	(0.02)**	(0.04)*	(0.03)**	(0.06)	(0.03)**	(0.07)**	(0.04)**	(0.12)	(0.03)**	(0.05)	(0.05)*	(0.07)
June	0.69	0.81	0.86	1.00	0.62	0.69	0.90	0.91	0.75	0.85	0.82	1.03
	(0.02)**	(0.04)**	(0.04)**	(0.07)	(0.02)**	(0.06)**	(0.05)*	(0.12)	(0.03)**	(0.04)**	(0.05)**	(0.08)

July	0.60 (0.02)**	0.79 (0.04)**	0.83 (0.04)**	0.88 (0.07)	0.53 (0.02)**	0.71 (0.07)**	0.81 (0.05)**	0.76 (0.11)*	0.67 (0.03)**	0.81 (0.04)**	0.84 (0.05)**	0.92 (0.08)
August	0.64 (0.02)**	0.76 (0.04)**	0.81 (0.04)**	0.86 (0.07)	0.59 (0.03)**	0.57 (0.06)**	0.82 (0.05)**	0.75 (0.12)	0.69 (0.03)**	0.81 (0.04)**	0.80 (0.05)**	0.89 (0.08)
September	0.77 (0.02)**	0.77 (0.03)**	0.76 (0.03)**	0.89 (0.06)	0.74 (0.03)**	0.60 (0.06)**	0.73 (0.04)**	0.69 (0.08)**	0.79 (0.03)**	0.81 (0.04)**	0.79 (0.05)**	0.96 (0.08)
October	0.70 (0.02)**	0.70 (0.03)**	0.81 (0.03)**	0.89 (0.06)	0.64 (0.03)**	0.60 (0.06)**	0.76 (0.04)**	0.85 (0.10)	0.77 (0.03)**	0.73 (0.04)**	0.89 (0.05)*	0.90 (0.07)
November	0.66 (0.02)**	0.68 (0.03)**	0.70 (0.03)**	0.84 (0.06)*	0.60 (0.03)**	0.58 (0.06)**	0.72 (0.04)**	0.76 (0.10)*	0.72 (0.03)**	0.70 (0.04)**	0.69 (0.04)**	0.86 (0.08)
December	0.62 (0.02)**	0.65 (0.04)**	0.76 (0.04)**	0.73 (0.06)**	0.54 (0.03)**	0.58 (0.06)**	0.73 (0.05)**	0.78 (0.12)	0.70 (0.03)**	0.67 (0.04)**	0.79 (0.06)**	0.70 (0.07)**
Number of observations	206,068		87,991		91,389		41,570		114,679		46,421	
Log-likelihood value	-315,081.8	-122,399.6	-183,624.4	-51,163.1	-140,908.2	-24,953.6	-95,285.1	-14,196.0	-155,753.3	-91,869.3	-76,761.1	-33,999.0

Notes: Standard Errors in parentheses. Significance levels: *significant at 5 per cent; **significant at 1 per cent.

Table A2.2 Estimation results of models on the duration of sick leave. All variables

		TOTAL		WOMEN		MEN	
		Common	Occupational	Common	Occupational	Common	Occupational
Gender and age (ref. Men aged 25-39)							
	Women aged 16-24	1.08 (0.05)	0.82 (0.07)*				
	Women aged 25-39	0.70 (0.03)**	0.66 (0.05)**				
	Women aged 40-54	0.38 (0.02)**	0.52 (0.06)**				
	Women aged 55 or more	0.19 (0.02)**	0.33 (0.09)**				
	Men aged 16-24	1.30 (0.05)**	1.31 (0.08)**				
	Men aged 40-54	0.55 (0.03)**	0.70 (0.05)**				
	Men aged 55 or more	0.23 (0.02)**	0.46 (0.06)**				
Age (ref. Aged 35-39)							
	Aged 16-19			2.02 (0.17)**	1.20 (0.21)	1.64 (0.14)**	1.83 (0.21)**
	Aged 20-24			1.66 (0.10)**	1.28 (0.18)	1.55 (0.10)**	1.62 (0.15)**
	Aged 25-29			1.25 (0.07)**	1.05 (0.15)	1.35 (0.08)**	1.36 (0.12)**
	Aged 30-34			1.06 (0.06)	1.12 (0.16)	1.24 (0.08)**	1.16 (0.10)
	Aged 40-44			0.74 (0.05)**	0.87 (0.14)	0.70 (0.05)**	1.04 (0.11)
	Aged 45-49			0.62 (0.05)**	1.01 (0.19)	0.57 (0.05)**	0.69 (0.09)**
	Aged 50-54			0.46 (0.04)**	0.61 (0.13)*	0.53 (0.05)**	0.69 (0.09)**
	Aged 55-59			0.36 (0.05)**	0.56 (0.16)*	0.27 (0.04)**	0.55 (0.09)**
	Aged 60-64			0.27 (0.05)**	0.31 (0.30)	0.19 (0.04)**	0.51 (0.13)*
Age of the youngest cohabitant (ref. Aged 20 or more)							
	Missing	0.87 (0.06)*	1.12 (0.12)	0.87 (0.09)	1.06 (0.22)	0.86 (0.08)	1.17 (0.15)
	Live alone	0.94 (0.04)	0.90 (0.06)	0.92 (0.05)	0.93 (0.12)	0.98 (0.05)	0.89 (0.07)
	Aged 0-3	0.83 (0.05)**	1.21 (0.12)	0.55 (0.03)**	1.05 (0.13)	1.17 (0.06)**	1.08 (0.08)
	Aged 4-6	1.05 (0.05)	1.07 (0.09)	0.97 (0.07)	1.10 (0.17)	1.18 (0.09)*	1.07 (0.11)
	Aged 7-11	0.90 (0.04)*	0.94 (0.07)	0.79 (0.05)**	0.94 (0.13)	1.04 (0.07)	0.93 (0.09)
	Aged 12-19	0.98 (0.04)	1.11 (0.07)	0.94 (0.05)	1.11 (0.13)	0.99 (0.05)	1.07 (0.08)
People aged 25-39 with children aged under 3							
	Female	0.65 (0.05)**	0.88 (0.15)				
	Male	1.34 (0.11)**	0.86 (0.11)				
Place of birth (ref. Spain)							
	EU-15	1.05 (0.08)	0.77 (0.11)	1.04 (0.11)	1.13 (0.32)	1.07 (0.12)	0.74 (0.12)
	Rest of Europe	1.01 (0.08)	0.99 (0.12)	1.22 (0.14)	1.12 (0.30)	0.89 (0.09)	1.03 (0.15)
	Latin America	1.31 (0.06)**	1.26 (0.09)**	1.44 (0.09)**	1.21 (0.15)	1.26 (0.09)**	1.35 (0.13)**
	Africa	1.20 (0.09)*	1.49 (0.14)**	1.14 (0.16)	1.81 (0.41)**	1.23 (0.11)*	1.49 (0.16)**
	Rest of the world	1.32 (0.22)	1.55 (0.43)	1.12 (0.41)	2.12 (1.71)	1.37 (0.27)	1.59 (0.50)

Degree of disability (ref. No disability)						
From 33% to 64%	0.48 (0.05)**	0.62 (0.10)**	0.56 (0.09)**	1.19 (0.28)	0.45 (0.07)**	0.54 (0.12)**
65% or more	0.43 (0.10)**	0.78 (0.53)	0.47 (0.16)*	0.12 (0.25)	0.46 (0.15)*	1.25 (0.91)
Social Security contribution group (ref. Skilled clerks)						
Engineers and other university graduates	0.72 (0.06)**	0.76 (0.23)	0.68 (0.06)**	1.40 (0.60)	0.85 (0.12)	0.37 (0.14)**
Engineering technicians and other skilled workers	0.90 (0.06)	1.01 (0.25)	0.84 (0.07)*	1.06 (0.32)	1.00 (0.14)	0.79 (0.32)
Administrative chiefs and managers	0.64 (0.07)**	1.19 (0.28)	0.58 (0.08)**	1.51 (0.55)	0.84 (0.15)	0.90 (0.28)
Assistants and other semi-skilled workers	0.73 (0.07)**	1.34 (0.29)	0.71 (0.08)**	2.04 (0.77)	0.82 (0.14)	0.92 (0.27)
Semi-skilled clerks	0.78 (0.06)**	1.17 (0.18)	0.78 (0.07)**	1.65 (0.32)*	0.84 (0.11)	0.81 (0.19)
Assistant clerks	1.13 (0.07)*	1.12 (0.16)	1.04 (0.06)	1.21 (0.20)	1.22 (0.15)	0.84 (0.21)
Skilled labourers	0.79 (0.05)**	1.43 (0.17)**	0.67 (0.05)**	1.56 (0.27)*	1.01 (0.10)	1.16 (0.22)
Semi-skilled labourers	0.83 (0.05)**	1.46 (0.18)**	0.73 (0.05)**	1.67 (0.26)**	1.08 (0.12)	1.15 (0.23)
Unskilled labourers	0.83 (0.05)**	1.47 (0.18)**	0.67 (0.04)**	1.56 (0.24)**	1.13 (0.12)	1.20 (0.24)
Economic activity (ref. Manufacturing)						
Primary sector	0.67 (0.11)*	0.98 (0.21)	0.70 (0.19)	0.90 (0.43)	0.69 (0.13)	1.04 (0.25)
Construction	0.71 (0.03)**	0.94 (0.06)	0.45 (0.06)**	0.78 (0.22)	0.73 (0.04)**	0.93 (0.07)
Wholesale and retail trade	0.81 (0.04)**	0.92 (0.07)	0.72 (0.05)**	0.85 (0.12)	0.89 (0.06)	0.96 (0.09)
Hotels, restaurants and transport	0.72 (0.04)**	0.92 (0.07)	0.65 (0.05)**	0.94 (0.13)	0.81 (0.06)**	0.85 (0.08)
Finance and other business activities	0.72 (0.04)**	0.90 (0.07)	0.71 (0.05)**	0.90 (0.13)	0.71 (0.05)**	0.93 (0.10)
Other services	0.87 (0.05)*	0.80 (0.08)*	0.80 (0.06)**	0.78 (0.13)	0.90 (0.09)	0.80 (0.12)
Type of employer (ref. Limited corporation (S.L.))						
Corporation (S.A.)	1.11 (0.04)**	1.03 (0.05)	1.12 (0.05)*	0.96 (0.09)	1.13 (0.05)*	1.09 (0.07)
NGO or association	1.01 (0.07)	0.78 (0.10)*	1.02 (0.08)	0.83 (0.17)	1.00 (0.11)	0.74 (0.12)
Local government	0.76 (0.06)**	1.19 (0.19)	0.76 (0.07)**	1.41 (0.32)	0.90 (0.12)	1.11 (0.25)
Public organization	1.18 (0.10)	0.75 (0.17)	1.22 (0.11)*	0.87 (0.26)	1.13 (0.20)	0.62 (0.20)
Central or regional government	0.61 (0.06)**	0.85 (0.27)	0.66 (0.07)**	1.05 (0.36)	0.58 (0.09)**	0.44 (0.23)
Other kind of organization	0.75 (0.05)**	0.87 (0.10)	0.74 (0.06)**	0.92 (0.17)	0.82 (0.10)	0.88 (0.13)
Physical person	0.68 (0.03)**	0.76 (0.06)**	0.73 (0.05)**	0.93 (0.14)	0.65 (0.04)**	0.72 (0.06)**
Number employees of the firm (ref. 1,001 – 5,000)						
0-50	0.63 (0.05)**	0.85 (0.10)	0.66 (0.05)**	0.70 (0.11)*	0.60 (0.07)**	1.00 (0.17)
51-100	0.73 (0.06)**	0.94 (0.12)	0.77 (0.07)**	0.74 (0.14)	0.70 (0.09)**	1.13 (0.20)
101-300	0.69 (0.05)**	0.94 (0.11)	0.74 (0.06)**	0.75 (0.12)	0.64 (0.08)**	1.17 (0.20)
301-600	0.80 (0.07)**	0.88 (0.12)	0.85 (0.07)	0.79 (0.15)	0.75 (0.10)*	1.00 (0.19)
601-1,000	0.97 (0.09)	0.98 (0.15)	1.01 (0.10)	0.99 (0.20)	0.89 (0.14)	0.99 (0.22)
More than 5,000	1.03 (0.14)	0.84 (0.21)	1.01 (0.15)	0.72 (0.23)	1.07 (0.21)	1.14 (0.35)
Type of contract and work time (ref. fixed-term and full-time)						
Open-ended and full-time	0.95 (0.03)	1.00 (0.05)	0.94 (0.04)	1.10 (0.11)	1.01 (0.04)	1.01 (0.06)
Open-ended and part-time	0.82 (0.04)**	0.97 (0.09)	0.85 (0.05)**	1.02 (0.12)	0.90 (0.09)	1.11 (0.17)
Fixed-term and part-time	1.18 (0.05)**	0.86 (0.08)	1.19 (0.06)**	0.90 (0.11)	1.14 (0.10)	0.88 (0.12)

Other kind of contract	0.98 (0.08)	1.05 (0.38)	0.97 (0.10)	0.98 (0.60)	1.13 (0.15)	1.29 (0.56)
Wage quintile (ref. Quintile 3)						
Quintile 1	0.89 (0.04)**	1.04 (0.08)	0.96 (0.05)	0.93 (0.12)	0.84 (0.06)*	1.13 (0.12)
Quintile 2	0.94 (0.04)	1.08 (0.06)	0.96 (0.05)	1.15 (0.13)	0.95 (0.05)	1.07 (0.08)
Quintile 4	1.07 (0.04)	1.01 (0.06)	1.06 (0.07)	0.94 (0.13)	1.10 (0.06)	1.02 (0.07)
Quintile 5	1.01 (0.05)	1.00 (0.07)	1.08 (0.07)	1.02 (0.18)	0.99 (0.06)	1.00 (0.08)
Region of residence (ref. Andalucía)						
Aragón	1.35 (0.13)**	0.57 (0.08)**	1.42 (0.17)**	0.77 (0.18)	1.33 (0.18)*	0.54 (0.09)**
Asturias	1.18 (0.11)	0.56 (0.09)**	1.20 (0.16)	0.53 (0.18)	1.14 (0.15)	0.54 (0.10)**
Baleares	1.56 (0.11)**	1.32 (0.16)*	1.60 (0.16)**	1.32 (0.28)	1.50 (0.15)**	1.37 (0.21)*
Canarias	1.31 (0.08)**	1.31 (0.15)*	1.33 (0.10)**	1.66 (0.35)*	1.29 (0.10)**	1.24 (0.17)
Cantabria	1.80 (0.18)**	0.49 (0.13)**	1.75 (0.26)**	0.74 (0.39)	1.86 (0.27)**	0.42 (0.12)**
Castilla y León	1.34 (0.10)**	0.98 (0.10)	1.50 (0.15)**	1.50 (0.27)*	1.23 (0.12)*	0.86 (0.11)
Castilla- La Mancha	1.11 (0.08)	1.11 (0.10)	1.10 (0.11)	1.38 (0.26)	1.17 (0.12)	1.11 (0.12)
Cataluña	1.18 (0.06)**	0.93 (0.06)	1.23 (0.08)**	1.14 (0.15)	1.12 (0.07)	0.89 (0.07)
Valencia	0.65 (0.03)**	0.62 (0.04)**	0.71 (0.05)**	0.86 (0.11)	0.60 (0.04)**	0.57 (0.05)**
Extremadura	0.96 (0.12)	0.96 (0.14)	1.00 (0.14)	1.24 (0.49)	0.98 (0.18)	0.88 (0.14)
Galicia	0.72 (0.04)**	0.51 (0.05)**	0.69 (0.06)**	0.63 (0.13)*	0.75 (0.06)**	0.48 (0.06)**
Madrid	1.76 (0.09)**	1.21 (0.09)**	1.89 (0.13)**	1.43 (0.20)*	1.63 (0.12)**	1.18 (0.10)
Murcia	0.88 (0.07)	0.54 (0.06)**	0.77 (0.09)*	0.53 (0.13)*	0.99 (0.11)	0.54 (0.07)**
Navarra	3.26 (0.32)**	1.01 (0.18)	3.25 (0.43)**	0.95 (0.40)	3.09 (0.42)**	1.01 (0.21)
País Vasco	1.11 (0.07)	0.81 (0.09)	1.21 (0.11)*	0.89 (0.21)	1.03 (0.09)	0.77 (0.10)*
La Rioja	1.80 (0.32)**	1.18 (0.28)	1.40 (0.32)	1.01 (0.41)	2.48 (0.62)**	1.23 (0.35)
Actual to potential experience ratio (ref. 0.76-1)						
Current job is the first one	1.31 (0.07)**	0.86 (0.07)	1.39 (0.11)**	1.08 (0.18)	1.22 (0.10)*	0.79 (0.08)*
One job before and close to the current one	1.38 (0.07)**	0.92 (0.08)	1.38 (0.09)**	1.23 (0.20)	1.30 (0.11)**	0.80 (0.09)
One short job and ended more than 3 years before the current one	1.20 (0.07)**	0.95 (0.10)	1.25 (0.10)**	1.11 (0.21)	1.15 (0.11)	0.90 (0.12)
Less than 0.25	1.12 (0.07)	0.89 (0.09)	1.23 (0.09)**	0.84 (0.13)	0.99 (0.11)	1.02 (0.13)
From 0.26 to 0.5	1.01 (0.04)	0.98 (0.07)	1.07 (0.05)	1.09 (0.14)	1.00 (0.06)	0.94 (0.08)
From 0.51 to 0.75	0.98 (0.03)	0.96 (0.05)	0.97 (0.04)	1.06 (0.11)	1.01 (0.05)	0.92 (0.06)
From 1.1 to 2 or more	0.93 (0.05)	0.77 (0.07)**	0.92 (0.06)	0.94 (0.17)	0.97 (0.07)	0.72 (0.08)**
Number of contract signed before current one (ref. from 0 to 10)						
From 11 to 20	1.02 (0.03)	1.10 (0.06)	1.02 (0.04)	0.92 (0.09)	1.02 (0.05)	1.21 (0.08)**
More than 20 contracts	1.05 (0.04)	1.09 (0.07)	1.06 (0.05)	0.81 (0.09)	1.06 (0.05)	1.26 (0.09)**
Day of entry into sick leave (ref. Wednesday)						
Saturday, Sunday and Monday	0.81 (0.03)**	0.82 (0.05)**	0.97 (0.04)	0.99 (0.11)	0.67 (0.03)**	0.78 (0.05)**
Tuesday	0.97 (0.04)	1.02 (0.06)	1.00 (0.05)	0.94 (0.12)	0.94 (0.05)	1.05 (0.08)
Thursday	0.87 (0.04)**	0.93 (0.06)	0.92 (0.05)	1.11 (0.14)	0.82 (0.05)**	0.89 (0.07)
Friday	0.69 (0.03)**	0.56 (0.04)**	0.75 (0.04)**	0.91 (0.11)	0.65 (0.04)**	0.46 (0.04)**

Month of entry into sick leave (ref. March)						
January	0.90 (0.04)*	0.97 (0.10)	0.93 (0.06)	0.98 (0.18)	0.88 (0.07)	0.94 (0.11)
February	0.94 (0.05)	0.95 (0.09)	0.98 (0.07)	1.03 (0.19)	0.90 (0.07)	0.90 (0.10)
April	0.78 (0.04)**	1.19 (0.12)	0.84 (0.06)*	1.19 (0.23)	0.72 (0.06)**	1.17 (0.14)
May	0.69 (0.04)**	1.19 (0.11)	0.72 (0.05)**	1.20 (0.21)	0.67 (0.05)**	1.17 (0.13)
June	0.66 (0.04)**	1.20 (0.11)	0.72 (0.05)**	1.44 (0.25)*	0.61 (0.05)**	1.12 (0.12)
July	0.68 (0.04)**	1.15 (0.11)	0.72 (0.05)**	1.27 (0.22)	0.64 (0.05)**	1.08 (0.12)
August	0.66 (0.04)**	1.02 (0.10)	0.68 (0.05)**	1.30 (0.23)	0.66 (0.06)**	0.90 (0.10)
September	0.68 (0.04)**	0.99 (0.09)	0.64 (0.05)**	1.20 (0.21)	0.73 (0.06)**	0.93 (0.11)
October	0.74 (0.04)**	0.98 (0.09)	0.72 (0.05)**	0.87 (0.16)	0.78 (0.06)**	0.99 (0.11)
November	0.81 (0.04)**	1.00 (0.09)	0.82 (0.05)**	1.04 (0.18)	0.79 (0.06)**	0.96 (0.11)
December	0.80 (0.04)**	0.87 (0.09)	0.83 (0.06)**	0.81 (0.15)	0.76 (0.06)**	0.88 (0.11)
Job tenure until sick leave (ref. Quantile 1)						
Quantile 2	1.01 (0.04)	0.90 (0.05)	0.93 (0.04)	0.94 (0.10)	1.11 (0.06)*	0.88 (0.06)
Quantile 3	0.88 (0.03)**	0.90 (0.05)	0.86 (0.04)**	0.89 (0.09)	0.92 (0.04)	0.92 (0.06)
Quantile 4	0.73 (0.02)**	0.85 (0.05)**	0.68 (0.03)**	0.97 (0.10)	0.78 (0.04)**	0.82 (0.05)**
Entity responsible for payment (ref. MATEPSS)						
National Social Security Institute	0.60 (0.02)**		0.61 (0.02)**		0.58 (0.02)**	
Number of observations	43,017	15,038	21,988	3,621	21,029	11,417
Log-likelihood value	-74,943.2	-20,833.4	-38,749.3	-4,853.5	-35,976.5	-15,882.4

Notes: Standard Errors in parentheses. Significance levels: *significant at 5 per cent; **significant at 1 per cent.

