Injured workers and their return to work: beyond individual disability and economic incentives

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Monica Galizzi[a], Roberto Leombruni[b,c], Lia Pacelli [b,c], Antonella Bena[d]

a - Department of Economics and Center for Women and Work (CWW); University of Massachusetts Lowell, 1 University Ave. Lowell, MA 01854-2881, U.S.A., phone: 978-934-2790, fax: 978-934-3071, e-mail: Monica_Galizzi@uml.edu
b – Department of Economics and Statistics, University of Torino, Lungodora Siena 100, 10153 Torino, Italy. Phone +39 011 6704983, fax: +39 011 6703895, e-mail: lia.pacelli@unito.it, roberto.leombruni@unito.it
c - LABORatorio Riccardo Revelli - Centre for Employment Studies, - Via Real Collegio 30, 10024 Moncalieri (To), Italy, Phone: +39 011 6705060, Fax +39 011 6705061, e-mail: labor_at_laboratoriorevelli.it
d – Epidemiologia Piemonte, Via Sabaudia, 164, 10095 Grugliasco (To), Italy. Phone:+39 011 40188510 - fax: +39 011 40188201, e-mail: antonella.bena@epi.piemonte.it

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Monica **Galizzi** is a Professor of Economics at the University of Massachusetts Lowell. Her research on the socio-economic consequences of occupational injuries has appeared on the Journal of Human Resources, the Journal of Labor Economics and on peer-reviewed interdisciplinary journals. She has been principal investigator and co-investigator of CDC-NIOSH grants.

Roberto **Leombruni** is assistant professor of econometrics at the University of Torino. His research on the relations between work and health appeared in the European Economic Review, Labour Economics, American Journal of Industrial Medicine, BMC Public Health and other peer-reviewed journals.

Lia **Pacelli** is assistant professor of economics at the University of Torino. Her research on the relations between work and health, on labour market flexibility and human capital accumulation appeared in the Journal of Labour Research, Applied Economics, International Journal of Manpower and other peer-reviewed journals.

Antonella **Bena** is an epidemiologist in the Occupational Epidemiology Unit of the Piedmont Region. Her research on occupational epidemiology and health services has appeared in American Journal of Industrial Medicine, Occupational and Environmental Medicine, BMC Public Health. She has been project leader of several Italian cooperative studies in occupational health.

Abstract

Purpose of this paper	First study of the factors affecting the return to work (RTW) of injured workers in an institutional setting where workers' earnings are fully compensated during the disability period.
Design/methodology/ approach	We use a unique dataset matching employer-employee panel data with Italian workers' compensation records. We estimate survival models accounting for workers' unobserved heterogeneity.
Findings	Workers with higher wage growth, higher relative wages and from firms with better histories of stable employment, return to work sooner. More vulnerable workers – immigrants, females, members of smaller firms – also tend to return sooner. But even when we control for such measures of commitment, status, and job security, high-wage workers RTW sooner.
Research limitations/implications (if applicable)	We use proxies as measures of commitment and status. We study blue collar workers without finer job qualifications. We estimate a reduced form model.
Practical implications (if applicable)	In an institutional environment where the immediate cost of workers' compensation benefits falls largely on firms, employers seem to pressure those workers whose time off is more costly, i.e., high-wage workers. The lack of evidence of ex post moral hazard behaviour also demands for a better understanding of the relationship between benefits and RTW.
Social implications	Workers who are induced to RTW before full recovery jeopardize their long-term health and employability. Firms that put such pressure on employees might generate social costs that can be particularity high in the case of high productivity workers.
What is original/value of paper	First quantitative analysis of an institutional setting where injured workers face 100% benefits replacement rate and have job security. This allows focusing on other workers' or employers' reasons to speed RTW. One of very few economics studies on this topic in the European context. It has implications for human resource managers, state regulators, and unions.

1. Introduction

Several western countries have witnessed a decline in the total number of reported occupational injuries over the past twenty years. This trend has also characterized the Italian labor market. In 2008, Italy reported a national incidence rate of 2.9%, corresponding to a total number of 790,278 notified injuries, 67% of which were recognized and compensated for temporary or permanent disabilities (Eurogip, 2010). The debate about the outcomes of occupational injuries has not diminished, however. This is partly because the overall cost of occupational injuries and illnesses in western countries is still quite high. It ranges between 2.6% and 3.8 % of GDP among countries that are members of the European Union (EU-OSHA ─ European Agency for Health and Safety at Work, 2014). For Italy, the latest available figure for the total cost net of prevention expenses was EUR 32.1 billion, or 2.1% of GDP in 2007 (INAIL, Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro, 2011). The cost of occupational injuries and illness in the U.S. for the same year (2007) was estimated at $250 billion, or 1.7% of GDP (Leigh, 2011). Furthermore, the debate about the compensability of occupational incidents continues because "disability compensation is the only universal program for which entitlement criteria are open to interpretation and for which, therefore, access can be severely restricted. Disability compensation provides one of the principal mechanisms through which society can regulate social spending" (Yelin, 1989, p.116). Indeed, across Australia, European countries, and North American jurisdictions, the last two decades have been characterized by the spread of aggressive early return programs (Seing *et al.*, 2015), with the effect of reducing the payment of workers' compensation benefits (Lippel, 2012).

Occupational injuries that result in time off work lead to substantial costs that are distributed among different stakeholders depending on labor market institutions and regulations. Countries vary greatly in the mechanisms that they use to compensate injured workers (OECD, 2003) but, interestingly, the cost covered by workers' compensation insurance systems often amounts to only a small percentage of the total costs associated with all occupational incidents: less than 25% in the U.S. (Leigh, 2011) and 34% in Italy (INAIL, 2011). Time off from work leads to additional costs because workers face potential reduced compensation and uncovered medical expenses, obsolescence of skills, or reduced future income, employability, and health (Galizzi and Boden, 2003). Workers' quality of life may be compromised as well because of physical and mental pain and suffering. Indeed, the longer the time off from work, the worse the consequences may be in terms of diminished self-esteem or increased resentment with consequences for family life and future relationships with coworkers or employers. Family members may also carry costs because of the need to provide care or to supplement income, especially in the case where the injured worker was the primary wage earner (Strunin and Boden, 2004). Employers incur costs in terms of lost productivity, damaged equipment, damaged reputations, and adjustment costs associated with the substituting or training of new workers. They also face administrative and legal costs, increases in insurance premiums, as well as accommodation costs and potential lower productivity upon return to work (Soklaridis, *et al.*, 2012). Insurers, health care providers, or taxpayers carry the costs associated with the administration of the workers' compensation cases, the benefits payments and those health care expenses that are transferred to public or private health insurance systems.

At the same time, it is very important to recognize that workers may be subject to pressure to speed their return to work, and that the push toward an early return to work can have very negative consequences if it is implemented at the expense of workers' full recoveries. For example, if workers are not completely healed before they return to work, their job demands may lead to the use of excessive medication, which may also lead to possible addiction (MacEachen *et al*., 2007). Or unhealed workers may end up being at higher risk for additional injuries. And even in the case where we may argue that early return to work before full recovery can actually serve a rehabilitative function, its success may largely depend on firms' abilities to accommodate workers, an ability that is often a function of firms' sizes and profitability. Therefore, workers who (are induced to) return to work before full recovery can jeopardize their long- term health and employability. As such, this might generate severe social costs.

Finally, it is important to notice that the consequences associated with injuries and time off from work go beyond all these listed economic, organizational, and personal costs. The consequences of such injuries also have a social justice component, given that such burdens fall disproportionally on low-wage workers who are often employed in the most hazardous jobs and whose compromised employability may lead to limited upper social mobility (OSHA, 2015).

The existing economic analysis on the topic of return to work has made use mainly of North American data and has focused on the workers' compensation benefits replacement rate as the key economic determinant of the speed to return to work. This suggests that the literature has mainly focused on supply side explanations of the dynamics of return to work (Yelin, 1989), on the moral hazard behavior induced possibly by disability benefits, or on the health constraints that may affect workers' ability to return to work. Very limited research has been conducted to assess how the demand of labor and, more generally, the interaction between individual workers' decisions and employers' behavior affect return to work patterns. There is general acknowledgment that this is a very critical area of research across disciplines.

This study aims at casting some light on this discussion by revisiting the approach that is standard in the literature and exploring an alternative hypothesis: if some workers may be subject to incentives to speed their return to work, possibly at the expense of their full recovery. To achieve this goal, we explore a new Italian data set that combines a national sample of matched employer-employee data with records from the Italian national workers' compensation agency, *INAIL*. These merged data permit us to study the determinants of return to work by analyzing the period between the time of the injury and the time of actual return to paid employment. In Italy this corresponds to the time when workers' compensation benefits are terminated. Furthermore, they permit us to study an institutional setting that differs dramatically from the one previously analyzed in U.S. studies. In fact, a combination of national laws and of union sector rules makes the workers' compensation replacement rate for most Italian injured workers equal to 100%. Such full wage replacement is financed by firms both through the experience ratings premium that they pay to the INAIL, and through direct reimbursement to the workers. Furthermore, labor laws impose that jobs will be guaranteed at the time when the worker is declared ready to return to work.

Such data and rules permit us to explore new research hypotheses about other factors that can speed the return to work in a setting where workers are not incentivized to speed their return because of their need to go back to full earnings. In this institutional environment, post injury moral hazard behavior should be greatly amplified resulting in very long periods off from work. However, other explanations related to firm costs, investment in specific human capital, commitment, and fear of retaliation may play an important role in inducing an early return. We test such hypotheses.

Finally, with this study we also want to contribute to the filling of a research gap. Since 2005, Europe has published more papers on the topic of return to work than the U.S. However, this increase has been mainly lead by research in northern European countries and in the medical field (Rollin and Gehanno, 2012). Most of the existing economic analysis on this subject is not very recent and has focused on the North American labor market. With this paper, we aim at bringing new economic and southern European evidence to the topic.

The paper continues as follows: in the next section we review the existing literature on the topic and present our research hypotheses. Section 3 describes the Italian institutional setting in detail, as its features are crucial in our study. Section 4 presents our unique dataset. Section 5 introduces the empirical model we estimate. Section 6 describes occupational injuries in Italy, while Section 7 presents and discusses the results of the econometric model. Section 8 draws some conclusions and comparisons between outcomes in the Italian system and the ones described by previous studies.

2. Background and Research Hypotheses

Literature review

The study of the factors influencing the return to work of injured workers has been the focus of several articles in the field of industrial medicine and occupational rehabilitation, although the economic literature has offered also important insights (for extensive reviews see Krause *et al.,* 2001). While one of the first important economic studies on the effect of illnesses and injuries on labor market outcomes referred to British workers (Fenn, 1981), most of the economic literature on return to work has made use of North American workers' compensation data. This literature was written in the early 90s partly as a response to the need to understand the escalating costs of the U.S. occupational incidents and of the corresponding workers' compensation claims.

Despite the interdisciplinary nature of this literature, several results appear to be quite consistent. As far as personal characteristics are concerned, older age, lower education, lower tenure, lower wage, part-time jobs, intermittent labor market experience, and problematic pre-injury medical history have been found to be negatively associated with the hazard of returning to work. Women have also been found to take a longer time to return to work, although the results are mixed when the analysis distinguishes between shorter and longer disability periods (Galizzi and Boden, 2003). The evidence is also mixed about the role played by union membership, given the differing functions that unions can play in providing employees with information, in protecting the jobs of injured workers, or in facilitating accommodations on the job. However, the factors that play a major role in determining the length of time off work are clearly associated with the event of the injury itself: the severity of the injury, the nature of the impairment, the injured body part, as well as the replacement rate measured as the ratio between weekly temporary disability benefits and the gross weekly pre-injury wage (Fenn, 1981; Butler *et al.*, 2001; Galizzi and Boden, 2003; Seabury *et al.*, 2011). As in the case of public and private disability insurances, the positive relationship between workers' compensation benefits level and claim frequency or claim duration has been interpreted as evidence of workers' moral hazard behavior (Dionne and St-Michel, 1991). Recently, a few studies estimating the likelihood of filing of workers' compensation claims have found new results that contradict such a theory (Bronchetti and McInerney, 2011). They suggest that the labor supply disincentive effects of workers' compensation benefits may have been overestimated (Butler, *et al*., 2001). They indicate that more focus should be put instead on studying the effect of the lack of clear communication to workers about standards and processes for terminating benefits payments (Belton, 2011), of the increasing restrictions for compensability that workers face (Spieler and Burton, 2012), or on the effect of different degrees of job security (Victor and Savych 2010).

Indeed, the most interesting results discussed in the most recent literature refer to the great importance that job characteristics and the organizational culture play in influencing the return to work of injured workers. Some previous economic studies had already found that the likelihood of such return was greatly affected by the workers' ability to return to the pre-injury employer (Galizzi and Boden, 2003; Reville, *et al*., 2001), by the degree of the physical demands of the job (Fenn, 1981), and by firm-specific disability management policies, such as the possibility of returning to work at reduced hours, to modified work tasks, or with modified equipment (McLaren *et al*., 2010). More recent studies have then highlighted the role played by individual key stakeholders, such as medical providers who decide the length of disability payments (Belton 2011) or supervisors who have to balance the conflicting needs of protecting workers' rights to recover from the injury while maintaining firms' high productivity (Stochkendahl *et al*., 2015).

The lessons and policy implications of these studies are somewhat limited, however, by the fact that countries vary in terms of rules protecting jobs, or accommodating and compensating disabled workers (Bloch and Prins, 2001). Therefore, the study by Anema *et al.* (2009) is quite important because it represents one of the very few cross-country comparisons of return to work patterns. It confirms the importance of compensation policy variables, but it also finds that work interventions and job characteristics are the *main* determinants of differences in return to work patterns across countries. Such variables carry even more explanatory power than patients' characteristics, health, and medical interventions. These results suggest the need to develop further studies that account for richer measures of employers' characteristics and organizational culture. Indeed, employer characteristics go beyond the measures of a firm's size, unionization, or industrial sector that are often used in economy analysis. In the context of the return to work of injured workers what seems to matter is organizational behavior: people-oriented culture (involvement in decision making, supportive and cooperative working relationships with coworkers and supervisors, workers' trust of – and attachment to – the company, sense of satisfaction, involvement on the job), or safety-oriented culture (case management policies and practices, ergonomics practices) (Franche *et al*.; 2005, Young, 2010).