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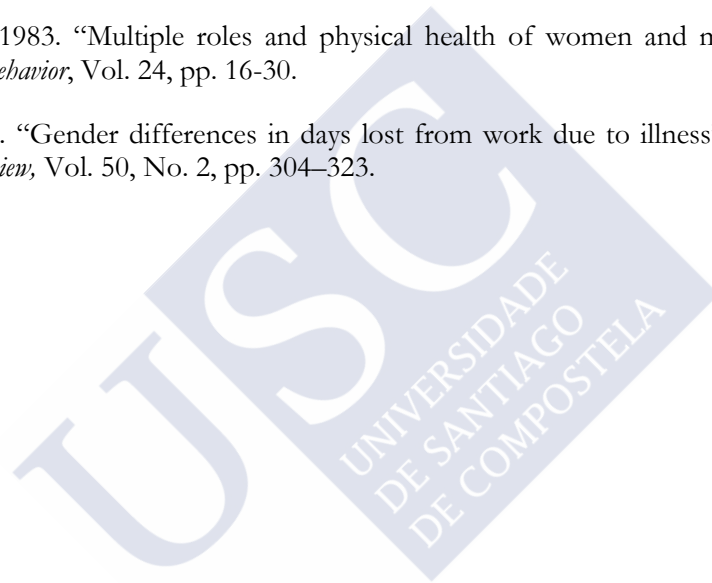
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CHAPTER 3

The impact of worker's age on the consequences of workplace accidents: Empirical evidence using Spanish data

1. Introduction

In the coming years, the Spanish labour force will age significantly. From 2012 to 2020, the economically active population aged 60 and over will increase by 33 per cent¹³. Moreover, by 2020, workers aged 60 and over will represent 6.2 per cent of the labour force, while they accounted for 4.7 per cent in 2012. As a result, older workers will be called on to remain productive later in life and to assume more strenuous jobs. In fact, the demographic pressure has led the European Union to develop some measures to foster what has been called active ageing, within the Stockholm and Barcelona targets (von Nordheim, 2004; Walker, 2008). The main goal is to achieve an increase in the participation rate of the elderly. These measures have been followed by complementary decisions by national governments. For example, in 2011, Spain delayed the mandatory retirement age from 65 to 67 years old (through a gradual increase from 2013 to 2027). If all of these measures succeed, the most visible result will be an increased number of older workers in the labour market. This ageing of the labour force may have important consequences for workplace accidents.

When the relationship between age and the consequences of the work-related injuries is analysed, it is important to take into account that older workers may exhibit certain characteristics that may exert opposite effects. On the one hand, these workers are generally more experienced and have a greater concern for the risks related to their job. This tends to reduce the number of injuries suffered by this group. On the other hand, given their age, these workers have a decreased ability to avoid unexpected accidents, suffer from diminished hearing and sight, and exude excessive confidence due to their experience, which could lead them to disregard the prevention measures for certain risks (Root, 1981; Blanch et al., 2009). Therefore, a priori, it is not easy to disentangle the ways in which ageing affects consequences of occupational injuries.

The evidence about the relationship between age and workplace accidents has been highly contradictory. Nevertheless, the most common finding is that accident frequency tends to decrease as age increases (Root, 1981; Mitchell, 1988), but that accident severity tends to increase with age (Landen and Hendricks, 1992; Truchon and Fillion, 2000). However, a negative relationship between age and accident severity was found in the case of temporary disabilities (Root, 1981; Mitchell, 1988), as well as to the average number of lost working days for white-

¹³ Author's calculations based on *Economically Active Population, Estimates and Projections* database (ILO, Department of Statistics).

collar and service workers (Dillingham, 1981). Additionally, a U-shaped relationship between age and the number of lost days per injury has also been reported (Blanch et al., 2009).

This chapter sheds light on this debate by providing empirical evidence regarding the effect of the worker's age on the severity of work-related injuries. Using data from the Spanish Statistics on Accidents at Work (*Estadística de Accidentes de Trabajo* in Spanish, EAT), an administrative record of all of the workplace accidents that cause sick leave, we assess if, once the accident has happened, the age of the worker has a significant effect on the severity of his or her injury, as well as on the duration of the sick leave. We add to the literature in several respects. First, previous authors who have examined this issue have generally used survey data. This type of data involve several limitations, among them the possibility of bias since the data on risk factors and workplace injuries are collected in the same questionnaire. The bias could occur because certain risk factors could make subjects more likely to remember work-related injuries and vice versa. We solve this limitation by using administrative data that contains information about all the work accidents that have occurred during a whole year and where all the information related to the accident is collected when the accident occurred. Second, the other important advantage of the database is that it includes a wide set of variables related to how the accident happened and its consequences. This allows us to take into account unobserved accident heterogeneity, a fact that, as discussed in next section, is especially relevant because older workers are more prone to suffer some type of accident or injury. Finally, the analysis takes into account two aspects of the consequences of workplace accidents: the degree of the injury and the duration of the sick leave. This allows us to study if there are differences in both dimensions across workers classified according to their age.

In this context the chapter is organised as follows. Section 2 describes the data used and summarises a descriptive analysis. Section 3 provides an econometric analysis of the impact of age on the severity of injuries, while Section 4 presents the results of the estimation of a model explaining the impact of age on the duration of the sick leave caused by workplace injuries. Finally, Section 5 presents the main conclusions.

2. Data and descriptive statistics

In this section, we present the data used in the chapter and summarise the main descriptive statistics. In turn, this will serve to characterise the workplace accidents suffered by individuals classified according to their age.

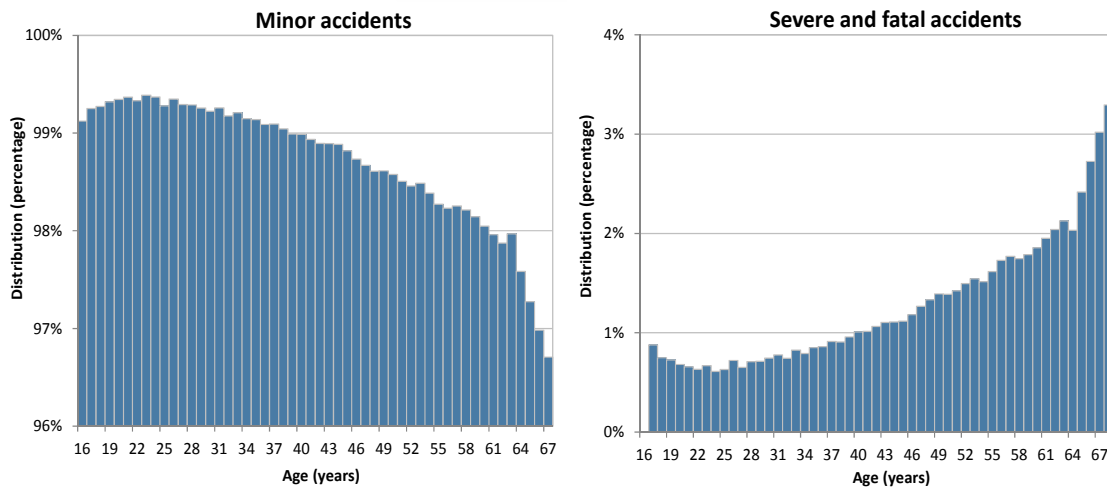
The data used are the administrative microdata from the Spanish Statistics on Accidents at Work (*Estadística de Accidentes de Trabajo* in Spanish, EAT), compiled by the Spanish Ministry of Labour. This database is based on administrative registrations of all of the workplace accidents that cause sick leave. Thus, the database includes every accident that cause the injured person to miss at least one day of work (excluding the day when the accident occurred) after a medical report is issued. In the event that an accident occurs, employers (or workers themselves when the injured person is self-employed) must fill in a form where they report (through the so-called *parte de accidentes de trabajo con baja*, PAT) all of the information related to the accident.

The EAT provides information on personal characteristics of each individual who has suffered an accident –such as gender, age, and place of birth– and also information about their professional characteristics –such as job seniority, type of contract, occupation, and daily earnings. Moreover, the EAT also contains information related to employer’s characteristics, such as industry, sector (public versus private), province where the firm operates, and number of workers in the firm. The EAT includes information on the establishment where the accident happened if the establishment is different from the place that the injured worker belongs. Finally, the EAT provides exhaustive information on the causes, circumstances, and consequences of the accident.

Regarding the sample selection we perform for our analysis, we focus on workplace accidents that occurred between 2004 and 2010. This is because a new notification procedure was fully implemented in 2004 and some relevant variables not considered previously were included in the files. Still, 2010 is the last year for which there is fully available information. In order to reduce heterogeneity associated with the labour supply side, we limit our sample to those workers covered by the Social Security General Regime. We also exclude self-employed workers from the sample because they are likely to have different incentives and possibilities to report work-related injuries. Moreover, observations corresponding to commuting accidents (i.e., those that occurred while the worker was commuting to or from his or her workplace) and to relapses have been deleted. Our selected sample, therefore, consists of 5,104,179 workplace accidents, of which 5,053,188 (99 per cent) are minor and 50,991 (1 per cent) are severe or fatal.

Figure 3.1 provides descriptive statistics to compare the consequences of workplace accidents across workers grouped by age. We observe that the injuries of older workers are substantially more likely to be severe or fatal than those of younger workers. Indeed, the more severe cases and fatalities account for larger proportions of the accidents among older workers than among younger ones. Conversely, minor accidents are more prevalent among younger workers.

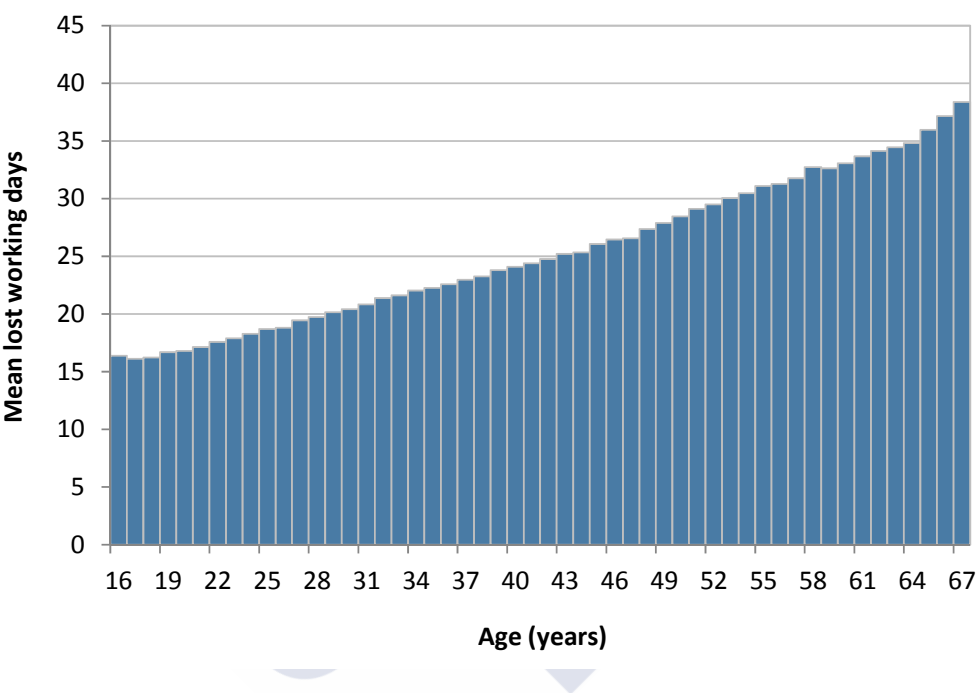
Figure 3.1 Distribution of the severity of workplace accidents by age



Source: Own elaboration based on EAT.

Figure 3.1 suggests that a work-related accident to an older worker would more likely result in greater severity of injury than it would if the same accident happened to a younger worker. As a result, it is expected that the average duration of the sick leave caused by a work-related injury would increase with age. In fact, Figure 3.2 shows that the highest average in lost working days due to work-related injury is found for higher age intervals. In particular, the average number of non-working days among workers aged 65 and over (36.6 days) is twice as high as for workers aged 16 to 24 (17.3 days).

Figure 3.2 Mean lost working days due to workplace accidents by age



Source: Own elaboration based on EAT.

Differences in the consequences of work-related injuries between older and younger workers could reflect the physical effects of ageing. For instance, declining bodily coordination among older workers could likely contribute to a greater number of injuries due to falling. Table 3.1 provides the distribution of work-related injuries according to the worker’s specific physical activity at the moment the accident occurred as well as how the injury was incurred, both broken down by the worker’s age. A look at the events leading to workplace accidents suggests that the relative risks of some types of events jump for the oldest group of workers. For instance, injuries due to bodily motion among workers aged 65 and over account for 42.1 per cent of all their injuries, but for workers aged 16-24 they represent only 23.6 per cent. Conversely, injuries associated with handling of objects are significantly higher for younger workers. The frequency declines from 32.5 per cent among 16-24 year-olds to 22.4 per cent for workers aged 65 and older.

Likewise, there also are age-specific patterns in how the injury was incurred. Falls account for about 23 per cent of injuries to workers aged 65 and over, but the percentage steadily declines

for younger workers (9.5 per cent). Conversely, injuries due to contact with sharp, pointed, rough, or coarse objects are markedly more frequent for younger workers. For workers aged 16 to 24, the contact with a sharp object produces 15.9 per cent of injuries compared with about 9.7 per cent for workers aged 65 and over (see Table 3.1).

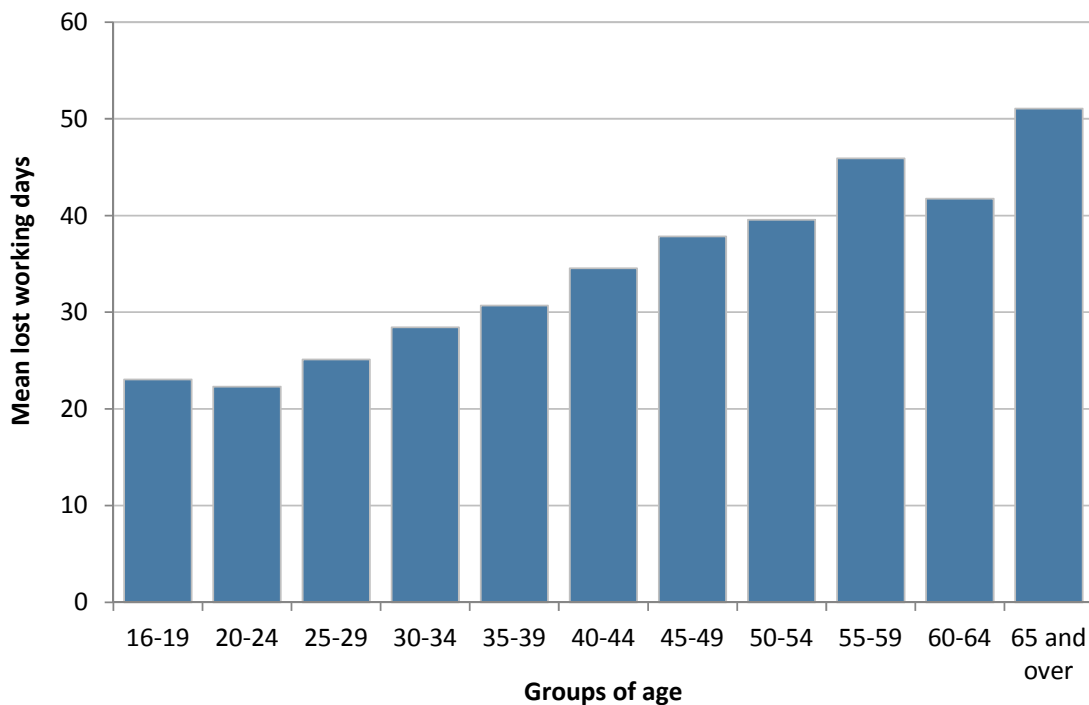
Table 3.1 Distribution of the characteristics of workplace accidents by age (percentage)

	16-24	25-39	40-49	50-59	60-64	65 and over
<i>Specific physical activity</i>						
Bodily motion	23.6	26.9	30.3	32.9	35.2	42.1
Handling of objects	32.5	30.6	29.3	28.2	26.6	22.4
Working with hand-held tools	15.7	14.3	13.6	13.6	14.0	11.9
Carrying by hand	14.2	13.7	13.4	12.2	11.6	9.9
Driving/being onboard a means of transport	5.8	5.7	4.8	3.9	4.0	5.3
Operating machinery	5.9	6.1	5.7	6.1	5.5	4.0
Other	2.4	2.7	2.9	3.0	3.2	4.4
<i>Mode of injury</i>						
Suffered acute overloading of body	31.9	38.4	40.5	37.8	33.6	27.3
Fall	9.5	10.0	11.6	14.3	17.1	23.4
Struck by or collided with something	21.4	18.5	16.7	16.5	17.0	17.5
Crashed into something	10.1	9.9	10.1	10.7	11.4	11.4
Came into contact with sharp, pointed, rough, or coarse object	15.9	12.5	10.7	10.2	10.7	9.7
Contact with electric voltage, temperature extreme, or hazardous substance	3.7	3.5	3.3	3.1	2.9	2.6
Trapped, crushed	3.6	3.1	2.9	3.0	2.8	2.6
Kicked or bitten	1.0	1.3	1.3	1.0	1.0	1.4
Heart attacks, strokes, or other non-traumatic pathologies	0.0	0.1	0.2	0.5	0.7	1.0
Drowning, buried	0.3	0.4	0.3	0.3	0.3	0.3
Other	2.6	2.4	2.4	2.5	2.6	2.8

Source: Own elaboration based on EAT.

Beyond the fact that older workers are more likely to be injured when they are performing physical activity (i.e., movement) or are more prone to certain type of accidents (i.e., falls), they will remain absent from their job more days than their younger counterparts who suffer the same work-related injury. Figure 3.3 depicts the mean lost working days due to a fall in the workplace for workers in elementary occupations in the manufacturing sector, separated by 11 age intervals. Once a worker has been injured by a fall in the workplace, the average number of lost working days is higher among the oldest group of workers than among other workers. Thus, workers aged 16-24 show an average of 23 days, while the mean lost working days among workers aged 65 and over is 51 days. This finding might indicate that older workers require a longer period of recuperation of a workplace accident when considering the same industry, occupation, and type of accident because of physiological changes associated with age that affect the body's capacity to heal.

Figure 3.3 Mean lost working days due to a fall in the workplace for manufacturing workers in elementary occupations by age group



Source: Own elaboration based on EAT.

In this section, we have shown that the workplace injuries of workers aged 65 and over are more likely to be severe or fatal. Furthermore, we observe that the physiological characteristics of the worker may imply a concentration of certain types of accidents. However, the descriptive analysis suggests that age effects are not simply the result of job differences between older and younger workers, because the findings hold even when we consider the same occupation, industry, and type of accident. In the next section, we analyse econometrically if age remains as a determinant of the severity of work-related injuries once we control for the worker's personal and professional characteristics, as well as for the characteristics of his or her workplace.

3. The impact of worker's age on the severity of work-related injuries

3.1. Empirical Strategy

The aim of this section is to evaluate empirically the impact of worker's age on the severity of work-related injuries. In particular, we want to identify if, once the accident has happened, the age of the injured worker has a significant effect on the severity of the injury. The basic estimating equation in the analysis is:

$$Y_{ijk} = \alpha + \beta_1 Age_{ijk} + \beta_2 X_{ijk} + \beta_3 V_{jk} + \beta_4 Z_k + \varepsilon_{ijk} \quad (1)$$

where i indexes individuals, j corresponds to a given workplace and k reflects a particular accident; Age is worker's age, X is a vector of worker's characteristics, V is a vector of workplace's characteristics and Z is a vector of variables capturing how the accident occurred.