Quantitative research in this area is complicated by the difficulty of obtaining measures that capture both injury and economic and organizational variables. This challenge partly explains the relatively limited number of more recent economic studies on the topic of return to work. The availability of new richer employer-employee data sets in several countries could prove to be very useful in this context. This paper is a step in this direction.

Research Hypotheses

Given the Italian institutional background (described in detail in the next section), we are studying a labor market where injured workers do not face monetary incentives to return to work because they are customarily compensated with a 100% benefits replacement rate. The lack of variation and full replacement rate among injured employees permits us to focus on other reasons that may explain potential different return to work likelihoods between high and low wage, or less and more vulnerable employees. Also, we study a setting where employers carry a large part of the immediate marginal monetary costs associated with the time off from work caused by a new injury. In this context, employers could face a stronger incentive to put pressure on workers to return to work, or to under-report injuries. Clearly, it is challenging to separately identify the effect of employee motivation (e.g., commitment or fear of retaliation) and the proactive behavior of employers to shorten the off work spells. Our strategy is to exploit the richness of our data to distinguish as much as possible among the following hypotheses:

a. *Employers face incentives to accelerate the return to work of the most "costly" workers.*

Early returns to work bring substantial monetary benefits to the firm. A spell off work generates costs for the firm that are proportional to the worker's wage. This is the case firstly because the firm's share of the monetary compensation to the worker is proportional to the wage[i]; secondly, because, if wages are a measure of productivity, the absence of a high-wage worker causes a higher production loss and higher adjustment costs. Therefore, we would expect firms to put more pressure or to provide more accommodations to high-wage injured workers to induce them to shorten their spells off work.

b. *Workers have feelings of job commitment that prevail on their belief of having the right to heal properly.*

Workers may have been paid efficiency wages before the injury[ii], i.e., higher wages aiming at eliciting stronger job commitment as predicted by the social exchange theory, gift exchange models (Rebitzer and Taylor, 2011), and as shown by the presenteeism and absenteeism literature (Löve *et al*., 2010). More committed workers are more likely to return to work sooner, despite the fact that workers who return to work before full recovery can jeopardize their long-term health, work ability, employability, and may increase the risk of new occupational incidents. Workers in firms that have invested more in firm-specific human capital may also be speeding their return to work to secure their long-term employment within the firm.

This means that higher wages may stand as a proxy for both higher firms' costs and stronger employees' attachment. To disentangle these two potential effects of *high individual wages* on the timing of the return to work, we exploit additional information contained in our longitudinal employer-employee data set (described in detail in Section 4). From this data we can gain some knowledge both about individual and firm employment histories. We observe a measure of *worker turnover* at the firm level, and we use it to proxy the level of commitment generated by human resource management at the firm level. Also, we can calculate *individual wage growth within the firm* that can be linked both to higher productivity and to higher job commitment; i.e., it can signal either a firm's performance feedback policy that triggers higher attachment, or the individual worker's higher commitment that is rewarded by speedier career progress within the firm.

c. Workers status within the firm can increase their decision latitude and their ability to accommodate/manage their own job after return

High individual wages could also capture workers who have higher status within the firm. Such status could be the result of greater education, skills, seniority, or supervisory duties. These are workers who may identify more with their jobs and who may want to return to work sooner. Or, they may be workers who command more respect from their managers (Stochkendahl *et al.,* 2015), or who have more decision latitude within the firm and better ability to avoid dangerous jobs and accommodate and manage their return to work. In our data we can capture workers' relative status within their firms. We have information about *tenure;* furthermore, the nature of the employer-employee matched data permits us to calculate a measure of *relative wages* that we can use as a proxy for a worker's standing within his/her firm (the ratio of individual blue collar wage and average blue collar wage within the firm).

d. Workers fear that a long time off from work will lead to retaliation in terms of future job loss, or poor future career prospects.

Because injuries produce significant adjustment costs, injured workers are often concerned about facing stigma and retaliation by their co-workers and by their employers if they take a long disability leave (Galizzi *et al.*, 2010). Such fear may lead workers to hasten their return to work. Or, to put it differently, firms can vary in their ability to influence their employees' decisions, and some employees may fear retaliation in terms of higher likelihood of future layoffs, or of compromised future career opportunities. In this context, a higher job security provided by the Employment Protection Legislation (EPL) is crucial to reassure workers about their future within the firm. Because employment protection is less stringent in *small firms*, we may expect workers in small firms to feel more pressure to return to work quickly.

At the same time, the small firm/limited EPL effect on return to work should be tested against a different explanation: that workers return more slowly to smaller firms because these establishments may have a harder time accommodating disabled employees.

Finally, some specific categories of workers may be more vulnerable to pressure to return to work before full recovery because they have weaker bargaining power. We know that *immigrants* are on average more exposed to the risk of displacement (i.e., discrimination); or they can feel this to be the case as their position in the labor market is usually weaker (Pastore and Villosio, 2012). The same argument can apply to Italian *female* employees, who often face substantial degrees of discrimination, comparable to the ones suffered by male foreigners workers (Venturini and Villosio, 2000;).

By controlling for all these additional factors — firm worker turnover, individual wage growth, firm's relative wages, size and selected workers' characteristics — we try to test our first hypothesis and single out the effect of firms' higher costs (as measured by wage levels) as the main reason for a firm to put pressure on workers for a speedier return to work versus the other hypotheses based on workers' commitment, status, fear of retaliation, and general preferences.

3. The Institutional Setting

In Italy, the length of the healing period following an occupational injury is decided by a doctor specialized in occupational medicine. In principle, this decision is based on medical grounds only, although in some instances it is possible to extend or reduce the leave. This can happen if the worker applies for an extension, or a shortening of the period off work, and the doctor agrees.

According to Italian law, injured workers' jobs are preserved until the employees return to work, i.e., all injured workers return to their previous firm, provided that they were originally hired with a permanent contract[iii]. Temporary contract workers, however, have to leave the firm if the contract expires before the end of the leave period. In this case, they have to look for a new employer at the end of the healing period.

Italian employers have to pay the insurance premium to the public insurance system (administered by INAIL, the Italian National Workers' Compensation Agency and one of our data providers). The amount of the premium depends on the intrinsic risk linked to the tasks performed within the firm, and on an additional bonus/malus scheme that increases a firm's premium as new work incidents are recorded. In the case of temporary disability, the public insurance system covers 60% of the wages up to 90 days of leave, and 75% afterward, subject to a maximum and a minimum (Eurogip, 2005). The residual is covered by the firm. In fact, all collective agreements on job contracts entail a top up of INAIL's disability benefit to 100% of the wage, with just a few exceptions that are not relevant to our study[iv] (Leombruni and Costamagna, 2013). This means that, in practice, Italian injured workers are guaranteed benefits corresponding to a 100% wage replacement rate (i.e., benefits cover the full labor cost, including taxes and social security contributions like the normal salaries). However, the time off work may still lead to the loss of overtime payments[v].

Finally, employers have to carry the adjustment costs that they incur when injured workers return to work but have to be offered accommodations because of their long-lasting temporary or permanent work disabilities. In fact, if the worker still suffers of a functional limitation resulting in a work disability (as stated by a medical certificate) upon return to work, the firm needs to explore the possibility of accommodating the worker by moving him/her to a new occupation; even if this implies a demotion, the firm cannot lower the salary. If there are no viable tasks, workers can be dismissed following a judicial sentence.

Despite some similarities, these features make the Italian system remarkably different from the one in North America (the one studied by most of the economic literature): the U.S.

workers' compensation system differs by state and is customarily designed to provide return to work incentives, as temporary disability benefits usually replace only 2/3 of the worker's pre-injury salary. In addition, in some states employers are given monetary incentives to rehire injured workers (Seabury *et al.*, 2011). In Italy, the injury does not produce immediate economic losses for the employees and a large part of the immediate financial burden of the injury falls on the employers. Therefore, in this institutional setting it becomes particularly relevant to study whether the length of spells off work is determined only on medical grounds, or whether it is also related to different determining factors, such as pressure by the firm for an early return, workers' attachment to – and status within– the firm, or discrimination toward more vulnerable categories of employees. To explore the role of these potential factors we need data that permits us to observe both employee and firm behaviors over time.

4. Data

We use a unique dataset that combines at the individual level work histories from WHIP, the Work Histories Italian Panel data based on records from the Italian social security administration (www.laboartoriorevelli.it/whip) and work-related injuries from INAIL, the Italian national workers' compensation agency. The data spans the period from 1994-2005. This is the first Italian database merging a sample of work histories and of occupational injuries on an individual basis (Bena *et al.*, 2012).

To the best of our knowledge only very few studies have exploited similar matched employer-employee and workers' compensation administrative data to study the determinants of the time off work (Reville *et al.*, 2001; McLaren *et al.*, 2010). These authors have focused on cases in specific states in the U.S. or reported by self-insured employers, while our data are for all types of injuries covered by INAIL across the whole country. The INAIL dataset records all injury events resulting in a leave longer than three days; shorter healing periods do not involve INAIL but are responsibilities of the firm, according to collective contract agreements. The data records a description of the injury event itself (when, how, where) and its consequences (nature of injury, length of temporary disability payment, or degree of permanent disability – if any). Furthermore, our data permits us to overcome a severe limitation of most U.S. studies on return to work that often relied only on temporary disability claims data to measure the spell until the first return to work. But U.S workers may not be rehired by their pre-injury employer, or may leave the labor force, or may be transitioning into permanent partial-disability benefits. Therefore, their day of "maximum medical improvement" may not coincide with the effective day of return to work. Conversely, the measure of spells off work in our Italian administrative data is a function of the actual date of injury and of the date when the workers return to actual employment, which coincides with the time when benefits end.

WHIP's reference population includes all Italian workers and pensioners, as well as social security provisions (several kinds of unemployment and invalidity benefits); it excludes only public sector employees hired on an open-ended contract and high skilled professions (e.g., lawyers) who are compensated with different insurance funds. The dependent employment section of WHIP is a matched employer-employee database that includes start and end dates of each employment spell, as well as worker characteristics (age, sex, place of birth), job characteristics (temporary vs. permanent contract, full-time vs. part- time, occupation, location), labor market outcomes (the number of days and weeks worked in a year and annual earnings) and firm characteristics (size, opening and closing date, sector, location, monthly new hires, and separations). The information of all individual earnings within each firm also permits us to calculate a measure of relative wages as the ratio between each worker's wage and the average of worker wages within the same firm and with the same job title (blue or white collar).

The INAIL dataset and the WHIP dependent employment section have been matched for a 1:15 random sample (about 1.5 million workers each year) covering the period 1994-2005, generating a unique source of information for the analysis of occupational injuries (Bena *et al.*, 2012).

For the purpose of this work we select only employees who have had a work incident in the observation period (about 260,000 individuals). We further select only those who were *blue collar* workers hired with a *permanent contract* at the moment of the injury. The first choice is motivated by the heterogeneity of occupations, types of injury, and physical demands of manual and non-manual occupations. The second choice is due to the specific regulation regarding temporary contract workers, for whom the working contract can expire before the end of the recovery period stated by the doctor. This excludes from the analysis a share of new hires, mainly after 2001 when temporary contracts were fully liberalized. Furthermore, in our analysis we study the hazard of returning to work after the incident: hence, we drop from our final dataset 1198 individuals who died because of their injury. We end up with a sample of 180,420 workers/spells off work, which we describe in Section 6. We should note that in this study we focus only on the first return to work and not necessarily on returns to work that have been sustained over time. Similarly, we study the first incident a worker experiences in our observation period[vi]. Repeated injuries and careers that may follow a first occupational injury are very important (Butler *et al*., 1995; Galizzi, 2013) but that is a different issue from the one we are addressing here. We discuss this in our conclusions.

5. Empirical framework

The empirical model

The main variable of interest for our analysis is the time off from work and we study it with the help of survival models. Our main concern is to mitigate the effect of unobserved heterogeneity on our estimated coefficients, as one never really observes all the factors that may affect the process under scrutiny. Unobserved heterogeneity may lead to an estimate of negative duration dependence simply because workers with higher hazards of returning to work will return sooner, leaving behind those workers who face greater difficulties in returning to employment (Galizzi and Boden, 2003). Furthermore, it may lead to a downward bias on the (absolute value of the) estimated parameters (Jenkins, 2005) so that we may end up estimating only a lower bound of the true and larger effect of the regressors on the hazard rate.

We estimate our model including explicitly unobserved heterogeneity, assuming that unobserved heterogeneity is uncorrelated to observables. In general, to model a general correlation between unobserved heterogeneity and the covariates would require data with repeated spells (i.e., repeated events) for each individual (Horowitz and Lee, 2004). However, selecting only individuals experiencing more than one injury would select a highly non-random sample that would compromise the generalization of any estimated result. But, in the context of survival analysis, Jenkins (2005) states that the effects of unobserved heterogeneity can be mitigated by the use of a flexible specification of the baseline hazard in a proportional hazard setting, as the shape of the baseline hazard would absorb the effect of unobserved heterogeneity so reducing its distortive impact on the estimated parameters β (equation 1). The most flexible option is to use a set of dummies on each time-interval.