The probability of a worker suffering a severe or fatal accident rather than minor can be written as a function of a series of covariates as:

$$y_{ijk}^* = \Pr(y_{ijk} = 1) = F(Age_{ijk}, X_{ijk}, V_{jk}, Z_k, \beta) \quad (2)$$

At the individual level we would observe $y_{ijt} = 1$ if $F(Age_{ijk}, X_{ijk}, V_{jk}, Z_k, \beta) > z^*$ and $y_{ijt} = 0$ otherwise. Given the dichotomous nature of the dependent variable, the proper model is a linear probability model (either a logit or a probit).

The explanatory variables in the empirical analysis include several personal characteristics of the workers, job attributes and establishment characteristics, as well as covariates capturing specific characteristics of the accident.

■ *Worker's personal characteristics:*

As discussed in the introduction, although the economic literature has stressed that worker's age is important in determining the severity of work-related accidents, there is no consensus about its effect. Indeed, some studies suggest that the severity of work-related injuries increases with age (Landen and Hendricks, 1992; Truchon and Fillion, 2000) and others, in contrast, find a negative relationship (Root, 1981; Mitchell, 1988, both in the case of temporary disabilities). Additionally, a U-shaped relationship between age and the number of lost days per injury has also been reported (Blanch et al., 2009). To isolate the importance of worker's age as a factor to explain the consequences of work-related accidents, we have introduced five dummy variables to represent age group: aged 25-39; aged 40-49; aged 50-59; aged 60-64; and aged 65 and over. The omitted category in this case is aged 16-24.

The age of the worker is strongly correlated with length of service. Older workers generally are more experienced and are therefore more mindful of workplace hazards. But at the same time, they might be exposed to more dangerous jobs that require greater experience. In order to reduce the heterogeneity among workers due to different levels of experience at the same job, we

have added 5 additional dummy variables: from 3 to 6 months; from 6 months to 1 year; from 1 to 3 years; from 3 to 10 years; and 10 or more years. The group of reference is less than 3 months of job seniority. Moreover, age by tenure interaction has been included as an explanatory variable. Finally, regressions have also been run for employees with 3 years of job seniority or less.

Regarding worker's personal characteristics, we also have controlled for worker's gender and place of birth.

■ *Worker's professional characteristics:*

From the dataset, we observe the worker's status in employment (employed in the private sector versus employed in the public sector), type of contract (open-ended or fixed-term), occupation, and earnings.

Information about the occupations of workers is an extremely important element in the analysis of work-related injuries. Moreover, we can consider this variable as a proxy for educational attainment. We have included nine dummy variables, one for each one of the occupation groups: armed forces; legislators, senior officials and managers; professionals; technicians and associate professionals; clerks; service workers and shop and market sales workers; skilled agricultural and fishery workers; craft and related trade workers; and plant and machine operators and assemblers. The omitted category for comparison is elementary occupations.

As indicated in Chapter 1, a worker's earnings may have an impact on the incentive to report a work-related injury. In particular, the impact of wages on absenteeism is ambiguous due to the income and substitution effects. When the paid sick leave represents 100 per cent of the wage, the substitution effect disappears and the effect of wage on sick leave is therefore positive. However, in the Spanish system the paid sick leave due to work-related injury represents 75 per cent of the wage (as described in Section 2 of Chapter 2). To study which of the two effects has a higher impact, we have introduced a dummy variable for each one of the four salary quantiles with quantile 3 as the omitted category.

■ *Establishment characteristics:*

One of the reasons that the consequences of workplace accidents vary among workers' age groups could be that the establishments where the accidents occur also differ. To uncover potential relationships between the consequences of accidents and the characteristics of establishments, a set of covariates has been included in the estimation: a dummy variable to indicate if the establishment belongs to the worker's firm, economic activity (grouped into ten categories: agriculture, forestry and fishing; mining and quarrying; manufacturing; construction; transportation and storage; accommodation and food service activities; public administration, defence and compulsory social security; education; human health, social work and veterinary activities; and other service activities), the size of the establishment, and its geographic location (coded according to the 17 Spanish regions).

As in many other countries, Spanish health and safety regulations fix certain requirements for safety equipment and procedures in terms of the number of workers employed. The *Occupational Risk Prevention Act (ORPA)* of 1995 requires firms with 500 employees or more in all industries and with 250-499 workers in certain industries to establish their own programmes for the prevention of occupational injuries, including the formation of health and safety committees involving both management and workers. Therefore, the size of the establishment where the accident occurred is a potentially relevant factor in explaining the consequences of workplace accidents, and it can be taken as a proxy of the prevention system that the firms carry out. We have included seven dummy variables to describe the size of the establishment: 5-9 employees, 10-24 employees, 25-49 employees, 50-99 employees, 100-249 employees, 250-499 employees, and 500 and more employees. The group of reference is less than 5 employees. We also have included a dummy variable to indicate if the establishment realised evaluation of workplace risks.

■ *Accident characteristics:*

Additionally, we have included a set of covariates capturing specific characteristics of the accident: type of location (in the usual establishment, on work-related travel, or somewhere else); year, day of the week, hours worked (grouped in 8 levels, from “0 to 3 hours of work” to “more than 22”), and time of day (day versus night work) when the accident occurred; if the type of activity carried out by the worker constitutes his or her usual task; place of occurrence (industrial site; construction site; farming, breeding, fish farming, or forest zone; tertiary activity area; health establishment; public area; in the home; sports area; in the air; underground; on/over water; in high pressure environments; and other); type of task the worker was performing (production, manufacturing, processing and storing; excavation, construction, repair and demolition; agricultural type work, forestry, horticulture, fish farming and work with live animals; service provided to enterprises and/or to the general public; movement, sport, and artistic activity; and other); and specific physical activity (operating machinery; working with hand-held tools; driving or being on board a means of transport or handling equipment; handling of objects; carrying by hand; movement; and other).

Finally, we have added a set of control variables related to how the injury incurred. In particular, we observe the mode of injury (contact with electrical voltage, extreme temperatures, or hazardous substances; drowning, buried; crashed into something; fall; struck by or collided with something; came into contact with sharp/pointed/rough/coarse object; trapped, crushed; suffered acute overloading of body; kicked or bitten; heart attacks, strokes and other non-traumatic pathologies; and other); the type of injury (superficial injuries and open wounds; fractures; dislocations, sprains and strains; traumatic amputations; concussion and internal injuries; burns, corrosions, scalds and frostbite; acute poisonings and infections; asphyxiation, drowning and non-fatal submersion; effects of noise, vibration, and pressure; effects of heat, light and radiation; psychological trauma, traumatic shock; multiple injuries; heart attacks, strokes and other non-traumatic pathologies; and other) and the part of the body injured (head; neck; back; trunk and internal organs; upper extremities; lower extremities; whole body and multiple sites; and other).

3.2. Summary of results

The results of the estimation of the probit model¹⁴ are summarised in Table 3.2. The values in the table represent the coefficients of the categories of the variables. A positive coefficient indicates that the corresponding category increases the probability of suffering a severe or fatal accident, while a negative coefficient indicates the opposite. Estimates that reach a significant probability level are denoted by asterisks; the standard errors are shown in parentheses. As evidenced by the large value of the likelihood ratio test, the overall explanatory power of the models is highly significant. The first column contains estimates based on the full sample and the second column offers the results for those workers with three or fewer years of job seniority. To conserve space, Table 3.2 reports the results involving only our main variables of interest; the full results are shown in Table A3.1 of the Appendix.

Table 3.2 Estimation results of probit models on the probability of suffering a severe or fatal workplace accident. Main variables

		All employees	Employees with 3 years of seniority or less
Gender (ref. Women)			
	Men	0.216** (0.008)	0.223** (0.010)
Age (ref. 16-24)			
	25-39	0.075** (0.007)	0.072** (0.008)
	40-49	0.183** (0.008)	0.181** (0.009)
	50-59	0.245** (0.009)	0.245** (0.011)
	60-64	0.288** (0.013)	0.290** (0.019)
	65 and over	0.326** (0.045)	0.337** (0.068)
Age*Tenure		0.000* (0.000)	0.000 (0.000)
Job seniority (ref. Fewer than 3 months)			
	From 3 to 6 months	-0.034** (0.008)	-0.036** (0.008)
	From 6 months to 1 year	-0.030** (0.008)	-0.035** (0.008)
	From 1 to 3 years	-0.010 (0.007)	-0.024* (0.011)
	From 3 to 10 years	-0.002 (0.009)	
	10 or more years	0.021 (0.014)	
Number of observations		5,104,179	3,446,587
Log-likelihood value		-186,479.9	-125,909.6

Notes: Standard errors in parentheses. Significance levels: *significant at 5 per cent; **significant at 1 per cent.

¹⁴ A probit model is estimated because the probistic regression is the natural model when the outcome is 1 exactly when a hidden Gaussian variable $Z_0 = X'\beta_0 + \varepsilon_0$ exceeds a threshold c , with $\varepsilon \sim N(0, \sigma^2)$.

From the results reported in Table 3.2, we may conclude that the probability that a work-related injury is severe or fatal clearly increases with the age of the injured worker. Taking the group of the youngest workers (from 16 to 24) as a reference, we observe that for every age group, the probability of a more severe accident increases from 7.5 per cent for the group aged 25 to 39 to 32.6 per cent for workers aged 65 and older. We observe that job seniority is significant only when the worker has been working less than 1 year at the same job. In particular, the injuries of workers who have been working at the same job from 3 months to 1 year are 3 per cent less likely to be severe or fatal than those of workers with less than 3 months of experience. Thus, the results suggest that after one year on the job, workers acquire enough tenure to avoid workplace hazards related to the lack of experience. Furthermore, we observe that the age by tenure interaction variable is insignificant.

Findings are remarkably similar when we look at the estimated results for the sample of accidents involving workers with 3 years of tenure or less, so we can safely consider that the fact of having a large number of experienced workers in the full sample does not hinder the effect of the worker's age in our study.

Given these results, we conclude that the impact of age on the severity of work-related injuries is mainly determined by the physiological characteristics of the worker. In other words, being a more experienced worker does not affect the severity of a work-related injury.

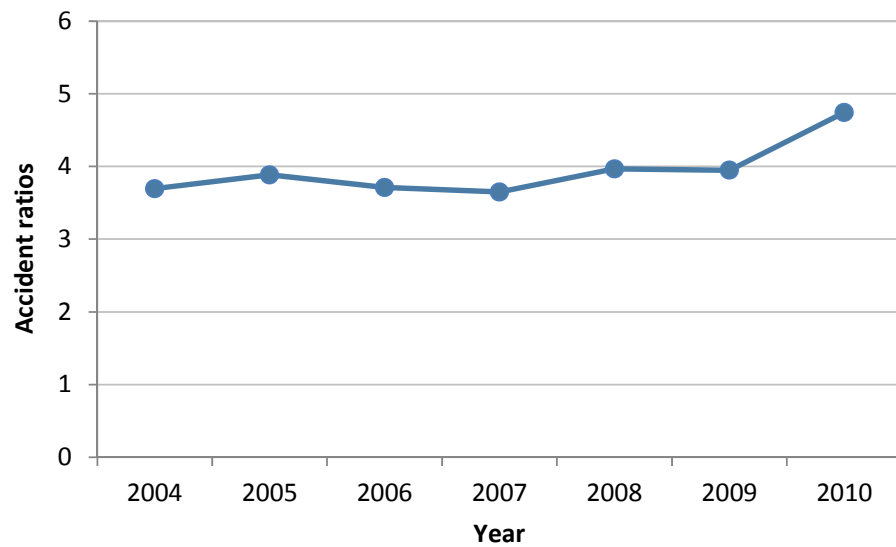
3.3. Sample selection bias correction

The EAT database presents an important limitation: it contains data only on workers that have experienced an accident, not data on all workers potentially at risk of having an accident. The main consequence is that the sample is highly selected. The variables that influence the probability of having an accident (among them, the age of the worker) determine whether or not an individual is included in the data set. To circumvent this problem, we follow the strategy proposed by García-Serrano et al. (2010) to estimate the impact of worker's age on the consequences of work-related injuries, in spite of the presence of sample selection¹⁵. The strategy consists of using an even more selected sample. On some occasions, when a worker suffers a work-related accident, other workers are involved in this accident. These workers are included in the data set as well and we can identify them through the variable *multiple accidents*.

Figure 3.4 presents evidence for the validity of the identification strategy. If multiple accidents capture the changes in the accident proneness composition of different groups, then the ratio of multiple to total accidents should be stable over time, everything else equal. In fact, Figure 3.4 shows that this ratio remains stable over the period of study. The strategy appears valid and, by focusing on this subset of accidents, the link between a worker's age and his or her inclusion in the sample is eliminated (García-Serrano et al., 2010). Our selected sample, therefore, consists of 39,108 work-related injuries, of which 37,130 (94.9 per cent) are minor and 1,978 (5.1 per cent) are severe or fatal.

¹⁵ This strategy in turn is based on the identification strategy proposed by Levitt and Porter (2001) in the context of the study of seat belt and air bag effectiveness.

Figure 3.4 Ratio multiple accidents to total accidents, 2004-2010



Source: Own elaboration based on EAT.

After limiting the sample to multiple accidents, the positive effect of age on the severity of work-related injuries survives. Further, controlling for sample selection significantly increases the impact of being an older worker (i.e. aged 65 and over) on the consequences of a workplace accident. In fact, controlling for sample selection, the injuries of workers aged 65 and over are 90 per cent more likely to be severe or fatal than those of their counterparts aged 16 to 24 (see Table 3.3).

Table 3.3 Estimation results of probit models on the probability of suffering a severe or fatal workplace accident correcting for sample selection. Main variables

		Sample correcting for sample selection
Gender (ref. Women)		
	Men	0.228** (0.057)
Age (ref. 16-24)		
	25-39	0.115* (0.047)
	40-49	0.207** (0.053)
	50-59	0.275** (0.062)
	60-64	0.365** (0.104)
	65 and over	0.896* (0.385)
Age * Tenure		0.000 (0.000)
Job seniority (ref. Fewer than 3 months)		0.001 (0.052)
	From 3 to 6 months	-0.010 (0.052)
	From 6 months to 1 year	-0.020 (0.049)
	From 1 to 3 years	-0.019 (0.058)
	From 3 to 10 years	-0.039 (0.094)
	10 or more years	0.001 (0.052)
Number of observations		38,974
Log-likelihood value		-4,675.7

Notes: Standard errors in parentheses. Significance levels: *significant at 5 per cent; **significant at 1 per cent.

Throughout this section, we have observed that, once we control for the main personal characteristics of the worker, his or her workplace, and the way the accident took place, the variable age significantly increases the probability that a given injury is severe or fatal. Furthermore, the analysis of work-related injuries and its determinants is strongly related to a rather different issue: the length of the sick leave associated to each injury. The expected result is that more severe injuries should be related to longer sick leave spells. The next section deals with this issue, analysing if age is a significant variable in the explanation of the duration of the sick leave caused by work-related injuries.

4. The impact of worker's age on the duration of sick leave caused by work-related injuries

Our previous results in Section 3 suggest that the older a worker is, the greater the probability that if he or she suffers a work-related injury, it will be severe or fatal. The expected result in terms of the duration of sick leave is that older workers will be out of work for longer periods of time. This fact would have an immediate impact on the health care cost (either public or private), and therefore should be added to the relevant information set in the debate regarding, for instance, the delay of the mandatory retirement age. In this section, we econometrically assess the impact of age on the duration of sick leave caused by work-related injuries. Our main objective is to analyse the number of days between when a worker suffers workplace accident until he or she returns to the workplace, and assess the effect of personal and job characteristics on such length.

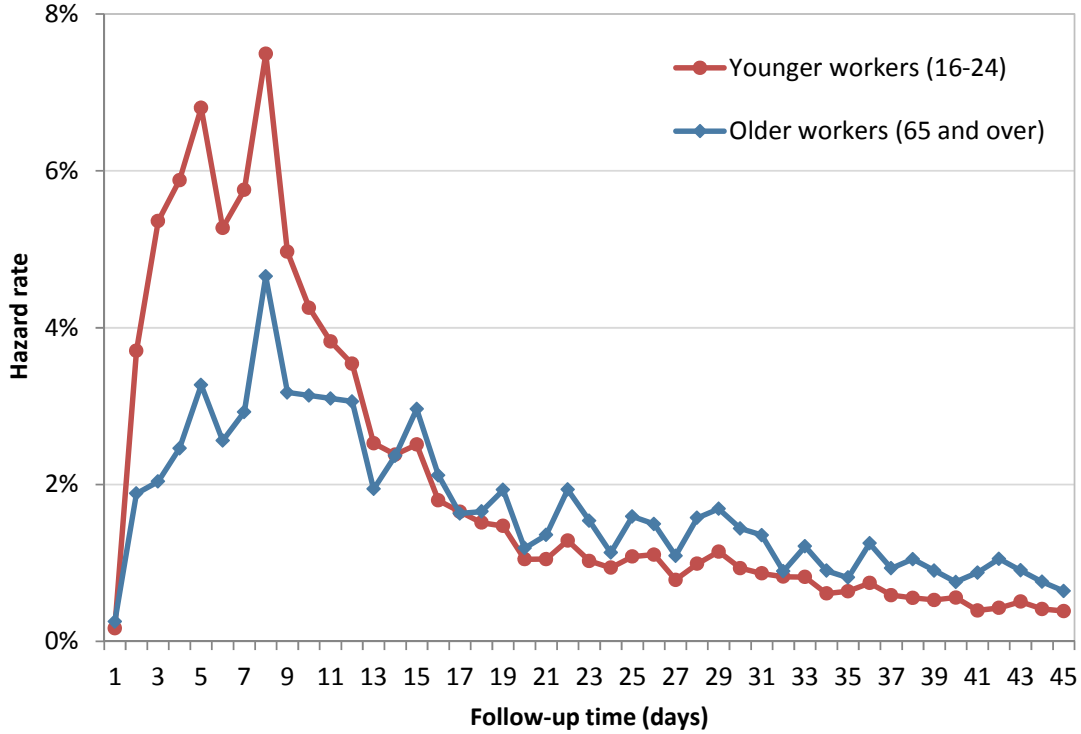
In the first step, a preliminary descriptive analysis of the sick leave spells is produced using hazard functions. The hazard ratio, or the probability of failure at a certain time, is the conditional probability of returning to work after sick leave at that time, given that an individual has not had this event just prior to that time. Figure 3.5 plots these hazard rates for workers aged 16 to 24 and workers aged 65 and over.

Looking at Figure 3.5, we can observe that institutional settings play a crucial role in the duration of sickness absence. In fact, Figure 3.5 reveals that many exits from activity occur at seven-day intervals starting on the 8th day, corresponding to the day after the medical certificate needs to be reissued. On the other hand, most sick leave spells end within the first 20 days. Given the shapes of these estimated baseline hazards, it seems clear that fitting a Weibull hazard would be appropriate¹⁶.

Further, Figure 3.5 shows that there are strong differences between younger (16-24) and older (65 and over) workers in the duration of sick leave spells due to work-related injuries. In fact, during the first 15 days, the hazard rate of returning to work after a workplace accident is higher for younger than for older workers. This means that the duration of sick leave spells is generally longer for older workers.

¹⁶ The Weibull distribution is suitable for modelling data with monotone hazard rates that either increase or decrease exponentially with time.

Figure 3.5 Hazard rates of returning to work after a workplace accident by age group



Source: Own elaboration based on EAT.

This study applies a duration model to estimate the hazard of ending the spell of sick leave due to work-related injury. Specifically, we study how a set of covariates have an impact on the probability of returning to the workplace when a worker has a sickness absence due to a work-related accident. We follow the methodology described in Chapter 2, Section 5.1.

As before, we have estimated the model for total sample, as well as for those workers who have been working at the same job for less than 3 years. We also have run the model controlling for sample selection. From our data, we select those observations with a sick leave of at least one day. We exclude the observations for fatal injuries. Our sample consists of 5,099,464 observations, for which we observe 4,241,796 complete durations (83.2%). We have included the same explanatory variables as the model for analysing the severity of work-related injuries. Nevertheless, we have also controlled for accident severity by including one dummy variable to indicate if the accident was severe or fatal.