To take full advantage of this property, in our estimations we use a discrete time setting, even though the return to work process is a continuous time process. We model a complementary log-log function because such a function is the discrete time counterpart of an underlying continuous time proportional hazard model (see Jenkins, 1995, for the proof). Its hazard rate reads as follows:

$$h_j\left(X_{ij}\right)=1-\exp\left[-\exp\left(X_{ij}^{'}\beta+\nu_i+\log\int_{t_{j-1}}^{t_j}\lambda_0(\tau)d\tau\right)\right] \qquad [1]$$

where X_{ij} is our vector of regressors for individual injured worker *i* (personal, firm, injury, and pecuniary characteristics of injury), *j* is the time spell in the discrete setting (weeks) while τ is time in its continuous flow within the spell, β is the vector of parameters to be estimated and $\lambda_0(\tau)$ is the baseline hazard function. As mentioned above, as a further source of robustness, we allow for the existence of time invariant unobserved individual heterogeneity, by assumption uncorrelated to the *X*; we call it *v* and we include it assuming a normal distribution $N\left(0,\sigma_v^2\right)$.

In this setting, the β coefficients are the same ones as those characterizing the continuous time hazard rate $h(t) = \lambda_0(t) \exp(X_{ij}^{'}\beta)$ and can be easily interpreted (Jenkins, 2005).

Finally, we define an indicator d_{it} that is equal to one if individual i returns to work in the interval $[t_{j-1}, t_j)$ and is equal to zero otherwise. In each interval, censored observations contribute to the likelihood function only information about the value of the survival function at the end of the interval. We write the log likelihood function as:

$$\text{Log } L=\sum_{i=1}^{n}\sum_{j=1}^{t_i}\{d_{ij}\log\, h_j(X_{ij})+(1-d_{ij})\log[1-h_j(X_{ij})]\} \qquad [2]$$

The chosen regressors

Across our specifications, the main data generating process for $X\beta$ is specified as follows. We control for the type of incident: nature of injury, body part injured, and degree of disability. We control for age, as we expect that any injury takes longer to recover from as age increases. We control also for individuals' past sick leaves[vii]. We expect those individuals who have experienced more of these episodes to have worse health and hence a reduced natural ability to recover. This last control can also be interpreted as capturing a higher propensity to absenteeism. In both cases we expect it to slow down the return to work.

To test the hypothesis that employers may put some pressure on “more expensive/productive” workers, we focus on the cost of each injured worker that we measure in terms of the (log of) individual gross real daily wage.

Because a high wage could also capture workers with higher job commitment who want to return to work sooner, we try to control for this effect by including two covariates aiming at capturing worker commitment. First, a measure of worker turnover at the firm level[viii], as firms that aim at increasing loyalty and commitment of their workers invest in specific human capital and experience a lower turnover rate of employees. Second, a dummy variable that captures whether the average annual real wage growth experienced by the worker since the time of his/her hiring at the firm is "high", i.e., above the 75^{th} percentile in the wage growth distribution across all firms[ix].

We use a dummy that signals whether the individual blue collar worker’s wage is above the average wage of blue collars in his/her own firm to capture the worker’s relative status. This could indicate a worker’s greater control on his/her job and a greater actual – or perceived– sense of being important and essential to the firm’s functioning.

Finally, to test the effect of perceived job security as a factor determining workers return to work patterns, we estimate whether workers return earlier as firm size decreases (the EPL hypothesis would require them to return earlier the smaller the firm); whether workers with longer tenure take longer to return to work; and whether more vulnerable workers (migrants and women) return earlier with respect to natives and men.

We control also for additional firm characteristics to capture the effect of firms' heterogeneity and competiveness: growing/shrinking firms, firm's age, and industrial sector. Finally, we control for geographical area and calendar year, to capture both the effect of regional practices and cultures, and the effect of the business cycle on labor market tightness. As a final robustness check, we split the sample by gender, nationality, firm size, and injury characteristics.

6. Descriptive analysis of occupational injuries

Our descriptive statistics refer to the previously described sample. They correspond to 180,420 individuals employed in 105,573 firms. This sample is made up of injured workers who were predominantly male (85%), native (83.5%), and full-time employees (94%), with an average age of 37 years and an average tenure of 4.6 years at the time of injury. They were employed in firms with an average size of 1611 employees, but a median size of 36 employees, and operating mainly in the construction (17%), metallic and machinery manufacturing (24%), textile and food manufacturing (18%), and trade (11%) sectors. The majority of these firms were located in the northern regions of the country (63%).

The length of time off work

Our variable of interest is the length of the spell off from work due to an on-the-job injury; our analysis excludes very short spells, as the INAIL dataset records injury events resulting in a leave longer than three days only. Table 1 displays the distribution of this variable. Almost all injured workers were back at work within two months: the average time off work across all cases was 27 days, with half of the employees returning to work within two weeks, a much shorter time frame than that usually found in other studies that have used U.S. workers' compensation data (Reville *et al.,* 2001; Galizzi and Boden 2003; McLaren *et* *al.*, 2010). This is a quite interesting result, given that Italian workers enjoy higher job security. Furthermore, we would have expected more pronounced evidence of post injury moral hazard behaviors given the 100% replacement rate enjoyed by injured Italian workers. The distribution of days off work is quite stable over the years that we are studying, although the distance between the 50^{th} and the 90^{th} percentiles has increased over the most recent years, possibly as an effect of a reform that was introduced in the country in 2000 and stressed that benefits were due not as insurance against loss of earnings capacity but as compensation for physical and psychological harm (EUROGIP, 2005). Off work spells longer than 90 days are quite rare, being less than 5% of the total.

Table 1 here

In our sample only 1.34% of workers left their employer before the end of the healing period; 4.12% separated upon return (during the same month). This is not surprising given that our sample is limited to permanent contract workers whose jobs at return are protected by law. It is interesting to notice that foreigners faced quite higher shares, 2.6% and 5.8% respectively, hinting to a possible case of discrimination or retaliation.

Injury severity

The time off work, together with the degree of permanent disability, is often used as a proxy of injury severity (Bena *et al.*, 2012). In our study, time off from work represents the outcome variable: therefore, we use only the information on the degree of permanent disability to assess the consequences of the incidents. We set two thresholds: a degree of permanent disability above 20% is said to generate a "severe permanent damage", while one between 1% and 19% generates a "mild permanent damage". A degree of 0% indicates a temporary disability. The 20% threshold is chosen to be above the legal thresholds granting specific compensations, which varied over time[x]. This choice is to avoid the bias due to the habit of overstating the degree of disability for workers just below the threshold, which can cause spurious heaps in the distribution of disability degrees.

In our sample, 89.7% of workers experienced only temporary and no permanent disability, 9.4% a mild damage, and 0.9% a serious one. As expected, there is a clear correlation between the degree of permanent disability and the length of time off from work (Figure 1).

Figure 1 here

It is important to note that a lack of permanent disability does not necessarily imply a lack of injury severity. In fact, temporary disabilities that require a long healing time can also be quite severe. Therefore, to reach a better understanding of the nature of injuries, we focus on the distribution of the occupational incidents by type of injury and body part. About one-third of recorded injuries were wounds or bruises in the upper extremities, and 11% were back injuries. In general, back injuries are among the most controversial work-related injuries, given the difficulty workers may encounter in proving that they are work-related. The injuries generating a serious permanent damage, are more frequently anatomic losses or, less frequently, fractures (details are available upon request).

Wages

One of the key variables in our analysis is the worker's individual wage. In our data we can compare the individual wage of injured workers to the average wage their firm pays to workers with similar qualification (blue-collar workers). We find that injured workers earned about 5% less than the average wage of blue collars in their own firm, and the share of injured workers earning less than the firm average was about 70%. To investigate this issue further, we split the sample by workers' tenure, age and firm size quartiles (Table 2). The main insight we gain from this analysis is that the negative wage gap between injured and non-injured workers is not due to sample selection (by tenure, age, or firm size), but it is present in all the subsamples we consider[xi]. Similarly, a significant share of injured "higher wage workers" was present in all the subsamples we considered. To the best of our knowledge there are not many analogous descriptive statistics measured at the firm level in the economic literature.

Table 2 here

To explore further who the injured "higher wage workers" are, we estimate a probit model (Table 3). The likelihood of being an injured "higher wage worker" increases with education (captured by age at first job) and tenure, i.e., with human capital as expected. It is higher for natives and males, which is consistent with the literature on wage differentials. Finally, it is higher for those who have had fewer job absences due to illness in the past (a proxy for both health conditions and commitment). Injured higher wage workers are also more likely to be employed in "dynamic" firms, i.e., firms that are smaller, younger, growing and located in the northern regions.

We will exploit this piece of information in the empirical model, where wage plays a crucial role. We will control both for the observable individual characteristics that have emerged as relevant in connection to wages, as well as for unobservable individual characteristics through the appropriate econometric methods.

Table 3 here

Firm size

Finally, given our interest in understanding the potential role played by employment protection legislation, we analyze the relationship between days off from work and firm size. We split our analysis also by age quartiles to reduce composition effects; in fact, age indicates the individuals' natural speed of recovery, and the average age of the workforce is lower in smaller firms. It emerges (Table 4) that for any given age group, workers in larger firms exhibit shorter spells off work on average, but this is clearly linked to the larger share of serious incidents reported by small firms compared to larger ones.

Table 4 here

To cast more light on the higher rate of serious injuries in small firms emerging in Table 4, we estimate the probability of suffering a severe permanent disability instead of a non-severe one (i.e., mild or no permanent damage). We estimate a probit model where the likelihood of suffering a permanent impairment above the 20% disability threshold is a function of firm size, conditional on the nature of injury, body part injured and worker's age. Table 5 shows that the conditional probability of experiencing a serious injury, given that the person was injured, decreases as firm size increases. This multivariate analysis excludes that the higher rate of serious injuries in small firms is due to simple (observable) composition effects.

Table 5 here

The higher frequency of severe incidents in smaller firms is consistent with the international literature. When focussing on fatal events (which are excluded from our sample), literature reports fatality rates which are up to 10 times higher in small firms with respect to medium-to-large size ones (Lentz and Wenzl, 2006). Literature documents also a higher share of severe injuries in small firms: e.g., in USA (Oleinick *et al.*, 1995), Britain (Nichols *et al.*, 1990), Italy (Fabiano *et al.*, 2004). It is also recognized that a higher exposure to ergonomic, physical, and chemical hazards exists in smaller firms (Sorensen *et al.*, 2007). Furthermore, prevention is more difficult in smaller firms because of fewer safety and health resources (Lentz and Wenzl, 2006), and also because safety regulations developed primarily for larger firms may be less effective in smaller ones (Breslin *et al.*, 2010).

While various explanations for this may be investigated, underreporting of injuries from small establishments is considered to be a substantial possibility (Oleinick *et al.*, 1995). Indeed, smaller firms enjoy a higher ability to under-report less severe or less "objective" injuries (while injuries with severe permanent damage are more difficult to under-report and hence show up more in statistics like Table 4). In fact, external monitoring is looser in small firms, and the additional insurance costs generated by a work injury can be more significant for a small business.

The point is relevant because it entails a potential bias in our estimations — in particular, on the estimated effect of firm size on the length of time off work before returning to the job. If small firms under-report, it may be easier to under-report less severe injuries. In that case, the composition of analyzed injuries in small firms will be biased toward more severe injuries' and the time off work will therefore be longer than otherwise. To tackle the issue, we will estimate our hazard model also by type of injury. Injuries that require immediate medical assistance (e.g., fractures, anatomic losses) are very difficult not to report and they might provide different estimates of our model. In fact, the next section will discuss how the effect of firm size on the hazard of returning to work only emerges when we focus on injuries that cannot be hidden**.**

7. Estimation Results

As discussed in Section 5, our regression analysis aims at highlighting the role played by individual wage ─ a potential measure of firm's costs or workers' commitment ─ and of other firms' and workers' characteristics on the hazard of returning to work after a first occupational injury.

We estimate a discrete time proportional hazard model with fully flexible baseline hazard and normally distributed random effects, i.e., time invariant unobserved individual heterogeneity uncorrelated to the X with a normal distribution $N(0, \sigma_v^2)$. Given the large number of controls we include in the specification, we tested for muticollinearity by calculating the Variance Inflation Factors (VIF)[xii] . We found that only the industry dummies are a matter of concern, as only they have VIF>10, and actually three of them (mechanics, food and textile, constructions) show a VIF above 30. We re-estimated the main model without industry dummies, as a robustness check: the estimated coefficients were only minimally changed, but their interpretation and their statistical significance were unchanged (results available upon request). Hence, we include the industry controls in the preferred specification presented in this study, as multicollinearity seems to be inconsequential and we fear an omitted variable issue in the alternative specification.

The estimated coefficients of the variables of interest are reported in Table 6 as *exp(β)*, i.e., hazard ratios; when *exp(β)>1* the return to work is faster, when *exp(β)*<1 the return to work is slower. The table highlights in bold the estimated coefficients that are significant at 90% confidence level.

Table 6 presents results from the whole sample (model A), as well as from several subsamples, i.e., by gender, nationality, firm size, and kind of injury. Results (details available upon request) are strongly robust across all these estimations, and are discussed jointly.

Table 6 here

The estimated conditional time profile of the hazard () shows that the likelihood of returning to work peaks at three weeks and then declines (Figure 2). Because the reimbursement to the employer provided by the public insurance system jumps from 60% to 75% of wages after 90 days of leave (12.8 weeks), we include separate intervals until 15 weeks to highlight an eventual sudden change in the return to work likelihood around that threshold, as the firm behavior can change (the workers' behavior is unaffected by this threshold as their replacement rate is always 100%). However, the estimated time profile shows no significant change around the 13 week threshold.

Figure 2 here

As far as injury characteristics are concerned, we find that the medical determinants (nature of injury and injured body part) influence the length of the spell off work as expected. As anticipated by Figure 1, injuries resulting in permanent disabilities dramatically lengthen the return to work compared to temporary disabilities. The more severe permanent disabilities also produce much longer spells off work. Regardless of the degree of permanent disability, the hazard is the lowest in the case of fractures and anatomic losses and the highest when injuries are caused by “foreign bodies”. Even when we control for tenure, we find that older workers and workers with a history of health problems (captured by the frequency of past sick leaves) delay return to work significantly (results not displayed are available upon request).