The regression results for the total sample, for workers with 3 or fewer years of job seniority and correcting for sample selection can be found in Table 3.4. This table provides the estimated hazard ratios. Hazard ratios at each survival time are related to absolute differences in characteristics:

$$\frac{h(t, X_1)}{h(t, X_2)} = \exp[\beta'(X_1 - X_2)] \quad (3)$$

So, hazard ratios are interpreted as follows. A value below (above) 1 means that the likelihood of a transition from sick leave back to work is lower (higher) than that of a worker in the comparison group with all others covariates held constant. As in the previous section, we will focus exclusively on the main variables affecting age differences on sick leave duration and omit the effects of other explanatory variables. The full estimation results for all variables are available in Table A3.2 of Appendix.

Table 3.4 Estimation results of models on the duration of sick leave after a workplace accident.
Main variables

		Full Sample		Sample correcting for sample selection
		All employees	Employees with 3 or fewer years of tenure	All employees
Gender (ref. Women)				
	Men	1.074** (0.002)	1.075** (0.002)	1.159** (0.023)
Age (ref. 16-24)				
	25-39	0.866** (0.002)	0.868** (0.002)	0.799** (0.017)
	40-49	0.743** (0.002)	0.744** (0.002)	0.706** (0.017)
	50-59	0.651** (0.002)	0.650** (0.002)	0.611** (0.019)
	60-64	0.588** (0.003)	0.578** (0.004)	0.531** (0.032)
	65 and over	0.567** (0.011)	0.569** (0.017)	0.498* (0.060)
Age*Tenure		0.999** (0.000)	0.999** (0.000)	0.999 (0.000)
Job seniority (ref. Fewer than 3 months)				
	From 3 to 6 months	1.026** (0.002)	1.027** (0.002)	1.073** (0.027)
	From 6 months to 1 year	1.030** (0.002)	1.034** (0.002)	1.050* (0.026)
	From 1 to 3 years	1.024** (0.002)	1.041** (0.003)	1.040 (0.024)
	From 3 to 10 years	1.004 (0.002)		0.994 (0.026)
	10 or more years	0.975** (0.004)		0.942 (0.041)
Number of observations		5,099,464	3,443,734	38,708
Log-likelihood value		-7,160,347.7	-4,814,933.2	-53,442.0

Notes: Standard Errors in parentheses. Significance levels: *significant at 5 per cent; **significant at 1 per cent.

Ignoring sample selection, our empirical results suggest that the duration of sick leave increases clearly with age. The hazard rate of returning to the workplace after sick leave for workers aged 65 and over is 0.57 times the hazard rate of workers aged 16 to 24. In other words, older workers

remain absent from work more days after a work-related injury than younger workers. Regarding job seniority, we find a U-shaped relationship between the number of lost working days due to a workplace accident and the length of service. Thus, the highest durations of sick leave are predicted for workers with fewer than 3 months of experience and for those with 10 or more years, while the lowest durations are rather found in the groups of workers with moderate experience – i.e. from 3 months to 3 years.

These results are observed in the three samples, but more clearly so when sample selection is controlled for. In fact, when sample selection is controlled, the expected absence duration for workers aged 65 and over is twice the duration expected for workers aged 16 to 24. In sum, our empirical evidence suggests that age is an important determinant in the explanation of sick leave duration related to workplace accidents. Once we control for the remaining determinants, we find a positive relationship between age and sick leave duration, which implies a greater cost in health care.

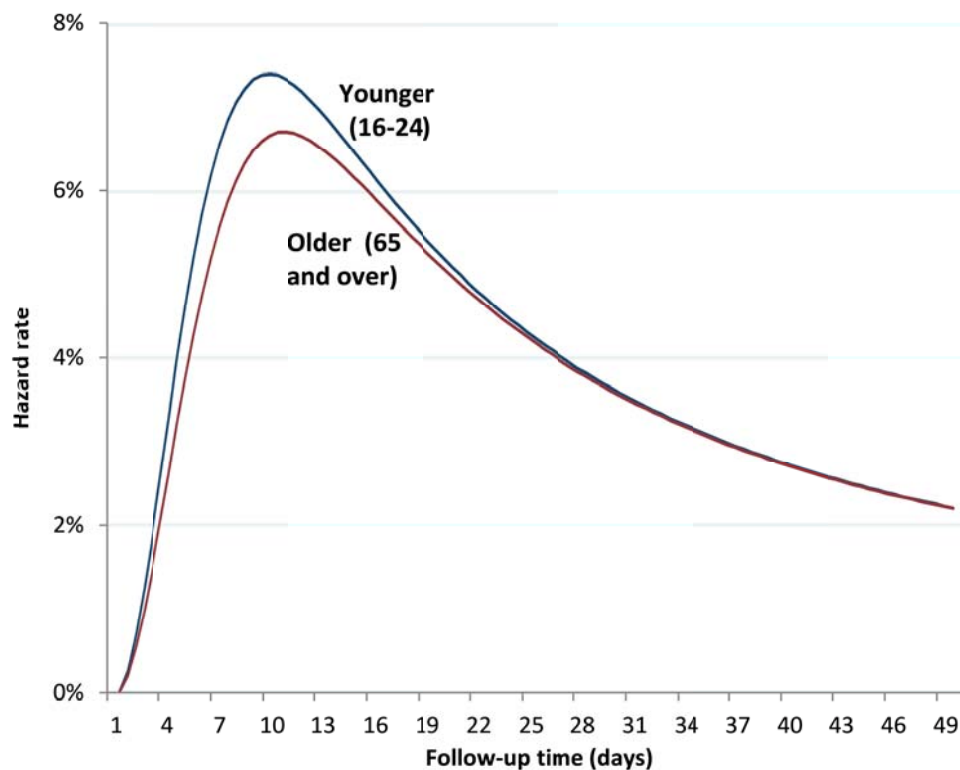
5. Conclusions

The current debate regarding the recent extension of the mandatory retirement age from 65 to 67 years has attracted the public attention, both from the media and academia, with strong opposite arguments between those defending the political decision and those opposed to it. In any case, and given the public statements of the main agents involved in this decision (government, worker's and employer's organizations, etc.) it seems that the main underlying concern is the sustainability of the public pension system. This chapter, however, brings to light different aspects of the decision of delaying the retirement age (or in other terms, increasing the number of older workers in activity), which remain hidden in the debate. Specifically, in this chapter we analyse the impact of age on the severity of work-related injuries, as well as on the duration of the sick leave related to them. If severity and the duration of the sick leave increase with age, we should expect that the delay of the retirement age would bring a greater number of severely injured workers. This may increase the cost of healthcare and thus compromise the potential gains from the delay in the retirement age. If, on the contrary, severity of injuries does not depend on age, there would not be special risks derived from this political decision. In order to clarify this fact, we need a detailed account of the impact of age on the severity of the injuries and the duration of the sick leave related to them; this is the contribution of the chapter.

We have developed our task in two steps. First, we have estimated a probit model, in which we explain the severity of a given injury as a function of the personal and professional characteristics of the injured worker, as well as of his or her workplace and of the accident itself. Our results allow us to assert that once the accident has happened, the probability that it results in a severe or fatal injury clearly increases with age. Second, we have applied a duration model to estimate the hazard of returning to work after a sick leave spell due to work-related injury. Our empirical analysis allows us to conclude that the duration of sick leave increases significantly with age, once we have controlled for the personal characteristics of the worker, the workplace, the type of accident, and the way in which it took place.

From a policy perspective our results suggest that the decision regarding increasing the total number of older workers in the labour market should be made with caution. If the retirement age is delayed, the *ceteris paribus* effect must be an increase in the total number of severely injured workers with prolonged sick leave, which may increase the total public health cost expenses. Delaying the retirement age requires additional measures in order to minimise these effects. For instance, the functional reallocation of these older workers towards tasks with lower incidence rates (or less severe injuries) could help in alleviating the aforementioned effects. Our results suggest the importance of a proper match between the capabilities of the worker and the demands of the job. In fact, older workers are not only more prone to certain types of accidents (i.e. falls), but they also remain on sick leave longer than their younger counterparts due to the same work-related injury. Figure 3.6 shows that, after controlling for the other workers' characteristics, around 7.5 per cent of the workers aged 16 to 24 return to activity after a sick leave spell due to a fall in the workplace before the 11th day, while this percentage decreases to less than 7 per cent in the case of workers aged 65 and over. In other words, even considering the same type of injury, the duration of a sick leave caused by work-related injury is clearly higher for the oldest workers.

Figure 3.6 Estimated hazard rate of returning to work after sick leave due to a fall in the workplace



Furthermore, older workers could benefit from continuous prevention training programmes. In this respect, even though the *Occupational Risk Prevention Act (ORPA)* had a great success in reducing the overall number of work-related injuries and their incidence, especially those deemed severe and fatal, there are still some aspects where legal regulation is still needed. The *ORPA*, passed in 1995, requires firms with 500 employees or more in all industries and with 250-499

workers in certain industries to establish their own programmes for the prevention of workplace accidents, including the formation of health and safety committees involving both management and workers. The *ORPA* was a legislative reaction to the high level of incidence of workplace accidents in the 1990s, with a special emphasis on the immediate physical determinants of work-related injuries, such as the manipulation of hazardous materials, body protection, signalling, etc. Age was not specifically considered as a determinant of work-related injuries, and our econometric results suggest that some legal reform is needed in this regard, given that the effect of this variable on the probability that an accident results in more severe injuries is as important as the usual suspects (for example, if the accident took place in the main workplace or not). In any case, our work suggests that age is an important variable to explain workplace accidents in Spain, and therefore should be taken into account in the empirical studies.



Appendix

Table A3.1 Estimation results of probit models on the probability of suffering a severe or fatal workplace accident. All variables

		Full Sample		Sample correcting for sample selection
		All employees	Employees with 3 or less years of tenure	All employees
Gender (ref. Women)				
	Men	0.216** (0.008)	0.223** (0.010)	0.228** (0.057)
Age (ref. 16-24)				
	25-39	0.075** (0.007)	0.072** (0.008)	0.115* (0.047)
	40-49	0.183** (0.008)	0.181** (0.009)	0.207** (0.053)
	50-59	0.245** (0.009)	0.245** (0.011)	0.275** (0.062)
	60-64	0.288** (0.013)	0.290** (0.019)	0.365** (0.104)
	65 and over	0.326** (0.045)	0.337** (0.068)	0.896* (0.385)
Age*Tenure		0.000* (0.000)	0.000 (0.000)	0.000 (0.000)
Place of birth (ref. Spain)				
	EU-15	0.117** (0.018)	0.122** (0.019)	-0.051 (0.109)
	Rest of Europe	0.158** (0.014)	0.145** (0.015)	0.225* (0.096)
	Africa	0.070** (0.012)	0.066** (0.013)	0.030 (0.085)
	Latin America	0.018 (0.011)	0.012 (0.012)	-0.044 (0.075)
	Rest of the world	0.208** (0.028)	0.227** (0.029)	0.297 (0.209)
	Missing	0.039 (0.079)	0.081 (0.091)	
Professional situation (ref. Employee private sector)				
	Employee public sector	0.103** (0.012)	0.098** (0.016)	-0.175* (0.080)
Occupation (ref. Elementary occupations)				
	Armed Forces	0.072* (0.034)	0.076 (0.043)	0.045 (0.226)
	Legislators, senior officials and managers	0.211** (0.030)	0.149** (0.049)	0.343 (0.186)
	Professionals	0.208** (0.017)	0.228** (0.024)	0.385** (0.104)
	Technicians and associate professionals	0.142** (0.014)	0.181** (0.018)	0.197* (0.086)
	Clerks	-0.037* (0.015)	-0.126** (0.021)	0.107 (0.110)
	Service workers and shop and market sales workers	-0.067** (0.01)	-0.060** (0.013)	-0.082 (0.070)
	Skilled agricultural and fishery workers	0.013 (0.024)	0.002 (0.030)	-0.023 (0.177)
	Craft and related trades workers	0.040**	0.038**	0.024

	(0.006)	(0.007)	(0.042)
Plant and machine operators, and assemblers	0.048** (0.007)	0.042** (0.009)	0.153** (0.049)
Type of contract (ref. Fixed-term contract)			
Open-ended contract	-0.017** (0.006)	-0.015* (0.007)	0.019 (0.042)
Job seniority (ref. Less than 3 months)			
From 3 to 6 months	-0.034** (0.008)	-0.036** (0.008)	0.001 (0.052)
From 6 months to 1 year	-0.030** (0.008)	-0.035** (0.008)	-0.010 (0.052)
From 1 to 3 years	-0.010 (0.007)	-0.024* (0.011)	-0.020 (0.049)
From 3 to 10 years	-0.002 (0.009)		-0.019 (0.058)
10 or more years	0.021 (0.014)		-0.039 (0.094)
Earnings (ref. Quantile 3)			
Quantile 1	0.006 (0.007)	0.009 (0.008)	0.032 (0.050)
Quantile 2	0.004 (0.006)	0.003 (0.007)	0.024 (0.044)
Quantile 4	0.009 (0.007)	0.028** (0.009)	0.077 (0.043)
Does the establishment belong to the worker's firm? (ref. No)			
Yes	-0.128** (0.007)	-0.119** (0.008)	-0.170** (0.044)
Economic activity (ref. Construction)			
Agriculture, forestry and fishing	0.034 (0.022)	0.045 (0.027)	0.070 (0.135)
Mining and quarrying	0.123** (0.022)	0.103** (0.029)	0.434** (0.131)
Manufacturing	0.028** (0.008)	0.032** (0.009)	0.005 (0.049)
Transport and storage	-0.013 (0.011)	0.012 (0.014)	0.057 (0.072)
Accommodation and food service activities	-0.090** (0.015)	-0.116** (0.017)	0.019 (0.124)
Public administration and defence; compulsory social security	-0.071** (0.015)	-0.075** (0.020)	-0.102 (0.099)
Education	-0.037 (0.024)	-0.070* (0.033)	-0.268 (0.191)
Human health, social work and veterinary activities	0.055** (0.020)	0.064* (0.026)	-0.210 (0.131)
Other service activities	-0.055** (0.009)	-0.058** (0.010)	-0.052 (0.054)
Location of the establishment (ref. Andalucía)			
Aragón	-0.307** (0.015)	-0.305** (0.018)	-0.305** (0.093)
Asturias	-0.237** (0.016)	-0.221** (0.020)	-0.157 (0.099)
Baleares	-0.192** (0.014)	-0.187** (0.017)	-0.395** (0.114)
Canarias	-0.292** (0.012)	-0.281** (0.015)	-0.235** (0.085)
Cantabria	-0.221** (0.020)	-0.242** (0.026)	-0.324* (0.125)
Castilla-La Mancha	-0.179**	-0.177**	-0.077

	(0.011)	(0.013)	(0.074)
Castilla y León	-0.203**	-0.208**	-0.060
	(0.011)	(0.013)	(0.066)
Cataluña	-0.110**	-0.099**	-0.073
	(0.008)	(0.009)	(0.053)
Comunidad Valenciana	-0.176**	-0.175**	-0.083
	(0.008)	(0.010)	(0.058)
Extremadura	0.028	0.014	0.129
	(0.015)	(0.018)	(0.100)
Galicia	-0.001	-0.012	-0.000
	(0.009)	(0.011)	(0.063)
Madrid	-0.310**	-0.303**	-0.238**
	(0.008)	(0.010)	(0.055)
Murcia	-0.217**	-0.195**	-0.223*
	(0.014)	(0.017)	(0.099)
Navarra	-0.204**	-0.188**	-0.356**
	(0.018)	(0.023)	(0.130)
País Vasco	-0.311**	-0.300**	-0.365**
	(0.012)	(0.015)	(0.076)
La Rioja	-0.316**	-0.303**	-0.072
	(0.028)	(0.035)	(0.148)
Ceuta y Melilla	-0.277**	-0.271**	-0.133
	(0.051)	(0.064)	(0.233)

Number employees of the firm (ref. 1-4 employees)

5-9 employees	-0.053**	-0.050**	0.029
	(0.008)	(0.009)	(0.058)
10-24 employees	-0.108**	-0.114**	-0.078
	(0.007)	(0.008)	(0.053)
25-49 employees	-0.157**	-0.165**	-0.069
	(0.008)	(0.009)	(0.056)
50-99 employees	-0.190**	-0.204**	-0.116
	(0.009)	(0.010)	(0.061)
100-249 employees	-0.262**	-0.260**	-0.149*
	(0.009)	(0.011)	(0.063)
250-499 employees	-0.262**	-0.262**	-0.326**
	(0.012)	(0.016)	(0.080)
More than 500 employees	-0.260**	-0.274**	-0.215**
	(0.011)	(0.015)	(0.075)

Did the establishment realised evaluation of workplace risks? (ref. No)

Yes	0.042**	0.052**	0.066
	(0.005)	(0.006)	(0.034)

Location of accident (ref. In the usual establishment)

On work-related travel	0.192**	0.164**	0.204**
	(0.010)	(0.012)	(0.055)
Somewhere else	0.291**	0.278**	0.267**
	(0.007)	(0.008)	(0.046)

Day of the week when the accident occurred (ref. Saturday or Sunday)

Monday	-0.084**	-0.088**	-0.114
	(0.009)	(0.012)	(0.060)
Tuesday	-0.062**	-0.072**	0.053
	(0.009)	(0.012)	(0.060)
Wednesday	-0.048**	-0.050**	-0.055
	(0.009)	(0.012)	(0.061)
Thursday	-0.037**	-0.037**	0.004
	(0.010)	(0.012)	(0.060)
Friday	-0.043**	-0.044**	-0.061

	(0.010)	(0.012)	(0.062)
Hours worked when the accident occurred (ref. 1, 2 or 3)			
4, 5 or 6	0.034** (0.005)	0.034** (0.006)	0.069* (0.033)
7, 8 or 9	0.050** (0.006)	0.053** (0.007)	0.052 (0.041)
10, 11 or 12	-0.017 (0.013)	-0.030 (0.017)	0.044 (0.088)
13, 14 or 15	0.098** (0.032)	0.137** (0.040)	0.145 (0.202)
16, 17 or 18	0.044 (0.030)	0.056 (0.037)	0.214 (0.218)
19, 20 or 21	0.113* (0.051)	0.149* (0.062)	0.660* (0.277)
22 and over	0.017 (0.076)	0.081 (0.093)	0.683 (0.354)
Time of day when the accident occurred (ref. From 8am to 8pm)			
From 8pm to 8am	0.036** (0.007)	0.041** (0.008)	0.020 (0.041)
Worker's usual task (ref. Yes)			
No	0.075** (0.01)	0.050** (0.013)	0.141* (0.061)
Place of occurrence (ref. Industrial site)			
Construction site, construction, opencast quarry, opencast mine	0.061** (0.009)	0.062** (0.010)	0.170** (0.060)
Farming, breeding, fish farming, forest zone	0.043 (0.022)	0.031 (0.028)	0.131 (0.146)
Tertiary activity area, office, amusement area, miscellaneous	0.036** (0.010)	0.056** (0.013)	-0.265** (0.089)
Health establishment	0.130** (0.020)	0.135** (0.027)	-0.047 (0.149)
Public area	-0.013 (0.010)	0.007 (0.013)	-0.109 (0.068)
In the home	0.035* (0.014)	0.050** (0.018)	-0.187 (0.122)
Sports area	0.171** (0.022)	0.181** (0.027)	0.152 (0.143)
In the air, elevated, excluding construction sites	0.593** (0.026)	0.596** (0.032)	0.962** (0.128)
Underground, excluding construction sites	0.011 (0.047)	0.031 (0.058)	0.135 (0.178)
On/over water, excluding construction sites	-0.009 (0.044)	-0.037 (0.054)	0.326 (0.247)
In high pressure environments, excluding construction sites	0.244 (0.170)	-0.473 (0.327)	
Other place of occurrence	0.013 (0.021)	0.014 (0.026)	-0.072 (0.130)
Type of task the worker was performing (ref. Production, manufacturing, processing, storing)			
Excavation, Construction, Repair, Demolition	0.061** (0.008)	0.066** (0.010)	0.114 (0.060)
Agricultural type work, forestry, horticulture, fish farming, work with live animals	0.107** (0.023)	0.103** (0.029)	-0.010 (0.170)
Service provided to enterprise and/or to the general public; intellectual activity	0.028* (0.011)	0.006 (0.014)	0.083 (0.080)
Movement, sport, artistic activity	0.127** (0.011)	0.137** (0.013)	0.064 (0.071)
Other working process	0.068**	0.075**	0.130**

	(0.006)	(0.008)	(0.049)
Specific physical activity (ref. Operating machine)			
Working with hand-held tools	-0.211** (0.009)	-0.215** (0.011)	-0.108 (0.069)
Driving/being on board a means of transport or handling equipment	-0.107** (0.012)	-0.115** (0.015)	-0.150 (0.081)
Handling of objects	-0.262** (0.008)	-0.278** (0.010)	-0.244** (0.065)
Carrying by hand	-0.365** (0.011)	-0.387** (0.014)	-0.354** (0.093)
Movement	-0.282** (0.009)	-0.286** (0.011)	-0.219** (0.071)
Other specific physical activity	-0.085** (0.012)	-0.092** (0.015)	-0.105* (0.073)
Mode of injury (ref. Fall)			
Contact with electric voltage, temperature extreme or hazardous substance	-0.290** (0.015)	-0.307** (0.018)	0.227** (0.085)
Drowning, buried	-0.300** (0.030)	-0.294** (0.035)	0.390** (0.113)
Crashed into something	-0.401** (0.009)	-0.418** (0.011)	-0.208** (0.074)
Struck by or collided with something	-0.289** (0.007)	-0.314** (0.008)	-0.224** (0.051)
Came into contact with sharp/pointed/rough/coarse object	-0.031** (0.009)	-0.053** (0.010)	-0.060 (0.093)
Trapped, crushed	0.170** (0.009)	0.149** (0.011)	0.430** (0.067)
Suffered acute overloading of body	-0.625** (0.009)	-0.679** (0.012)	-0.922** (0.102)
Kicked or bitten	-0.447** (0.020)	-0.402** (0.023)	-0.667** (0.099)
Heart attacks, strokes and other non-traumatic pathologies	0.545** (0.063)	0.591** (0.092)	0.472 (0.569)
Other mode of injury	-0.314** (0.014)	-0.358** (0.017)	-0.222 (0.115)
Type of injury (ref. Superficial injuries and open wounds)			
Fractures	1.345** (0.007)	1.371** (0.008)	1.873** (0.058)
Dislocations, sprains and strains	0.040** (0.009)	0.030** (0.011)	0.241** (0.073)
Traumatic amputation	2.160** (0.014)	2.210** (0.017)	2.580** (0.169)
Concussions and internal injuries	0.804** (0.009)	0.817** (0.010)	1.279** (0.065)
Burns, corrosions, scalds and frostbite	0.857** (0.017)	0.851** (0.021)	1.204** (0.089)
Acute poisonings and infections	0.504** (0.040)	0.480** (0.050)	0.459** (0.144)
Asphyxiation, drowning and non-fatal submersion	0.807** (0.037)	0.793** (0.044)	0.778** (0.115)
Effects of noise, vibration or pressure	0.272** (0.073)	0.320** (0.091)	
Effects of extreme temperatures, light and radiation	0.282** (0.072)	0.242** (0.087)	0.665 (0.347)
Psychological trauma, traumatic shock	0.751** (0.031)	0.754** (0.039)	1.187** (0.137)
Multiple injuries	1.218** (0.011)	1.238** (0.013)	1.441** (0.059)

Heart attacks, strokes and other non-traumatic pathologies	2.089** (0.062)	1.894** (0.091)	1.602** (0.547)
Other injuries	0.503** (0.013)	0.509** (0.016)	0.872** (0.092)
Part of body injured (ref. Head)			
Neck	-0.438** (0.018)	-0.408** (0.022)	-0.613** (0.091)
Back	-0.340** (0.011)	-0.312** (0.013)	-0.055 (0.070)
Trunk and internal organs	-0.224** (0.011)	-0.232** (0.013)	-0.037 (0.068)
Upper extremities	-0.584** (0.008)	-0.588** (0.010)	-0.591** (0.061)
Lower extremities	-0.322** (0.008)	-0.316** (0.010)	-0.182** (0.060)
Whole body and multiple sites	0.154** (0.011)	0.153** (0.013)	0.372** (0.053)
Other parts of the body	-0.094** (0.021)	-0.107** (0.027)	0.263* (0.106)
Year of the accident (ref. 2010)			
2004	0.175** (0.009)	0.165** (0.012)	0.143* (0.059)
2005	0.122** (0.009)	0.118** (0.012)	0.172** (0.058)
2006	0.079** (0.009)	0.082** (0.012)	0.116* (0.059)
2007	0.065** (0.009)	0.060** (0.012)	-0.125* (0.058)
2008	0.011 (0.009)	0.009 (0.012)	-0.093 (0.059)
2009	0.001 (0.010)	-0.003 (0.013)	-0.095 (0.063)
Constant	-2.189** (0.023)	-2.190** (0.028)	-2.422** (0.162)
Number of observations	5,104,179	3,446,587	38,974
Log-likelihood value	-186,479.9	-125,909.6	-4,675.7

Notes: Standard errors in parentheses. Significance levels: *significant at 5 per cent; **significant at 1 per cent.

Table A3.2 Estimation results of models on the duration of sick leave after a workplace accident. All variables

		Full Sample		Sample correcting for sample selection
		All employees	Employees with 3 or less years of tenure	All employees
Gender (ref. Women)				
	Men	1.074** (0.002)	1.075** (0.002)	1.159** (0.023)
Age (ref. 16-24)				
	25-39	0.866** (0.002)	0.868** (0.002)	0.799** (0.017)
	40-49	0.743** (0.002)	0.744** (0.002)	0.706** (0.017)
	50-59	0.651** (0.002)	0.650** (0.002)	0.611** (0.019)
	60-64	0.588** (0.003)	0.578** (0.004)	0.531** (0.032)
	65 and over	0.567** (0.011)	0.569** (0.017)	0.498* (0.060)
Age*Tenure		0.999** (0.000)	0.999** (0.000)	0.999 (0.000)
Place of birth (ref. Spain)				
	EU-15	0.722** (0.004)	0.721** (0.004)	0.631** (0.047)
	Rest of Europe	0.715** (0.003)	0.718** (0.004)	0.763** (0.046)
	Africa	0.772** (0.003)	0.770** (0.003)	0.736** (0.034)
	Latin America	0.794** (0.007)	0.794** (0.008)	0.736* (0.092)
	Rest of the world	0.780** (0.002)	0.784** (0.002)	0.882** (0.031)
	Missing	0.948* (0.021)	0.937* (0.024)	1.210 (0.192)
Professional situation (ref. Employee private sector)				
	Employee public sector	0.858** (0.003)	0.878** (0.004)	0.777** (0.025)
Occupation (ref. Elementary occupations)				
	Armed Forces	0.993 (0.009)	0.990 (0.011)	0.821* (0.077)
	Legislators, senior officials and managers	0.914** (0.010)	0.908** (0.016)	0.840 (0.089)
	Professionals	0.921** (0.005)	0.898** (0.007)	0.928 (0.047)
	Technicians and associate professionals	0.951** (0.004)	0.941** (0.005)	0.966 (0.037)
	Clerks	1.026** (0.004)	1.027** (0.005)	1.020 (0.041)
	Service workers and shop and market sales workers	1.004 (0.002)	1.011** (0.003)	1.054* (0.027)
	Skilled agricultural and fishery workers	1.009 (0.007)	1.007 (0.008)	1.156 (0.087)
	Craft and related trades workers	0.986** (0.002)	0.987** (0.002)	0.957* (0.020)

Plant and machine operators, and assemblers	0.979** (0.002)	0.981** (0.002)	0.938** (0.023)
Type of contract (ref. Fixed-term contract)			
Open-ended contract	0.989** (0.002)	0.981** (0.002)	1.027 (0.020)
Job seniority (ref. Fewer than 3 months)			
From 3 to 6 months	1.026** (0.002)	1.027** (0.002)	1.073** (0.027)
From 6 months to 1 year	1.030** (0.002)	1.034** (0.002)	1.050* (0.026)
From 1 to 3 years	1.024** (0.002)	1.041** (0.003)	1.040 (0.024)
From 3 to 10 years	1.004 (0.002)		0.994 (0.026)
10 or more years	0.975** (0.004)		0.942 (0.041)
Earnings (ref. Quantile 3)			
Quantile 1	1.018** (0.002)	1.016** (0.002)	1.043 (0.023)
Quantile 2	1.012** (0.002)	1.007** (0.002)	1.038 (0.022)
Quantile 4	0.987** (0.002)	0.982** (0.002)	1.009 (0.021)
Does the establishment belong to the worker's firm? (ref. No)			
Yes	0.958** (0.002)	0.942** (0.002)	1.009 (0.025)
Economic activity (ref. Construction)			
Agriculture, forestry and fishing	0.979** (0.006)	0.977** (0.007)	0.982 (0.067)
Mining and quarrying	0.957** (0.007)	0.965** (0.009)	0.891 (0.079)
Manufacturing	0.984** (0.002)	0.985** (0.003)	0.990 (0.025)
Transport and storage	0.998 (0.003)	0.999 (0.004)	1.013 (0.038)
Accommodation and food service activities	1.031** (0.004)	1.034** (0.004)	0.977 (0.046)
Public administration and defence; compulsory social security	1.096** (0.005)	1.060** (0.006)	1.142** (0.049)
Education	1.072** (0.007)	1.070** (0.009)	1.100 (0.083)
Human health, social work and veterinary activities	0.924** (0.005)	0.930** (0.006)	0.877** (0.044)
Other service activities	1.007** (0.002)	1.005 (0.003)	0.987 (0.027)
Location of the establishment (ref. Andalucía)			
Aragón	0.915** (0.003)	0.927** (0.004)	0.898* (0.041)
Asturias	0.725** (0.003)	0.745** (0.004)	0.676** (0.033)
Baleares	1.168** (0.004)	1.170** (0.005)	1.116* (0.054)
Canarias	1.038** (0.003)	1.042** (0.004)	1.059 (0.037)
Cantabria	0.813** (0.005)	0.840** (0.006)	0.741** (0.042)
Castilla-La Mancha	0.856** (0.003)	0.860** (0.003)	0.901** (0.033)

Castilla y León	0.891** (0.003)	0.905** (0.003)	0.888** (0.030)
Cataluña	0.887** (0.002)	0.882** (0.002)	0.931** (0.023)
Comunidad Valenciana	0.870** (0.002)	0.878** (0.002)	0.889** (0.025)
Extremadura	0.960** (0.004)	0.963** (0.005)	0.934 (0.054)
Galicia	0.814** (0.002)	0.829** (0.003)	0.767** (0.026)
Madrid	0.981** (0.002)	0.980** (0.002)	1.040 (0.025)
Murcia	0.771** (0.003)	0.773** (0.003)	0.724** (0.031)
Navarra	1.114** (0.005)	1.120** (0.007)	1.004 (0.055)
País Vasco	0.943** (0.003)	0.946** (0.003)	0.919** (0.029)
La Rioja	1.068** (0.007)	1.095** (0.009)	1.143* (0.073)
Ceuta y Melilla	0.854** (0.011)	0.860** (0.015)	0.902 (0.093)
Number employees of the firm (ref. 1-4 employees)			
5-9 employees	1.049** (0.002)	1.048** (0.003)	1.008 (0.032)
10-24 employees	1.082** (0.002)	1.079** (0.003)	1.018 (0.029)
25-49 employees	1.104** (0.002)	1.099** (0.003)	1.063* (0.031)
50-99 employees	1.113** (0.003)	1.108** (0.003)	1.042 (0.032)
100-249 employees	1.110** (0.003)	1.106** (0.003)	1.048 (0.032)
250-499 employees	1.097** (0.003)	1.097** (0.004)	1.017 (0.035)
More than 500 employees	1.014** (0.003)	1.024** (0.004)	1.027 (0.034)
Did the establishment realised evaluation of workplace risks? (ref. No)			
Yes	1.027** (0.001)	1.029** (0.002)	1.007 (0.016)
Location of accident (ref. In the usual establishment)			
On work-related travel	0.936** (0.003)	0.945** (0.004)	0.935** (0.023)
Somewhere else	0.979** (0.002)	0.983** (0.003)	0.888** (0.025)
Day of the week when the accident occurred (ref. Saturday or Sunday)			
Monday	1.078** (0.003)	1.083** (0.003)	1.097** (0.028)
Tuesday	1.069** (0.003)	1.076** (0.003)	1.063* (0.028)
Wednesday	1.058** (0.003)	1.064** (0.003)	1.079** (0.029)
Thursday	1.013** (0.003)	1.016** (0.003)	1.027 (0.027)
Friday	0.975** (0.003)	0.976** (0.003)	0.976 (0.027)
Hours worked when the accident occurred (ref. 1, 2 or 3)			
4, 5 or 6	0.991**	0.990**	0.970*

	(0.001)	(0.002)	(0.015)
7, 8 or 9	0.994** (0.002)	0.992** (0.002)	0.956* (0.019)
10, 11 or 12	0.966** (0.003)	0.962** (0.004)	0.986 (0.039)
13, 14 or 15	1.029** (0.009)	1.010 (0.012)	0.831* (0.077)
16, 17 or 18	1.053** (0.008)	1.055** (0.011)	0.902 (0.097)
19, 20 or 21	1.050** (0.014)	1.046** (0.017)	1.040 (0.118)
22 and over	1.020 (0.019)	1.035 (0.025)	0.760 (0.133)
Time of day when the accident occurred (ref. From 8am to 8pm)			
From 8pm to 8am	0.983** (0.002)	0.984** (0.002)	0.979 (0.017)
Worker's usual task (ref. Yes)			
No	0.985** (0.003)	0.979** (0.003)	1.018 (0.031)
Place of occurrence (ref. Industrial site)			
Construction site, construction, opencast quarry, opencast mine	0.965** (0.002)	0.963** (0.003)	0.944 (0.031)
Farming, breeding, fish farming, forest zone	0.983** (0.006)	0.990 (0.008)	1.029 (0.079)
Tertiary activity area, office, amusement area, miscellaneous	0.990** (0.002)	0.985** (0.003)	0.972 (0.032)
Health establishment	0.875** (0.004)	0.881** (0.005)	0.908 (0.048)
Public area	0.968** (0.003)	0.965** (0.003)	0.993 (0.031)
In the home	0.992* (0.004)	0.989* (0.005)	1.049 (0.055)
Sports area	0.878** (0.006)	0.858** (0.007)	0.714** (0.058)
In the air, elevated, excluding construction sites	0.843** (0.011)	0.842** (0.014)	0.733* (0.093)
Underground, excluding construction sites	0.950** (0.013)	0.965* (0.016)	0.952 (0.111)
On/over water, excluding construction sites	1.011 (0.014)	0.999 (0.017)	1.049 (0.166)
In high pressure environments, excluding construction sites	0.777** (0.048)	0.713** (0.050)	1.859 (1.205)
Other place of occurrence	0.932** (0.006)	0.922** (0.007)	1.039 (0.067)
Type of task the worker was performing (ref. Production, manufacturing, processing, storing)			
Excavation, Construction, Repair, Demolition	0.982** (0.002)	0.983** (0.003)	0.906** (0.030)
Agricultural type work, forestry, horticulture, fish farming, work with live animals	1.005 (0.007)	0.996 (0.008)	0.967 (0.079)
Service provided to enterprise and/or to the general public; intellectual activity	0.984** (0.002)	0.983** (0.003)	0.933* (0.029)
Movement, sport, artistic activity	0.931** (0.003)	0.934** (0.004)	0.957 (0.030)
Other working process	0.988** (0.002)	0.989** (0.002)	0.961 (0.023)
Specific physical activity (ref. Operating machine)			
Working with hand-held tools	1.123** (0.003)	1.127** (0.004)	1.140** (0.046)

Driving/being on board a means of transport or handling equipment	0.895** (0.004)	0.909** (0.005)	0.893* (0.039)
Handling of objects	1.115** (0.003)	1.117** (0.004)	1.155** (0.042)
Carrying by hand	1.117** (0.003)	1.122** (0.004)	1.159** (0.049)
Movement	1.061** (0.003)	1.067** (0.004)	1.164** (0.045)
Other specific physical activity	0.994 (0.004)	1.004 (0.005)	1.027 (0.043)
Mode of injury (ref. Fall)			
Contact with electric voltage, temperature extreme or hazardous substance	1.519** (0.007)	1.497** (0.008)	1.604** (0.082)
Drowning, buried	1.519** (0.017)	1.485** (0.019)	1.379** (0.123)
Crashed into something	1.241** (0.003)	1.231** (0.004)	1.331** (0.051)
Struck by or collided with something	1.230** (0.003)	1.222** (0.004)	1.162** (0.037)
Came into contact with sharp/pointed/rough/coarse object	1.339** (0.004)	1.314** (0.004)	1.352** (0.054)
Trapped, crushed	1.153** (0.005)	1.140** (0.005)	0.992 (0.051)
Suffered acute overloading of body	1.172** (0.003)	1.187** (0.003)	1.283** (0.042)
Kicked or bitten	1.298** (0.007)	1.282** (0.009)	1.569** (0.062)
Heart attacks, strokes and other non-traumatic pathologies	0.822** (0.052)	0.886 (0.071)	0.517 (0.207)
Other mode of injury	1.137** (0.005)	1.129** (0.006)	1.075 (0.066)
Type of injury (ref. Superficial injuries and open wounds)			
Fractures	0.318** (0.001)	0.313** (0.001)	0.232** (0.008)
Dislocations, sprains and strains	0.870** (0.001)	0.871** (0.002)	0.867** (0.016)
Traumatic amputation	0.292** (0.004)	0.289** (0.005)	0.233** (0.049)
Concussions and internal injuries	0.823** (0.002)	0.835** (0.003)	0.792** (0.025)
Burns, corrosions, scalds and frostbite	0.863** (0.005)	0.871** (0.006)	0.615** (0.033)
Acute poisonings and infections	1.024 (0.014)	1.044** (0.017)	1.395** (0.107)
Asphyxiation, drowning and non-fatal submersion	1.018 (0.017)	1.045* (0.020)	1.292** (0.100)
Effects of noise, vibration or pressure	0.942** (0.017)	0.932** (0.021)	0.504** (0.091)
Effects of extreme temperatures, light and radiation	1.394** (0.031)	1.419** (0.036)	1.616* (0.318)
Psychological trauma, traumatic shock	0.633** (0.009)	0.666** (0.011)	0.453** (0.035)
Multiple injuries	0.624** (0.004)	0.624** (0.005)	0.627** (0.021)
Heart attacks, strokes and other non-traumatic pathologies	0.269** (0.017)	0.304** (0.024)	0.953 (0.349)
Other injuries	0.865** (0.003)	0.887** (0.004)	0.848** (0.036)
Part of body injured (ref. Head)			

	Neck	0.600** (0.002)	0.605** (0.003)	0.700** (0.024)
	Back	0.683** (0.002)	0.688** (0.002)	0.831** (0.027)
	Trunk and internal organs	0.654** (0.002)	0.659** (0.003)	0.801** (0.032)
	Upper extremities	0.536** (0.001)	0.552** (0.002)	0.730** (0.021)
	Lower extremities	0.543** (0.001)	0.554** (0.002)	0.679** (0.021)
	Whole body and multiple sites	0.510** (0.002)	0.522** (0.003)	0.648** (0.021)
	Other parts of the body	0.584** (0.005)	0.597** (0.006)	0.753** (0.052)
Year of the accident (ref. 2010)				
	2004	1.078** (0.003)	1.101** (0.003)	1.127** (0.031)
	2005	0.978** (0.002)	1.005 (0.003)	1.040 (0.028)
	2006	1.008** (0.002)	1.024** (0.003)	1.064* (0.028)
	2007	0.822** (0.002)	0.836** (0.002)	0.899** (0.023)
	2008	1.047** (0.002)	1.043** (0.003)	1.088** (0.028)
	2009	1.037** (0.003)	1.031** (0.003)	1.150** (0.031)
Accident severity (ref. Minor)				
	Severe	0.091** (0.001)	0.089** (0.001)	0.074** (0.004)
People who suffered a fall in the workplace				
	Young (16-24)	1.114** (0.006)	1.113** (0.006)	0.950 (0.063)
	Older (65 and over)	0.931* (0.040)	0.936* (0.021)	0.433 (0.348)
	Constant	0.097** (0.001)	0.094** (0.001)	0.063** (0.005)
Number of observations		5,099,464	3,443,734	38,708
Log-likelihood value		-7,160,347.7	-4,814,933.2	-53,442.0

Notes: Standard errors in parentheses. Significance levels: *significant at 5 per cent; **significant at 1 per cent.

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CHAPTER 4

A regional view on workplace accidents in Spain

1. Introduction

The intense process of economic growth that the Spanish economy experienced from the 1990's through the first decade of the current century was joined by unprecedented levels of employment creation. These newly created jobs caused the Spanish economy to narrow the gap between itself and its European neighbours in terms of key labour market figures, such as activity and unemployment rates. However, the very high incidence of workplace accidents was an important dimension of this process that was far from satisfactory. According to data from the International Labour Organization, the 2007 incidence rate of non-fatal accidents in Spain was 57.5 per 1,000 workers – 1.5 times higher than in France, and 2.1 times higher than in Germany. Regarding fatal accidents (those with higher economic and social costs), the incidence rate in Spain was of 3.6 per 100,000 workers – 0.2 and 1.5 accidents per 100,000 workers more than in France and Germany, respectively. The impact of the global crisis on the labour market in Spain has been much stronger than in most advanced countries. However, the incidence rates of workplace accidents remain high in comparison with other advanced countries. In 2011, the incidence rate of non-fatal accidents in Spain was 35.9 per 1,000 workers – 3.9 and 2.8 times higher than in Australia and Canada¹⁷, respectively.