Conditional on the above medical determinants of the speed of return to work, we now turn to the non-health related dimensions of the issue at stake. One of our hypotheses stated that in an institutional environment where the marginal monetary cost of new occupational injuries falls largely on firms (that have to cover first 40% and then 25% of wages ─ plus any administrative cost ─ and face a worsening of their experience rating), employers might be inclined to pressure ─ or to accommodate more promptly ─ the most costly/productive workers so that they will return to work sooner. Indeed, our estimations show that a higher individual wage speeds the return to work.

However, as we discussed before, higher wages could also indicate efficiency wages and, therefore, stronger workers' commitment toward their employers. Therefore, the simple effect of wages on the hazard does not permit us to test the high wage/cost hypothesis against the high commitment hypothesis. For this reason our model specification tries to control for workers' commitment through other variables: the history of the injured worker's wage growth within the firm and the history of the firm's effort to retain its employees. We assume that workers will be more attached to employers who have rewarded them more over time through raises (either to elicit higher commitment or because of larger investment in specific human capital), and to employers who have a history of better human resources management and of valuing long-term employment relations with their workers (so decreasing workers' turnover in excess to job creation and destruction). Indeed, we find that a higher wage growth experienced by the worker within the current firm is linked to a significantly speedier return to work. Also, the higher the excess worker turnover in the firm the slower is the return to work. Therefore, to the extent that our model specification and variables capture workers' commitment, our results show that more attached workers will speed their return to work after an occupational injury. The dummy signaling whether the wage of the injured worker is higher than the average wage of other blue collars in the same firm also has a large and significant effect. This suggests that workers with higher status within the firm speed their return to work possibly because they feel more respected or urgently needed. Or because they are more able to advocate for their own accommodation, or they have less physically demanding jobs (a feature we can unfortunately not control for in our data). But most importantly, our results show that, controlling for commitment and relative status, higher wage workers (i.e., workers with higher human capital or 'preferred' workers as discussed in Section 6) have even shorter spells off work, suggesting potential pressure to return to work is put on their more costly employees by firms.

Firms can also vary in their ability to influence their employees' decisions. Even in an institutional setting that requires the firm to guarantee a job to injured workers upon their return to work, employees may fear retaliation in term of higher likelihood of future layoffs, or compromised future career opportunities. This is more likely to happen in firms where EPL is less enforceable and there is lower job security, as in small firms (Garibaldi *et al.*, 2004). However, initially the estimated effect of firm size on return to work produces mixed results (models A-I in Table 6). In fact, the interpretation of this coefficient ─ and therefore of the role played by potential perceived job insecurity ─ is complicated by the pattern of under-reporting of occupational injuries in smaller firms that we detected earlier in Table 5. Hence, we split the sample by types of injury (models J to Q in Table 6). Some injuries are likely to require immediate medical treatment ("fractures", "anatomic losses"). In consequence, firms' under-reporting of these injuries is less likely and we should be able to observe most, if not all, of them regardless of firms' dimensions. Indeed, the results for these last estimated models become clearer (models J to Q in Table 6). The effect of firm size on the length of time off from work (that we estimate by selecting these more objective injuries) confirms the job security explanation: workers take longer time to return to larger firms after fractures and anatomic losses (although in this last case the tiny sample size provides quite imprecise estimates). Notice that the selection on these injuries is likely to identify workers who are more likely to need accommodation upon their return to work. These accommodations are much easier to implement ─ and are therefore more likely in larger firms. The fact that we still estimate a speedier return to small firms supports even more strongly our “job security” hypothesis.

Workers may also differ in their vulnerability and, therefore, in their perception that a long time off from work will jeopardize their employment prospects. Higher seniority workers are likely to feel more secure on their jobs. In fact, we find that tenure ─ conditional on wage, wage growth, relative wage, firm’s growth and age ─ slows down the return to work significantly. Conversely, our results show that, given the same type of injury and work history, women return to work sooner. The estimated hazard shows also that foreign-born workers return to work significantly earlier than natives. These results are consistent with the lower job security/discrimination/retaliation hypothesis, although we cannot dismiss alternative explanations. For example, immigrants could be characterized not only by less employment protection but also by a "healthy worker effect” that might explain a shorter healing period: those who migrate could be healthier than those who do not. Although we try to control for workers’ general health through our variable capturing past illnesses, it is difficult to completely dismiss this alternative hypothesis. In fact, immigrants could also be more hesitant to disclose illnesses and ask for sick leave. It is also plausible that immigrants have less access to good medical care with respect to natives: this would actually worsen their general health and their ability to heal. With our data it is not possible to identify the prevailing effect, or whether they compensate for each other. However, none of the above arguments (healthy worker or reduced access to healthcare) apply to women, who still return to work significantly earlier.

Finally, our analysis also includes several variables aiming at capturing other dimensions of the work environment. Studies on firm performances indicate that firms usually become more efficient at addressing new problems, including safety problems, over time (Seabury *et al.*, 2014). Accordingly, in our study older firms are able to speed up the return to work of injured workers more quickly than new firms, conditional on all the mentioned controls. Injured workers also return faster to work at expanding firms than they do to shrinking and stable firms. This could indicate that workers may experience some pressure to return to work faster when they are ─ or feel ─ much needed. Finally, we find a significant difference in the hazard of returning to work depending on whether workers were employed by firms operating in the northeastern, central or southern regions of the country with respect to northwestern regions. Workers in the northeast take less to return to work. This may suggest regional differences in medical, employment, or cultural norms.

8. Conclusions

Early return to work after an injury is desirable because long spells off from work imply productivity losses and adjustment costs for the firm. Workers' skills also risk becoming obsolete. Potential resentment on the part of co-workers and employers can jeopardize future employment and career perspectives. Quality of life of the worker and the family is severely compromised. At the same time, when workers return to work before complete healing, they increase their probability of long-term health problems and, therefore, of repeated absences or injuries.

This study represents one of the first analyses exploring the factors affecting the return to work of injured workers in an institutional setting ─ the Italian labour market─ where workers do not face an immediate financial incentive to return to work to limit their earnings losses. A combination of labor market regulations and union practices guarantees Italian injured employees both job security and workers' compensation benefits corresponding to a 100% replacement.

We exploit a matched employer-employee data set, merged with administrative workers' compensation data, to assess whether information about workers' and firms' employment histories can provide us with additional insights about incentives that speed returns to work.