In the Spanish case, there is a further characteristic of the incidence of workplace accidents: a strong geographical component. Data from the Estadística de Accidentes de Trabajo (EAT hereafter) published by the Spanish Ministry of Labour show substantial regional differences in incidence rates for workplace accidents. For instance, in 2011, Guadalajara registered the highest incidence rate of minor accidents (48.2 per 1,000 workers), which is 1.8 times greater than in Castellón (26.2 per 1,000 workers), the Spanish province with the lowest incidence. If we consider the severe and fatal accidents, the differences are even greater. In fact, with 0.8 severe and fatal accidents per 1,000 workers, the incidence of workplace accidents in Soria is 9.4 times higher than in Ávila (0.1), the province with the lowest incidence of severe and fatal accidents. At the same time, the regional analysis allows us to observe that a region exhibiting high incidence in a certain type of accident (e.g., non-fatal) does not imply the same high incidence in other type of accident (e.g., severe and fatal).

The existing literature has studied workplace accidents from many different perspectives. The evaluation of job safety programs (see *inter alia* Viscusi, 1979, 1986; McCaffrey, 1983; Curington, 1986; Lanoie, 1992; Gray and Scholz, 1993), the influence of asymmetric information on reporting rates through a moral hazard perspective (see for instance Butler and Worral, 1991;

¹⁷ Australia and Canada are the only two advanced economies with recent available data on workplace accidents.

Butler et al., 1996; Bolduc et al., 2002) and the effect of the employment contract on job accidents (Amuedo-Dorantes, 2002; Guadalupe, 2003; Hernanz and Toharia, 2006; García-Serrano et al., 2010) are examples of such different approaches. In addition to these studies, another interesting aspect for which there is less existing literature is the geographical distribution of workplace accidents¹⁸.

This chapter aims to provide a first approach to the economic analysis of workplace accidents from a regional perspective in Spain. Specifically, we are interested in identifying through descriptive statistical techniques potential regional patterns in the incidence of workplace accidents. Moreover, additional information regarding the movements in the relative position of each province within the distribution will also be provided. In a second step, we aim to identify the economic determinants of the incidence rates of workplace accidents at the provincial level. To do so, we estimate by panel data techniques an econometric model that explains the incidence rates of workplace accidents based on a set of explanatory variables, which include both labour market variables and a set of variables that serve as a proxy for the efforts developed by the authorities to avoid job accidents primarily through workplace inspections. Finally, the effect of these two sets of variables on the characteristics of the geographical distribution of workplace accidents in Spain is analysed. In order to assess the extent to which the features observed in the spatial distribution of the workplace accidents can be explained by variables potentially affecting the incidence of workplace accidents, we follow the methodology applied by López-Bazo et al. (2005) to study the distribution of unemployment rates in Spain.

The chapter is organized as follows. Section 2 analyses the evolution in the spatial distribution of workplace accidents in Spain between 1995 and 2011. Section 3 provides empirical evidence regarding the determinants of workplace accidents incidence at the regional level in Spain. The fourth section assesses how the geographical distribution of workplace accidents in Spain is explained by variables potentially affecting the incidence of workplace accidents. Finally, Section 5 summarizes the main results and presents the conclusions.

2. Workplace accidents in Spain: regional dynamics

In this section, we analyse the evolution of workplace accidents in Spain in the spatial distribution. Our key variable will be the provincial incidence rates for workplace accidents. The incidence rate is defined as the number of accidents at work per 1,000 persons in employment. The use of incidence rates instead of the total number of accidents at work allows abstraction from the evolution of total employment. Data on accidents are based on the Spanish Statistics on Accidents at Work (*Estadística de Accidentes de Trabajo* in Spanish, EAT), compiled by the Spanish Ministry of Labour. This database includes all those accidents that take the injured person from the workplace for at least one day (excluding the day when the accident occurred) and after a medical report is issued. We limit our sample to those workers covered by the Social Security General Regime. In order to calculate incidence rates for accidents at work, the

¹⁸ In this vein, Corrales Herrero et al. (2008) analysed the differences in the duration of absences as a consequence of workplace accidents among Spanish regions. Their results show unreasonably longer durations in the regions situated in the North of Spain.

reference population is the number of workers covered by the Social Security General Regime.

Our territorial unit of reference is the province, which corresponds to the level 3 of the Nomenclature of Territorial Units for Statistics (NUTS3) of Eurostat. There are 52 Spanish provinces. We have chosen this spatial category because the Spanish Labour and Social Security Inspectorate (Inspección de Trabajo y Seguridad Social, ITSS), which is the administrative organisation responsible for controlling and monitoring the Law on the Prevention of Occupational Risks (Ley de Prevención de Riesgos Laborales, LPRL) is divided territorially into provinces. Our data runs from 1995 to 2011; 1995 is the year when the Law on the Prevention of Occupational Risks¹⁹ was adopted, and 2011 is the latest year with available information.

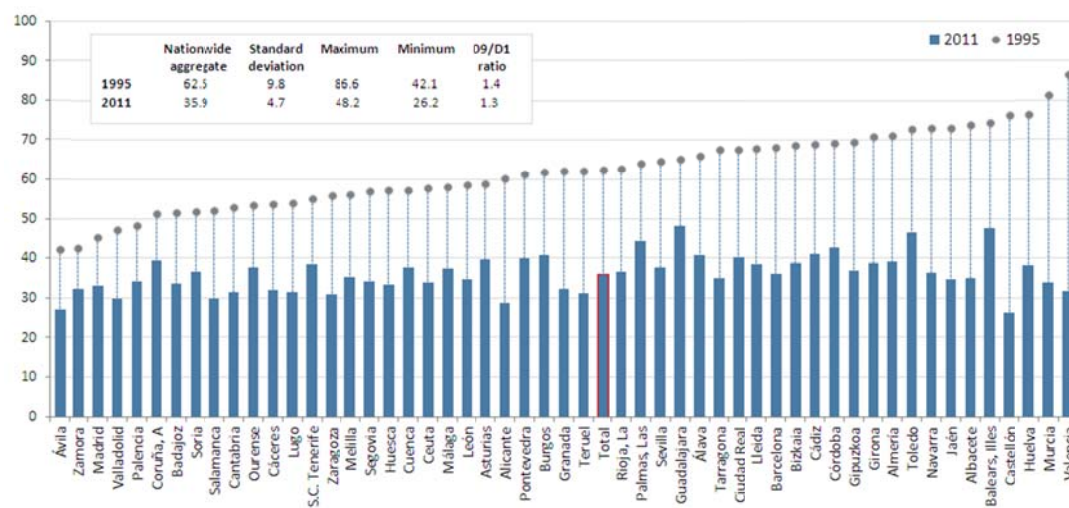
Figure 4.1 shows provincial incidence rates of workplace accidents in 1995 and 2011 by level of severity. This comparison of incidence rates of workplace accidents by province provides a clear picture of the magnitude of the spatial differences. The most recent figures indicate that the incidence rate of minor accidents in Guadalajara (the province with the highest incidence) at 48.2 is 1.8 times greater than in Castellón (26.2), where the incidence of minor accidents is the lowest (Figure 4.1-Panel A). The differences are even more pronounced when we look at the severe and fatal accidents. In fact, with 0.8 severe and fatal accidents per 1,000 workers, the incidence of workplace accidents in Soria is 9.4 times higher than in Ávila (0.1), the province with the lowest incidence of severe and fatal accidents (Figure 4.1-Panel B).

The sharp drop in workplace accidents observed between 1995 and 2011 had an uneven impact on the regional disparities. While regional differentials in the incidence of minor accidents decreased, the spatial differences in the incidence of severe and fatal accidents widened. Between 1995 and 2011, both the ratio between the maximum and the minimum value and the ratio between the ninth and the first decile decreased in the case of minor accidents. By contrast, both ratios actually increased in the case of the severe and fatal accidents.

¹⁹ The Law on the Prevention of Occupational Risks was a legislative reaction to the high level of incidence of occupational injuries in the 90s, with a special emphasis on the immediate physical determinants of workplace accidents, such as the manipulation of hazardous materials, body protection, signalling, etc. Moreover, this law changed the general attitude of authorities with respect to workplace accidents and risk prevention. Indeed, since the Law was passed in 1995, the incidence of workplace accidents has been markedly reduced, especially for the most severe cases.

Figure 4.1 Incidence rates of workplace accidents by province, 1995 and 2011

Panel A. Minor accidents



Panel B. Severe and fatal accidents



Note: The D9/D1 ratio is the ratio between the ninth and the first decile.

Source: Own elaboration based on EAT and Ministry of Labour.

Figure 4.1 already hinted at a decrease in inequality of regional incidence rate of minor accidents and an increase in inequality in the case of severe and fatal accidents. Now, we want to verify this with techniques that allow us more precise conclusions. Figure 4.2 plots the estimated density function of the distribution of regional incidence rates of workplace accidents relative to the Spanish average incidence rate for 1995 and 2011. Therefore, a value equal to one indicates that the province behaves similarly to the national average, while a value above (below) one indicates that the incidence rate of the province is higher (lower) than the Spanish average incidence rate.

Estimates are based on calculations using Gaussian kernel functions²⁰. It is well known that the results of density estimations depend on the bandwidth of the kernel. Following Silverman (1986), the optimal bandwidth is estimated by:

$$\hat{h} = 0.9An^{-1/5} \quad (1)$$

where

$$A = \min(\hat{\sigma}, IQR/1.349) \quad (2)$$

where σ is the standard deviation and IQR is the interquartile range of the series.

The results reveal the presence of significant differences in the external shape of the distribution of the relative incidence rates of minor accidents between 1995 and 2011, showing that the initial situation does not remain stable throughout time. In 1995, the shape of the distribution was bimodal, characterised by the existence of a group of regions with values just below the national average and a second group of regions situated just above. However, the probability mass concentrated just above the average increased sharply between 1995 and 2011. In other words, the number of provinces with incidence rates just above the average has increased during the sixteen years considered. As a result, the bimodality observed in 1995 has largely diminished. Simultaneously, there has been a reduction in the distance between the extreme values of the distribution (Figure 4.2-Panel A).

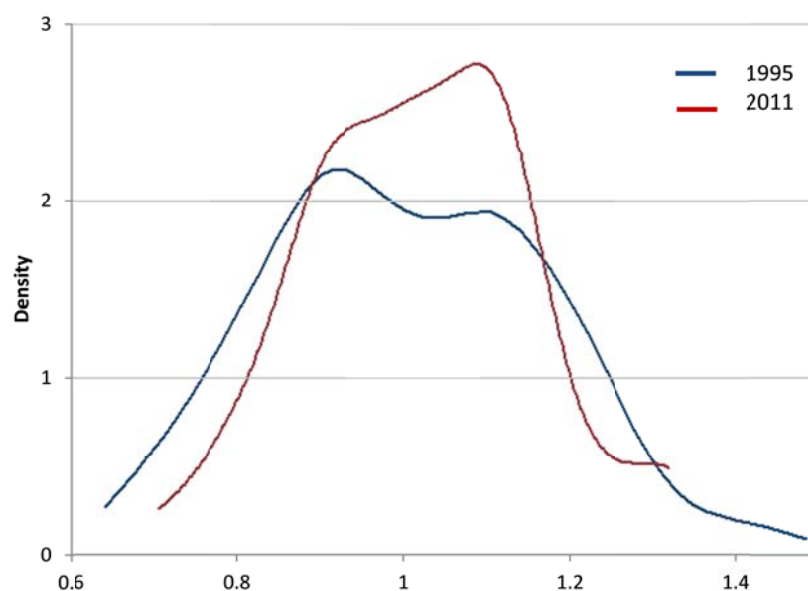
The distribution of the relative incidence rates of severe and fatal accidents has also undergone several notable changes between 1995 and 2011. First, the slight signs of bimodality already observed in 1995 have clearly increased. In particular, the distribution has gained mass around the national average. Thus, in 2011, there were two clusters of provinces: one around the Spanish average and other group of provinces with incidence rates that are 1.5 times the national average (Figure 4.2-Panel B).

The results suggest a convergence in the regional incidence rates of minor accidents in Spain to a value just above the national average. By contrast, there seems to have been a trend towards polarization in two groups of regions as regards incidence rates of severe and fatal accidents. However, the analysis does not provide any information regarding the movements in the relative position of each province within the distribution. In order to identify these dynamics, we carry out two further exercises: we first estimate the transition matrices, and next we estimate stochastic kernels for the regional distribution of relative incidence rates of workplace accidents over the period under analysis.

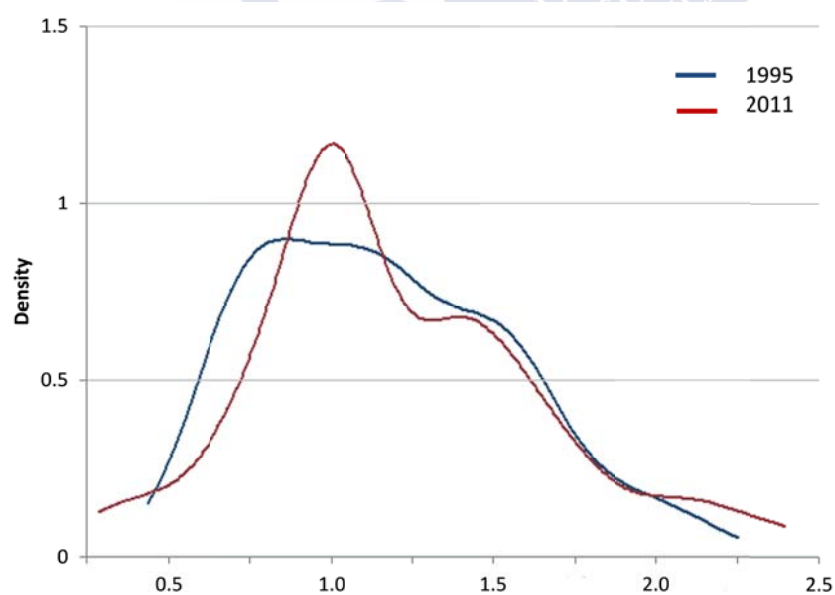
²⁰ We use the Gaussian kernel density function, but we experimented with other kernels. For example, using the Epanechnikov kernel function delivers exactly the same results, as long as the bandwidth is held constant across estimation methods.

Figure 4.2 Estimated density functions of provincial differences in incidence rates of workplace accidents, 1995 and 2011

Panel A. Minor accidents



Panel B. Severe and fatal accidents



Note: Gaussian kernel with bandwidth according to Silverman (1986).

Source: Own elaboration based on EAT and Ministry of Labour.

A transition matrix categorizes the various relative incidence rates of workplace accidents into a manageable number of ranges, and lists these ranges both across the top and down the side of the matrix. The number in each cell indicates the probability that a province that had a relative incidence rate in the row range in 1995 changes to a relative incidence rate in the column range

in 2011. Therefore, those provinces located in the diagonal remain with a similar relative incidence rate between 1995 and 2011. Cells above the diagonal suggest upward mobility, while cells below the diagonal suggest downward mobility. Of course, every province ends in one column range or another, so the probabilities along each row sum up to 100 per cent. The first row and the first column show the number of provinces in each of the intervals in 1995 and 2011, respectively.

Table 4.1 reports the transition probability matrix linking the 1995 and 2011 distribution of Spanish relative incidence rates of minor workplace accidents. We observe a strong degree of mobility throughout the time span studied. Indeed, few provinces in 2011 show the same relative incidence rate as in 1995. More specifically, we observe that the provinces with the lowest and highest incidence rates experienced much greater mobility. By 2011, only 27.3 per cent of the provinces below 0.86 times the national average remained in this range, while 55 per cent of them moved to between 0.86 and 1.04 times the national average. Likewise, of the regions with an initial incidence rate above 1.13 times the national average, only 18.2 remained in this interval while 64 per cent moved to between 0.93 and 1.13 times the national average. However, provinces with incidence rates close to the national average experienced much greater persistence – the bulk of the provinces with initial incidence rates between 0.86 and 1.13 times the average ended up in one of the three intervals between 0.86 and 1.13 times the average. The results in Table 4.1 confirm the convergence to the national average in the incidence rates of minor workplace accidents already observed in Figure 4.2.

Table 4.1 Transition probability matrix from 1995 to 2011 for relative incidence rates of minor workplace accidents

			2011 ranges of relative incidence rate				
			0.00-0.86	0.86-0.93	0.93-1.04	1.04-1.13	1.13-1.40
			N=5	N=9	N=16	N=14	N=8
1995 ranges of relative incidence rate	0.00-0.86	N=1 1	27.3	27.3	27.3	18.2	0.0
	0.86-0.93	N=9	0.0	33.3	44.4	22.2	0.0
	0.93-1.04	N=1 1	9.1	18.2	18.2	36.4	18.2
	1.04-1.13	N=1 0	0.0	0.0	30.0	30.0	40.0
	1.13-1.40	N=1 1	9.1	9.1	36.4	27.3	18.2

Source: Own elaboration based on EAT and Ministry of Labour.

Table 4.2 reports the transition probability matrix for the relative incidence rates of severe and fatal accidents. In this table, we observe two facts. First, most of the provinces with initial incidence rates below 1.51 times the national average ended up between 0.79 and 1.21 times the national average. Second, we see strong persistence among the regions with highest incidence rates: of the regions with an initial incidence rate above 1.51 times the national average, 45.5 per cent remained above 1.51 times the average, while 45.5 per cent moved just one class down. These results confirm the polarization in terms of the incidence of severe and fatal workplace

accidents also observed Figure 4.2.

Table 4.2 Transition probability matrix from 1995 to 2011 for relative incidence rates of severe and fatal workplace accidents

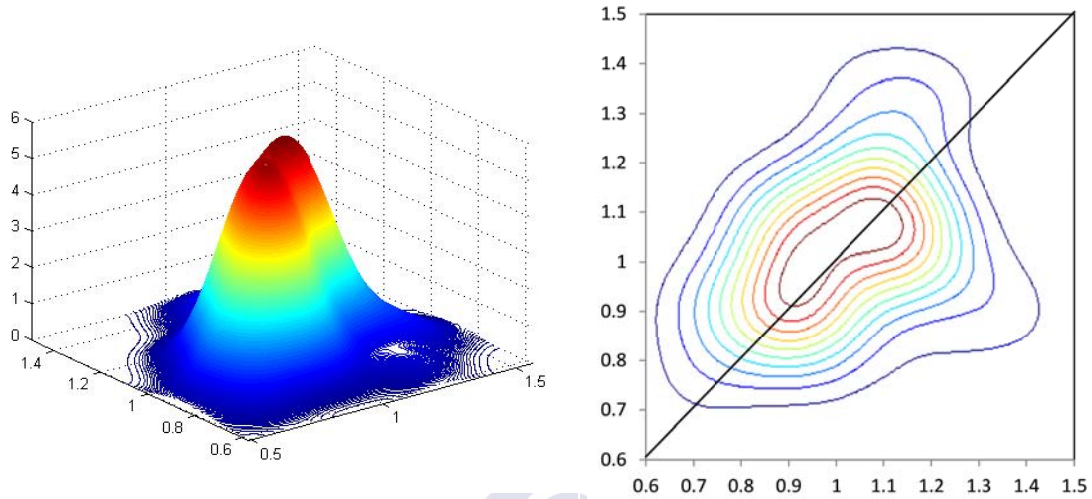
			2011 ranges of relative incidence rate				
			(0.00-0.79)	(0.79-1.05)	(1.05-1.21)	(1.21-1.51)	(1.51-2.40)
			N=6	N=17	N=7	N=10	N=12
1995 ranges of relative incidence rate	0.00-0.79	N=1 0	30.0	40.0	10.0	10.0	10.0
	0.79-1.05	N=1 1	9.1	63.6	9.1	9.1	9.1
	1.05-1.21	N=1 0	10.0	40.0	10.0	20.0	20.0
	1.21-1.51	N=1 0	10.0	20.0	30.0	10.0	30.0
	1.51-2.40	N=1 1	0.0	0.0	9.1	45.5	45.5

Source: Own elaboration based on EAT and Ministry of Labour.

Relative incidence rates of workplace accidents are a continuous variable and this means that any categorization of them into specific intervals is arbitrary. Therefore, the conclusions derived from transitions matrices are highly dependent on the amplitude of the intervals. In order to circumvent this caveat, we estimate the stochastic kernels, which are the representation of the transition matrices when the number of ranges tends to infinity. A stochastic kernel shows in a three-dimensional diagram how the distribution observed at period t evolves towards the observed distribution in period $t+s$. We also provide the two-dimensional contour map, which are the projections of the kernel in the $t, t+s$ plane. From this type of graphs we may identify i) persistence in the distribution when the density is located along the 45° line, ii) convergence, when the density is parallel to the X-axis, and iii) overtaking, when most of the graph is turned 90° back clockwise from the 45° diagonal (Quah, 1997).

Figure 4.3 depicts the stochastic kernel for the incidence rates differentials in minor accidents for the period of 1995-2011. The estimated kernel suggests that the regional distribution of minor accidents in the Spanish provinces was characterized mainly by convergence. Although the estimated kernel does not show a strong convergence, most of the density is located parallel to the X-axis. This suggests that all provinces tend to show more similar incidence rates of minor accidents in 2011 than in 1995. Moreover, the figure also confirms that this convergence is mainly to a value just above the national average.

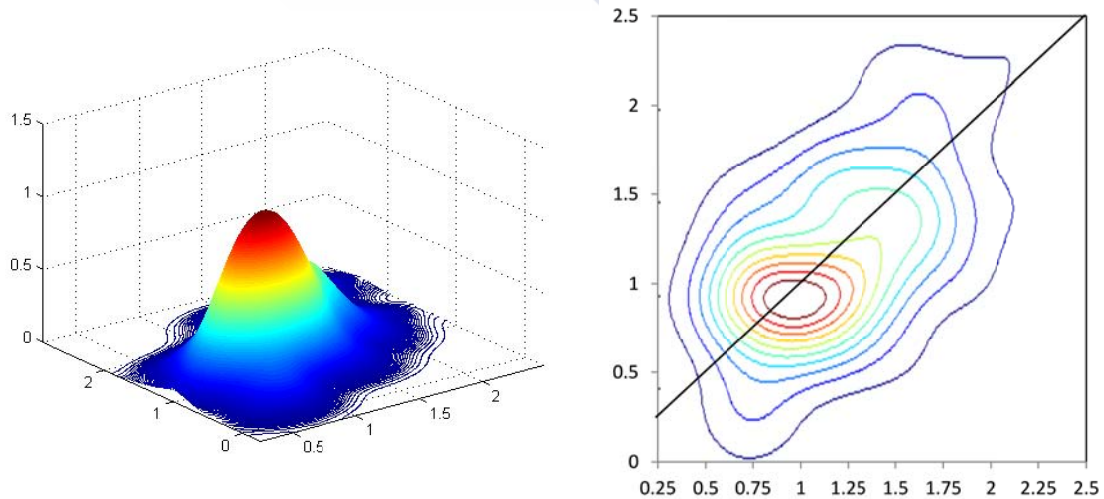
Figure 4.3 Estimated stochastic kernel for provincial differences in incidence rates of workplace accidents. Minor accidents



Source: Own elaboration based on EAT and Ministry of Labour.

Likewise, Figure 4.4 shows the estimated stochastic kernel for provincial differences in the incidence rates of severe and fatal accidents. The estimated kernel shows that the regional distribution of the severe and fatal accidents during the 1995-2011 period was characterized by strong persistence. In fact, we can clearly observe how the mass of probability runs along the diagonal that defines persistence.

Figure 4.4 Estimated stochastic kernel for provincial differences in incidence rates of workplace accidents. Severe and fatal accidents



Source: Own elaboration based on EAT and Ministry of Labour.

In this section, we have observed the existence of a large differential across the Spanish

provinces in the incidence of workplace accidents. Moreover, the geographical distribution of minor accidents is characterized by convergence to a value just above the national average, while there is a trend towards polarization in two groups of regions in regards to incidence rates of severe and fatal accidents. In this context, the following sections aim to explain why provinces have different incidence rates of workplace accidents, as well as the causes of the dynamics observed so far.

3. An empirical model of regional workplace accidents

3.1. Specification of the workplace accidents equation and data

In this section, we will provide evidence regarding the determinants of workplace accidents at the regional level in Spain. As indicated in Chapter 1, the risk of sickness absence due to work-related injury is determined by the interplay of incentives faced by workers and firms. Nevertheless, the probability of sickness absence is also influenced by government regulation. For example, as described by Lanoie (1991), the intensification of government prevention policies, such as increasing the penalty in case of non-compliance with safety standards, may exert opposite effects on workplace accidents. On the one hand, these measures could lead to a reduction in the risk of accident since it would increase the expected cost of an accident for employers, inducing them to devote more resources to safety. On the other hand, workers might become less careful due to feeling they work under safer conditions resulting from this intensification in workplace injury prevention. Hence, the present empirical model of regional workplace accidents ($RISK_{it}$) considers prevention variables ($PREVENTION_{it}$) and labour market variables often encountered in the literature ($LABOUR_{it}$), all of them for province i in period t :

$$RISK_{it} = f(PREVENTION_{it}; LABOUR_{it}) \quad (3)$$

In selecting the particular set of variables for these broad categories, previous contributions to the analysis of workplace accidents, particularly those by Viscusi (1986) and Lanoie (1992) have been taken into account. However, the final set of explanatory variables has been conditioned by data availability at the provincial level for the period under analysis. Table 4.3 provides a precise definition of all the variables used in the analysis, their mean, standard deviation and source.

Two different data series are used as the dependent variable: the incidence rate of minor accidents and the incidence rate of severe and fatal accidents. As in the previous section, the incidence rate is defined as the number of accidents at work per 1,000 persons in employment. Data on accidents are based on the Spanish Statistics on Accidents at Work (*Estadística de Accidentes de Trabajo* in Spanish, EAT), compiled by the Spanish Ministry of Labour. We limit our sample to those workers covered by the Social Security General Regime. In order to calculate incidence rates for accidents at work, the reference population is the number of workers covered by the Social Security General Regime.

Table 4.3 Definition, mean, standard deviation and source of variables used in the regression analysis

Variable	Definition	Mean	Standard Deviation	Source
<i>Dependent variables</i>				
<i>MINOR</i>	Number of minor accidents at work per 1,000 employees	62.3	16.4	EAT and Ministry of Labour
<i>SEVERE</i>	Number of severe and fatal accidents at work per 1,000 employees	0.94	0.48	EAT and Ministry of Labour
<i>Independent variables</i>				
<i>INSPECTORS</i>	Number of labour inspectors per 1,000 employees	0.17	0.06	Labour and Social Security Inspectorate Statistics
<i>INSPECTION</i>	Number of inspections per 1,000 employees	41.1	26.2	Labour and Social Security Inspectorate Statistics
<i>INFRACTION</i>	Number of penalties, standstills and injunctions imposed as percentage of total inspections	0.41	0.13	Labour and Social Security Inspectorate Statistics
<i>FEMALE</i>	Percentage of female workers in the female labour force	80.1	9.3	Labour Force Survey (EPA)
<i>EDUCATION</i>	Percentage of workers with a university degree	9.5	3.3	Fundación Bancaja e Ivie (Instituto Valenciano de Investigaciones Económicas)
<i>INDUSTRY</i>	Percentage of workers in industry	17.3	7.0	Labour Force Survey (EPA)
<i>CONSTRUCTION</i>	Percentage of workers in construction	11.6	2.9	Labour Force Survey (EPA)
<i>SERVICES</i>	Percentage of workers in services	61.7	8.6	Labour Force Survey (EPA)
<i>MACHLAB</i>	Capital in machinery and equipment per employee	24.7	5.6	Fundación BBVA
<i>URATE</i>	Ratio of the unemployed to the labour force	14.5	7.1	Labour Force Survey (EPA)

Regarding the independent variables, the intensity of workplace inspections by the Job Safety Agency (Inspección de Trabajo) is taken into account. This public agency is concerned with the prevention of accidents, the investigation of severe accidents and the proposition of sanctions to those firms that do not comply with the regulations. Even though the main regulation is nationwide, the decisions regarding the number of inspections, the type and number of firms to be inspected, the sanctions regime, etc. is under the control of regional governments. Therefore, it is likely that regional differences on the inspection intensity could also be a factor behind the different impact of workplace accidents at the regional level. The empirical model includes three prevention measures: the number of labour inspectors per 1,000 employees (*INSPECTORS*); the number of inspections per 1,000 employees (*INSPECTION*); and the number of penalties, standstills and injunctions imposed as percentage of total inspections (*INFRACTION*).

According to Viscusi (1986) and Lanoie (1992), it is plausible that the impact of safety-enforcing measures on accidents occurs with a lag because, among other things, there can be a lag involved in making capital investment decisions required for compliance with standards.

The selection of variables often encountered in the literature that account for labour market conditions was largely conditioned by the availability of data at the provincial level for the entire period under study. In regards to workforce's characteristics, it is expected that, *ceteris paribus*, jobs with a higher fraction of female and educated workers should involve less physical effort and, therefore, lower risk of workplace accidents (Viscusi, 1986; Lanoie, 1992). Therefore, differences in the share of the female workers in the labour force (*FEMALE*) and in the share of workers that have a university degree (*EDUCATION*) across provinces are expected to influence regional incidence of workplace accidents.

To control for the industrial mix, the shares of employment in industry (*INDUSTRY*), construction (*CONSTRUCTION*) and services (*SERVICES*) are included. The share of employment in agriculture is omitted to avoid perfect co-linearity. Thus, coefficients of the other shares are referred to as deviations from the base category. We are aware that this sectoral disaggregation does not allow us to control for differences across provinces in the activities within each broad category. However, these are the most detailed data available at the level of provinces for the period under analysis.

The ratio of capital in machinery and equipment to labour (*MACHLAB*) is also considered in this empirical model. This ratio is expected to have a positive impact on workplace accidents since workers usually face more risk as their contact with machinery increases (Curington, 1986; Lanoie, 1992). If the average ratio of machinery and equipment to labour in the Spanish provinces differs, this might explain some of the inequality in the geographical distribution of workplace accidents.

The unemployment rate (*URATE*) is included to capture business cycle effects. As described in Chapter 1, it has been argued that workplace accident rates exhibit a pro-cyclical nature. There are two explanations to this fact. Terrés de Ercilla et al. (2004) and Martín-Román (2006) argue that during economic upturns workers increase their effort level, which makes them less cautious regarding job safety. This fact would increase the total number of accidents as well as the incidence rate of accidents. On the other hand, Boone and van Ours (2006) argue that during the upturns workers are more likely to report job accidents because it would be easier to find a new job if they are fired for absenteeism. This increases reporting rates, and therefore incidence rates. As a result, a negative relationship between unemployment rate and the incidence of workplace accidents is expected.

Finally, following Viscusi (1986) and Lanoie (1992), a lagged dependent variable is included in each equation to serve as a proxy for the safety conditions that prevailed in the previous period.

The analysis draws on a cross-sectional time-series econometric model based on a panel of 51 provinces with annual data during the period 1995 to 2011. However, because of lagged variables, the regressions are based on the 1997-2011 period. Hence, the sample contains 714 observations.

3.2. Estimation results

From (3) and the collection of variables described above, the following equations are estimated:

$$\begin{aligned} MINOR_{it} = & \beta_1 INSPECTORS_{i,t-1} + \beta_2 INSPECTION_{i,t-1} + \beta_3 INFRACTION_{i,t-1} + \\ & \beta_4 FEMALE_{it} + \beta_5 EDUCATION_{it} + \beta_6 INDUSTRY_{it} + \beta_7 CONSTRUCTION_{it} + \\ & \beta_8 SERVICES_{it} + \beta_9 MACHLAB_{it} + \beta_{10} URATE_{it} + \beta_{11} MINOR_{i,t-1} + \mu_i + \tau_t + \varepsilon_{it} \end{aligned} \quad (4)$$

$$\begin{aligned} SEVERE_{it} = & \beta_1 INSPECTORS_{i,t-1} + \beta_2 INSPECTION_{i,t-1} + \beta_3 INFRACTION_{i,t-1} + \\ & \beta_4 FEMALE_{it} + \beta_5 EDUCATION_{it} + \beta_6 INDUSTRY_{it} + \beta_7 CONSTRUCTION_{it} + \\ & \beta_8 SERVICES_{it} + \beta_9 MACHLAB_{it} + \beta_{10} URATE_{it} + \beta_{11} SEVERE_{i,t-1} + \mu_i + \tau_t + \varepsilon_{it} \end{aligned} \quad (5)$$

where μ_i is an unobservable fixed effect for province i , τ_t reflects omitted fixed influences that vary across time but not across provinces and ε is the perturbation. The fixed provincial effects are included in the model to measure time-invariant unobservable effects on the incidence rates of workplace accidents. Fixed time effects are included to account for shifts in the incidence rate of workplace accidents that are common to all provinces as a result of cyclical effects. According to Viscusi (1986) and Lanoie (1992), time dummy variables could capture technological trends and aspects of the prevention policies that are not captured in the independent variables but that are time-dependent.

The model was estimated first using the least-squares dummy variables estimator following the results in favour of this estimator by the Hausman test. However, several tests were performed to check the suitability of this estimator. First, following Pesaran (2004), a test (CD) was performed to detect potential problems of cross-sectional dependence. This test accepts the null hypothesis of cross-sectional independence in both equations (CD= 1.295 with $p= 0.1955$ for equation 4; and CD=-0.129 with $p= 0.8975$ for equation 5). Second, following Wooldridge (2002), a test was computed to check for serial correlation in the two equations. The test accepts the null hypothesis of no serial correlation at the usual levels for the minor accidents equation ($F=3.308$ with $p=0.075$). However, the test rejects the null hypothesis for the equation on severe and fatal accidents ($F= 19.392$ with $p=0.0001$). Therefore, equation on minor accidents was estimated using the ordinary least-squares (OLS) method adjusted by White's (1980) heteroskedastic-consistent covariance matrix to correct the estimates for unknown forms of heteroskedasticity, while the equation on severe and fatal accidents was estimated using generalized least-squares (GLS) estimator. The latter is obtained by subtracting the first-order correlation coefficient for the residuals times the observation of each province in the previous period from the observation of each province in each period for each variable.

When a fixed-effects model is performed with panel data, lagged dependent variables will be correlated with the error term giving rise to endogeneity (Hsiao, 1986). To address this concern, we estimate the previous models using a Generalized Method of Moments (GMM) estimator, instrumenting for the lagged dependent variable using the dependent variable lagged two periods. This instrument was found to be valid according to the Hansen-Sargan test.

Table 4.4 Estimation results of the risk equations

	Dependent variables			
	<i>MINOR_{it}</i>		<i>SEVERE_{it}</i>	
	(OLS estimates)	(GMM estimates)	(GLS estimates)	(GMM estimates)
<i>INSPECTORS_{i,t-1}</i>	-32.390 (12.22)**	-17.846 (25.22)	0.064 (0.210)	2.602 (0.907)
<i>INSPECTION_{i,t-1}</i>	0.044 (0.024)*	0.087 (0.040)**	-0.001 (0.005)*	-0.001 (0.001)*
<i>INFRACTION_{i,t-1}</i>	6.966 (3.591)*	7.217 (5.981)*	-0.033 (0.059)*	-0.049 (0.054)*
<i>FEMALE_{i,t}</i>	-0.806 (0.448)*	-1.102 (0.371)***	-0.007 (0.004)*	-0.023 (0.017)
<i>EDUCATION_{i,t}</i>	0.855 (0.402)	1.029 (0.546)	-0.001 (0.003)	-0.075 (0.015)
<i>INDUSTRY_{i,t}</i>	0.435 (0.219)*	0.436 (0.505)*	-0.008 (0.002)***	-0.090 (0.014)***
<i>CONSTRUCTION_{i,t}</i>	-0.060 (0.146)	0.027 (0.484)	-0.008 (0.004)**	-0.034 (0.016)**
<i>SERVICES_{i,t}</i>	0.371 (0.154)**	0.723 (0.473)*	-0.009 (0.002)***	-0.031 (0.011)***
<i>MACHLAB_{i,t}</i>	-0.210 (0.351)	0.016 (0.340)	-0.002 (0.002)	-0.011 (0.0162)
<i>URATE_{i,t}</i>	-1.545 (0.522)***	-2.448 (0.453)***	-0.002 (0.006)	-0.009 (0.021)
Lagged dependent variable	0.346 (0.112)***	0.028 (0.039)*	0.517 (0.026)**	-0.180 (0.041)***
Constant	104.394 (43.44)**		1.874 (0.455)**	
$\bar{R}^2$	0.864		0.881	
Number of observations	714		714	

Notes: Each equation also includes a set of province and time dummies. Standard errors in parentheses. Significance levels: *significant at 10 per cent; **significant at 5 per cent; ***significant at 1 per cent.

Table 4.4 summarises estimations for the whole period for the 51 Spanish provinces. The first and the second column correspond to the OLS and GMM estimation, respectively, of the determinants of minor workplace accidents, while the third and fourth summarise the GLS and GMM estimation, respectively, for severe and fatal accidents incidence. The explanatory power is satisfactory since our model is able to explain 86.4 and 88.1 per cent of the variations in the incidence of minor and severe or fatal workplace accidents, respectively.

A number of interesting results arise from the analysis. Regarding safety-enforcing variables, the inspection and the infraction rate have a positive and significant coefficient in the minor accidents equation. Provinces with a higher number of inspections per 1,000 workers and a higher percentage of infractions have a higher incidence of minor accidents. However, the

coefficients of these two variables have the expected negative sign on the incidence of severe and fatal accidents. These results suggest that an increase in the intensity of workplace inspections would be followed by an important reduction in the incidence rate of severe and fatal accidents, but would have the opposite effect on the workplace accidents of less severity. A plausible explanation is that the investment in resources for safety due to the intensification of government prevention measures has a successful impact on the rate of severe and fatal accidents. However, at the same time, workers might become less careful since they might feel they work under safer conditions because of this intensification in prevention leading to an increase in the incidence of minor accidents. These results are in accordance with those found by Viscusi (1986) and Lanoie (1992). Furthermore, provinces that have a higher number of labour inspectors per 1,000 workers enjoy lower incidence rates of minor accidents, though this variable became insignificant in explaining the incidence of severe and fatal accidents.

As for the labour market variables, provinces with a higher percentage of female workers have a lower incidence of minor and severe or fatal accidents. These results are consistent with those observed in Chapter 2, where we found that women have lower risk of sick leave due to occupational disease or injury than men. Furthermore, most of the sectoral employment shares are significant, confirming that the industrial mix affects provincial incidence rates of workplace accidents. Provinces with a higher percentage of workers in industry and services have a higher incidence of minor accidents than those provinces with a higher percentage of workers in agriculture. However, provinces with a higher percentage of workers in agriculture have the highest incidence of severe and fatal accidents. In addition, the unemployment rate, as a business cycle variable, has a negative effect on the incidence of workplace accidents, which is coherent with some theoretical models discussed in Chapter 1; an economic upturn (reflected in a decrease of the unemployment rate) is usually followed by an increase in the incidence of workplace accidents, as discussed in Boone and van Ours (2006), Terrés de Ercilla et al. (2004) and Martín-Román (2006). Finally, neither human capital nor investment in machinery and equipment show significant coefficients.

4. What caused regional workplace accidents to converge/polarize?

Our previous results in Section 3 confirm that prevention and labour market variables are jointly significant in explaining the incidence rate of workplace accidents in the Spanish provinces. This section aims to analyse the effect of these two sets of variables in regard to the characteristics of the geographical distribution of workplace accidents in Spain. In order to assess the extent to which the features observed in the spatial distribution of the workplace accidents can be explained by variables potentially affecting the incidence of workplace accidents, we follow the methodology applied by López-Bazo et al. (2005) to study the distribution of unemployment rates in Spain.

Following López-Bazo et al. (2005), the effect of a factor X (prevention or labour market variables) on the incidence rate of workplace accidents of province i in period t (R_{Xit}) relative to the Spanish average incidence rate is computed as:

$$R_X_{it} = (X_{it} - \bar{X}_t)\hat{\beta}_X \quad (6)$$

where X_{it} is a vector with observation for the variables included in factor X for province i and period t , $\bar{X}_t$ is the vector of averages across provinces for those variables in period t , and $\hat{\beta}_X$ is the vector of coefficients of the variables estimated in the previous section. Next, differentials for conditional incidence rates are computed by subtracting the effect of the factor from the incidence rate differentials:

$$RCOND_{it} = (R_{it} - \bar{R}_t) - R_X_{it} \quad (7)$$

where $\bar{R}_t$ is the national average incidence rate of workplace accidents in period t .

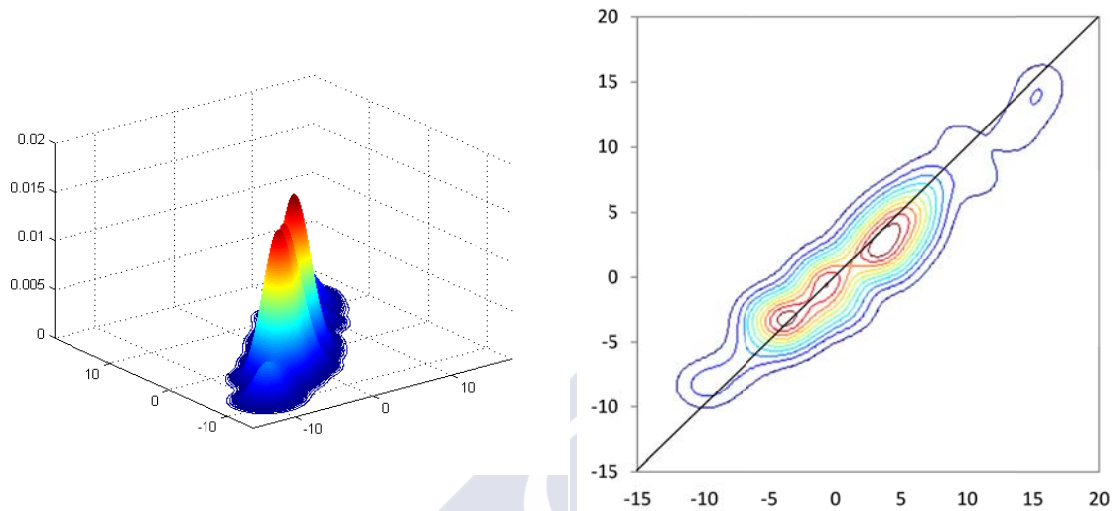
Following this methodology, we will obtain conditional distributions under the assumption that all provinces would show the same values for the variables included in each set of variables. If the factor had no effect on the distribution for a particular year, then the real and conditional distributions should not differ (López-Bazo et al., 2005). The difference between the actual and the conditional distribution can be displayed using stochastic kernels. From these charts we may identify that: i) the specific factor does not affect the observed distribution when the density is located along the 45° line, and ii) the dispersion in the real distribution is mostly caused by the factor when the density is parallel to the X-axis.

Figure 4.5 and Figure 4.6 show the changes between the actual distribution and the distribution conditioned to (no difference across provinces in) the prevention and to the labour market variables, respectively, for 2011. A number of interesting results arise from this analysis. First, the contribution of the different categories of variables to explain the geographical distribution of workplace accidents differs between minor and severe or fatal accidents. Secondly, while the prevention variables did not exert any significant influence on the provincial distribution of minor accidents, they account for a large part of the characteristics of the distribution of severe and fatal accidents. In fact, the stochastic kernel for the effect of the prevention variables on the distribution of the incidence of minor accidents (Figure 4.5-Panel A) depicts how the mass of probability runs along the diagonal defining no change between the actual and the conditional distribution. By contrast, Figure 4.5-Panel B shows that, when we simulate no difference across provinces in government prevention policies, all provinces show similar incidence rates of severe and fatal accidents since most of the density is located parallel to the X-axis.

Likewise, the contribution of the labour market variables to the geographical distribution of workplace accidents is also far from homogeneous (Figure 4.6). In the case of minor accidents, the kernel is placed parallel to the X-axis suggesting that the distribution is much more concentrated when the effect of the labour market variables is netted out (Figure 4.6-Panel A). By contrast, the labour market variables do not significantly affect the distribution of severe and fatal accidents. In fact, the kernel is located along the diagonal, which suggests no change between the actual distribution and the distribution conditioned to the labour market variables (Figure 4.6-Panel B).

Figure 4.5 Effect of the prevention variables on the distribution of the incidence rates of workplace accidents. 2011

Panel A. Minor accidents



Panel B. Severe and fatal accidents

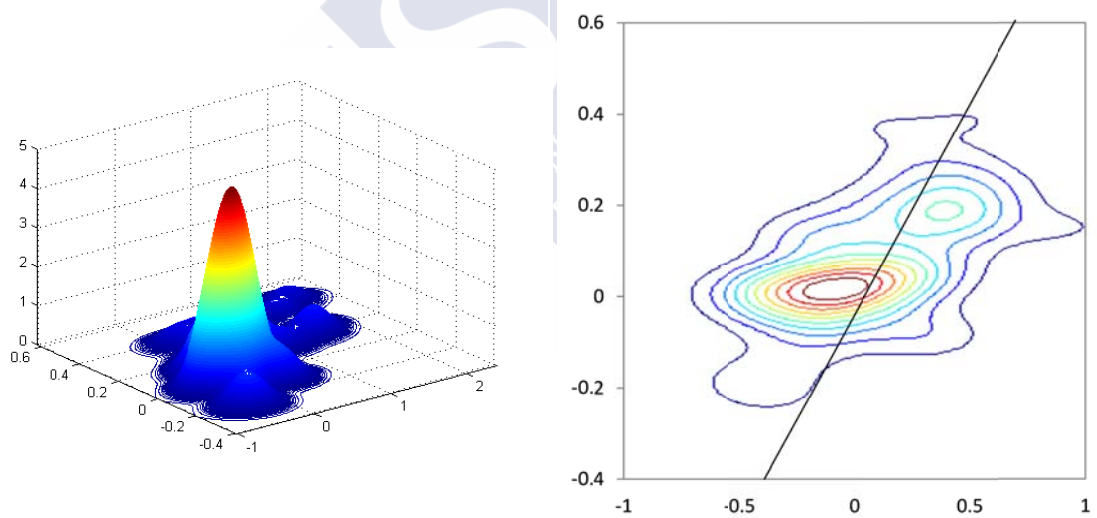
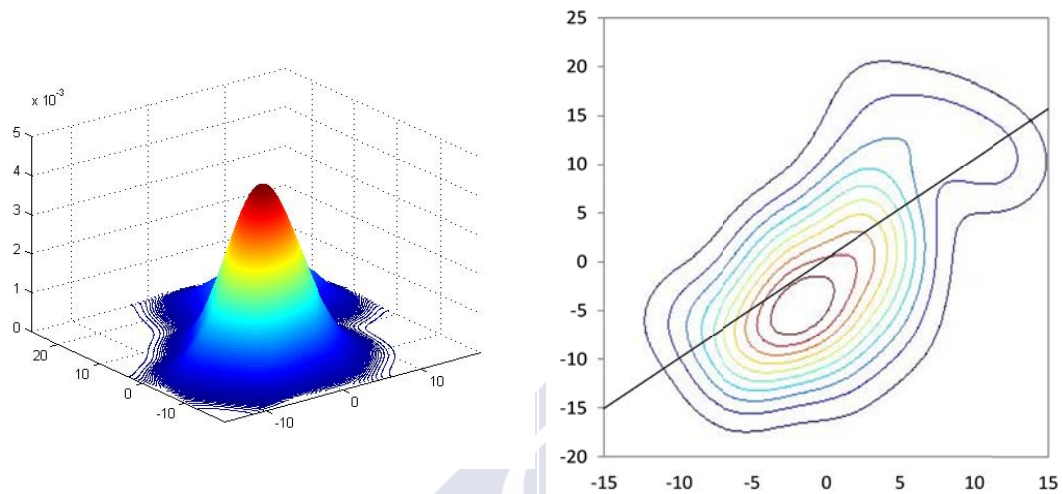
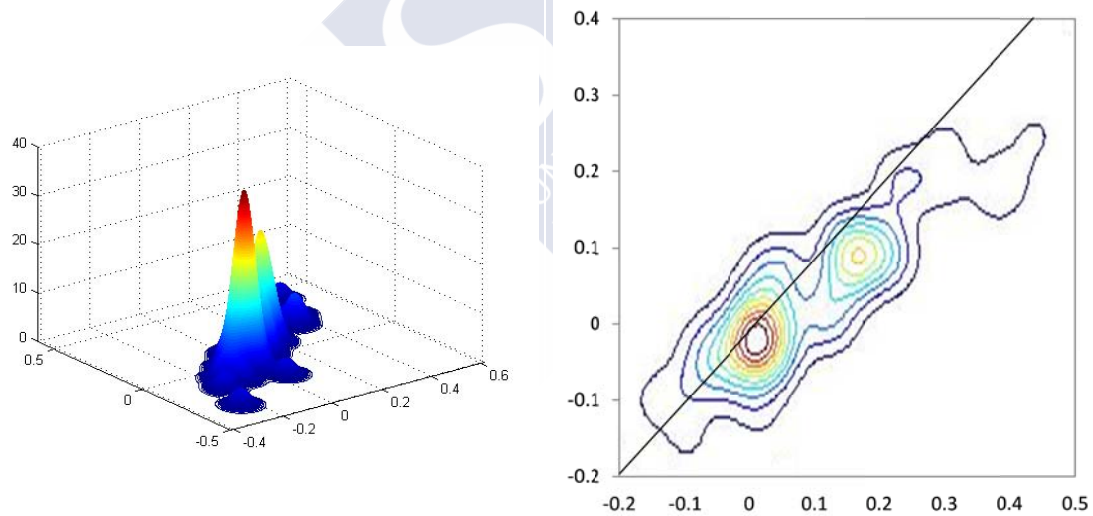


Figure 4.6 Effect of the labour market variables on the distribution of the incidence rates of workplace accidents. 2011

Panel A. Minor accidents



Panel B. Severe and fatal accidents



5. Conclusions

This chapter has examined, through descriptive statistical techniques, the regional distribution of the incidence of workplace accidents in Spain, as well as its performance over the last two decades. It also has analysed the contribution of government prevention measures and labour market variables in giving rise to spatial differences in the incidence of workplace accidents. The results show the existence of a large differential across Spanish provinces in the incidence of workplace accidents. Moreover, the evolution in the geographical distribution of minor accidents is characterized by convergence to a value just above the national average, while there is a trend towards polarization in two groups of regions in regards to incidence rates of severe and fatal accidents.

The econometric analysis carried out in this chapter confirms that government prevention measures and labour market variables are jointly significant in explaining the incidence rate of workplace accidents in the Spanish provinces. However, the contribution of the different categories of variables to explain the geographical distribution of workplace accidents differs between minor and severe or fatal accidents. While the large dispersion in the provincial distribution of labour market variables explains most of the observed inequality in the incidence rate of minor accidents, the differences across provinces in the government prevention measures account for a large part of the characteristics of the distribution of severe and fatal accidents.

These results call for a modification of the current framework that would reduce the regional disparities in the intensity of inspection and sanction regimes in order to prevent severe and fatal workplace accidents with higher economic and social costs. The Inspectorate of Labour and Social Security plans its interventions according to the objectives fixed by the relevant authorities, which may be at general or territorial level. The establishment of general objectives for the interventions regarding occupational health and safety that may be incorporated in the territorial programmes would take into account the current regional imbalance in the intensity of the inspection and could thus contribute to their reduction.

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CONCLUSIONS

This thesis has examined absence from work due to sickness in Spain. The main findings confirm that labour supply factors such as gender and age are important in determining sickness absence, as shown by the conventional income-leisure choice model. However, labour demand factors and labour market institutions also play a role. This thesis confirms that government prevention measures are significant in explaining the incidence rate of workplace accidents in the Spanish provinces. Moreover, the differences across provinces in the government prevention measures explain most of the observed inequality in the incidence of severe and fatal accidents.

In the first chapter, the review of the current state of knowledge confirms an upsurge of research both theoretical and empirical on the factors determining worker absenteeism. The traditional approach to explaining absenteeism is based on the conventional income-leisure choice model, where the difference between the number of contractual working hours and the number of desired working hours by workers at the going wages provides the motivation for absence. According to the income-leisure choice model, some labour supply factors are important drivers of sickness absence. In fact, the main findings of Chapter 2 demonstrate that both incidence and duration of sick leave are higher for women than for men. In the same vein, Chapter 3 has showed that the probability of suffering a severe or fatal accident, as well as the duration of the sick leave, increases with the worker's age.

More specifically, Chapter 2 has analysed gender differences in the incidence of sickness absence, as well as in the duration of sick leave. In this chapter we have considered two types of causes for sick leave: common disease or accident and occupational illness or injury. This distinction has revealed essential differences between men and women in the incidence and duration of sick leave in Spain. Our results confirm that women have a higher incidence of sick leave due to common disease or accident than men. But the reverse is true when the reason for absence from work is occupational illness or injury. We find that the presence of children under 3 years old in the household is one of the most important variables explaining the differences in sickness absence between women and men. Indeed, when there are children under 3 years in the household, the probability of sick leave due to common illness or injury for open-ended workers aged 25 to 39 within first 400 days of employment is roughly 10 per cent for men, but increases to 15 per cent in the case of women. Furthermore, we find that 8 per cent of the open-ended male workers aged 25 to 39 with children less than 3 years old return to work after a sick leave spell due to common illness or injury before the 5th day, while this percentage decreases to less than 6 per cent in the case of women.

In the third chapter, we have examined the impact of worker's age on the consequences of workplace accidents. The analysis has showed that the probability of suffering a severe or fatal accident increases with the worker's age once personal, job, and accident characteristics are controlled for. In particular, taking the group of the youngest workers (from 16 to 24) as a reference, we observe that for every age group, the probability of a more severe accident increases from 7.5 per cent for the group aged 25 to 39 to 32.6 per cent for workers aged 65 and older. Likewise, the results reveal that the duration of sick leave increases clearly with age.

Indeed, the expected absence duration for workers aged 65 and over is twice the duration expected for workers aged 16 to 24.

As indicated in Chapter 1, the traditional approach interprets sickness absence exclusively from a labour supply perspective. However, the exclusion of labour demand considerations leads to a poorly specified model. Indeed, the costlier absence is to employers, the more likely they are to respond. Though some progress has been made in incorporating demand side aspects to the analysis, this approach is still somewhat underdeveloped. To fill this void, Chapter 4 has analysed the contribution of government intervention in occupational health and safety (OSH) in giving rise to spatial differences in the incidence of workplace accidents. Our results confirm that government prevention measures and labour market variables are jointly significant in explaining the incidence rate of workplace accidents in the Spanish provinces. However, the contribution of the different categories of variables to explain the geographical distribution of workplace accidents differs between minor and severe or fatal accidents. While the large dispersion in the provincial distribution of labour market variables explains most of the observed inequality in the incidence rate of minor accidents, the differences across provinces in the government prevention measures account for a large part of the characteristics of the distribution of severe and fatal accidents.

Like most European countries, Spain's public sickness insurance scheme is a major component of its social security system. Moreover, the cost of sick leave is larger than the amount paid to the sick worker while he or she is absent from work; production losses and health care outlays are also socioeconomic costs of sickness absence. Furthermore, we should bear in mind that some temporary sick or injured workers could become permanently disabled and hence leave the labour force. Therefore, the knowledge regarding the determinants of incidence and duration of absence from work due to illness is very relevant for public policy. Some interesting policy implications arise from this thesis:

First, the findings of this thesis imply that various factors can assist workers with the care of their dependants and, in turn, reduce their absence from work. The need for facilities for the care of children is emphasized because their presence in the household is associated with a high probability of employee absence. Some potential policies to address the problem include longer maternity leaves, improving the access to subsidized day-care facilities for children, and preferential tax treatment for hiring help in the house.

Second, the results suggest that the decision regarding increasing the total number of older workers in the labour market should be made with caution. If the retirement age is delayed, the *ceteris paribus* effect must be an increase in the total number of severely injured workers with prolonged sick leave, which may increase the total public health cost expenses. From a policy perspective, the results point out the importance of a proper match between the capabilities of the worker and the demands of the job. Therefore, decisions about delaying the retirement age require additional measures, such as the occupational reallocation of these older workers to tasks with lower incidence rates and provide them with continuous prevention training programmes.

Finally, the results of this thesis call for a modification of the current framework that would reduce the regional disparities in the intensity of inspection and sanction regimes in order to

prevent severe and fatal workplace accidents with higher economic and social costs. The Inspectorate of Labour and Social Security plans its interventions according to the objectives fixed by the relevant authorities, which may be at general or territorial level. The establishment of general objectives for the interventions regarding occupational health and safety that may be incorporated in the territorial programmes would take into account the current regional imbalance in the intensity of the inspection and could thus contribute to their reduction.

Until very recently, sickness absence has received less attention than other areas of labour economics. However, there has been an upsurge of research both theoretical and empirical on the factors determining worker absenteeism. Given the socioeconomic costs of sickness absence, further research in this area is expected in the near future. Indeed, there are quite a few interesting avenues for future research. First of all, multiple spells of sick leave need to be addressed once the study of a single spell has provided enough elements to design the empirical strategy. Secondly, the nature of the employment relationship, open-ended or fixed-term, has been identified as key to analyse the incidence of sick leave, but very little has been done to investigate its impact. Finally, equally or more useful for public policy is to research the consequences of sick leave for the labour market outcomes of all workers, but more particularly of women with children and older workers.



RESUMEN

Esta tesis analiza el absentismo laboral por enfermedad o accidente en España. El primer capítulo repasa el estado actual del conocimiento relacionado con la teoría y evidencia empírica sobre absentismo laboral por enfermedad dentro de un contexto económico. La literatura económica ha destacado que factores relacionados con la oferta de trabajo, como por ejemplo el género y la edad, son importantes a la hora de explicar el absentismo laboral por enfermedad. No obstante, según la evidencia empírica, el efecto de estas variables es incierto. Los capítulos 2 y 3 de esta tesis tienen como objetivo contribuir a este debate ofreciendo evidencia empírica en relación al impacto del género y la edad, respectivamente, sobre el absentismo laboral por enfermedad. Finalmente, el capítulo 4 analiza la contribución de la intervención gubernamental en materia de salud y seguridad en el trabajo al aumento de las disparidades territoriales en la incidencia de los accidentes de trabajo.

En concreto, el capítulo 2 se centra en la explicación de las diferencias de género en el absentismo laboral. Los datos utilizados proceden de la Muestra Continua de Vidas Laborales del año 2006, a la que se ha añadido información sobre todos los episodios de incapacidad temporal cubiertos por el sistema de Seguridad Social español durante el periodo 2005-2006. El análisis empírico realizado en este capítulo está dividido en dos partes. En primer lugar, estimamos un modelo de riesgos en competencia para estudiar el impacto de las características del trabajador sobre el tiempo transcurrido desde el comienzo de una relación laboral hasta que aparece el primer episodio de incapacidad temporal. En segundo lugar, estimamos un modelo de duración simple para examinar como esas mismas características afectan al tiempo de baja laboral. Los resultados muestran que la incidencia, así como la duración de las bajas laborales, es más elevada en las mujeres que en los hombres. Más concretamente, la presencia de niños menores de 3 años en el hogar es una de las variables más importantes a la hora de explicar las diferencias en absentismo laboral por enfermedad entre mujeres y hombres.

El capítulo 3 examina el impacto de la edad del trabajador sobre las consecuencias de los accidentes de trabajo. En base a datos procedentes de la Estadística de Accidentes de Trabajo para el periodo 2004-2010, estimamos un modelo multinomial para analizar el impacto de la edad del trabajador en la probabilidad de sufrir un accidente grave o mortal. Además, estimamos un modelo de duración simple para calcular el efecto de la edad del trabajador sobre la duración de la baja laboral ocasionada por un accidente de trabajo. El análisis muestra que la probabilidad de sufrir un accidente grave o mortal, al igual que la duración de la baja laboral causada por el mismo, aumenta con la edad del trabajador una vez que se ha controlado por las características personales y profesionales del individuo, así como por las propias circunstancias del accidente. Desde una perspectiva política, los resultados destacan la importancia de que exista un vínculo adecuado entre las capacidades del trabajador y las exigencias del puesto de trabajo. Por lo tanto, prolongar la edad activa de los trabajadores exige medidas adicionales para evitar o minimizar sus efectos negativos. Por ejemplo, la reubicación funcional de estos trabajadores hacia tareas en las que la incidencia de los accidentes (o la gravedad de los mismos) sea menor, contribuiría a paliar los efectos mencionados.

Finalmente, el capítulo 4 analiza la distribución regional de la incidencia de los accidentes de trabajo en España, así como su evolución a lo largo de las dos últimas décadas. Este capítulo también analiza la contribución de factores socioeconómicos y de medidas de prevención de riesgos laborales al aumento de las disparidades territoriales en la incidencia de los accidentes de trabajo. Los resultados sugieren la modificación del actual marco legal bajo el cual se rige la actividad de la Inspección Laboral, en la medida en que estos cambios reducirían la magnitud de las diferencias territoriales.