Our descriptive analysis shows some important results. We find that injured workers earn 5% less than the average wage in their own firm, and that the share of injured workers earning less than the firm average is about 70%. Most importantly, we find that the high level of workers' compensation benefits income replacement and job security does not exacerbate moral hazard behaviour. In fact, our data show that, if anything, Italian injured workers' periods off work are shorter than the ones observed in North American countries where replacement rates are lower and employees are not guaranteed a job at their pre-injury employer. We are aware of the difficulty of comparing results from studies based on data coming from different sources. For example, our data covers workers who suffered both a temporary and a permanent disability, while some other studies may have focused only on specific types of injuries. Also, our data refers to workers hired with permanent and not temporary contracts, a classification that is not applicable to the U.S. labor market characterised by the "employment-at-will" doctrine. There are also other possible explanations that could explain our results. For example, litigated work injury claims are very rare in Italy while the workers' compensation system in the U.S. is known for being very litigious. Higher litigation rates may very well be responsible for the longer time off work found in U.S. studies. Another hypothesis could be that the U.S is characterised by more injury under-reporting. Then only the most severe cases would turn into claims and generate longer durations off work. Or, if US employers face fewer incentives to accommodate and rehire injured weeks, this could also lead to longer spells off work. Conversely, for several decades Italy was ranked as the strictest country in terms of employment protection legislations and until recently was still the European country were employees faced the highest dismissals costs (severance pay, indemnity, legal fees, etc.) (Laga, 2012). Despite all these caveats, however, we think that our results are still quite intriguing. The U.S. workers' compensation benefits are designed to replace only partially the pre-injury wage to minimize disincentives to a prompt return to work. The Italian experience seems to suggest that more generous benefits and higher job security do not necessarily lead to more "abuse" of the workers' compensation systems in terms of longer absences. Instead, what emerges is the key role that firms' pre-injury remuneration and human resources policies have in explaining the hazard of returning to work.

In fact, our multivariate analysis suggests that on one side, workers who are likely to have developed stronger attachment to their firm ─ because of better compensation over time and because they are employed by firms with better histories of stable employing ─ tend to return to work sooner. The same is true for workers with higher relative status within the firm. Workers who may feel more vulnerable ─ such as immigrant or female workers ─ or less protected by employment protection legislation ─ such as employees in smaller firms ─ also tend to return to work sooner. On the other side, even when we control for all these measures of commitment, status, and job security we find that high wage workers return to work sooner. Because we study an institutional environment where the marginal cost of workers' compensation benefits falls largely on firms, we interpret this result as an indication that in this setting firms put pressure on those workers whose time off ends being more costly to the employer, i.e., high wage workers. In our data these are the workers with larger human capital, shorter history of absenteeism, more likely to be males and natives, and employed in more dynamic firms.

Our study shares some of the limitations common to analyses that have explored the determinants of spells off from work after a first occupational injury. Our measure of time off work focuses on time until the first return to work as recorded by the disability payments administrative records. Given the Italian institutional setting, this measure should capture correctly the time of return to paid employment and for that reason overcome a limitation of several previous studies that could only make use of information about the length of temporary disability payments. However, studies based on North American data have shown that a first return to work is often not synonymous with a "successful return to work" (Butler *et al.*, 1995). In fact, a first spell of work is often followed by additional episodes of occupational injuries and temporary disabilities (Galizzi 2013), of unstable employment (Butler *et al.*, 1995; Galizzi and Boden 2003), or of compromised work reintegration and advancement. There is no reason to believe that these issues should not characterize European labor markets as well. Therefore, our future research will focus on the problem of recurrent injuries, unemployment spells, and careers that may follow an occupational injury.

Our analysis is also original because it is the first study to analyze return to work in an institutional setting where most injured workers are guaranteed a 100% workers' compensation replacement rate. Our data set does not permit control for the potential loss of overtime compensation, however. This could represent another important channel pressuring high wage workers to return to work sooner.

Our current study is also focused on Italian injured employees who were employed with permanent contracts. The Italian legislation introduced changes that facilitate the hiring of employees on temporary contracts after 2001. Such workers are not protected in terms of a guaranteed job at the end of their spell of disability and may face very different incentives to return to work. Their role within the firm may be different as well. Therefore, our future analysis will also explore potential differences in occupational injury outcomes between workers employed with permanent or temporary contracts.

Finally, our research has made use of and stressed the role played by measures of firm's turnover, firm's relative wages, individual wage growth, firm size, and workers' gender and nationality. We have done so to capture the role played by firms' costs, workers' status, job commitment and job security. Such an approach was guided by the increasing awareness produced by qualitative studies that return to work patterns cannot be properly understood without knowledge of the work environment, and of the perceived quality of workplace relations (Krause *et al.*, 2001; Young 2010). Our study provides evidence from quantitative data but from reduced form estimates. However, through the use of a variety of original variables we cast some light on the potential different behaviours of employers and employees. Also, despite our effort to estimate a model that accounts also for unobserved heterogeneity, we are aware that administrative data is not designed to capture all these work environment factors. Therefore, our study also suggests the need to develop further research on this topic by combining administrative data with survey and qualitative data.

To conclude, our results suggest the importance of employees' commitment, status, and job security considerations. Even when our proxies for these factors are controlled for, the findings show that high wage workers return to work sooner. This suggests that employers may put more pressure on — or may be more willing to accommodate — the most costly employees to reduce the financial burden associated with their obligation to replace workers' lost earnings and productivity. This finding highlights a different dynamic from the one that has been previously shown in studies concerning the North American labour market, where the focus is often on workers' moral hazard behaviours or earning losses. They stress the role that firms can play by investing in human capital or by eliciting commitment. Our study therefore represents not only an important contribution to understanding the understudied economic factors affecting the outcomes of occupational injuries in the European context: it also challenges our understating of the role played by benefits, wage replacement rates, and job security play in determining spells off work. Our study highlights that return to work policies have to be designed to reflect, address and coordinate all the different stakeholders' interests – workers, employers, and public agencies whose concerns are largely affected by institutions and regulations.

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TABLES

Table 1: Distribution of days off from work by calendar year (10th percentile, 25th percentile, median, 75th percentile, 90th percentile)

Year	P10	P25	Median	P75	P90
1994	5	7	13	26	53
1995	5	7	13	26	52
1996	5	7	13	26	54
1997	5	7	12.5	26	54
1998	5	7	13	26	55
1999	5	7	13	28	59
2000	5	7	14	29	62
2001	5	7	13	29	60
2002	5	7	14	29	63
2003	5	7	14	29	64
2004	5	7	14	31	66
2005	5	7	14	32	69

Table 2: Wages of injured workers relative to average wages within their own firm (median of the distribution) and share of injured workers earning wages above the average wage within their own firm.

	median (w_i - w_f) / w_f	share w_i>w_f
tenure quartiles		
1	-0.086	0.192
2	-0.066	0.231
3	-0.044	0.300
4	-0.004	0.429
age quartiles		
1	-0.081	0.196
2	-0.049	0.276
3	-0.034	0.324
4	-0.020	0.364
firm size quartiles		
1	-0.027	0.309
2	-0.052	0.304
3	-0.057	0.296
4	-0.058	0.251
Total	-.047	.288

Note:

- W_i=individual wage; W_f=average wage of blue collars in the firm
- Tenure quartiles cuts: 303, 1022, 2835 days.
- Age quartiles cuts: 28, 36, 45 years old.
- Firm size quartiles cuts: 10, 36, 199 employees.

Table 3: Probability of being an injured "high wage worker": Probit model.

	Coef.	Robust Std. Err.
age at first job:		
20-25	**0.126**	0.010
26-30	**0.225**	0.011
> 30	**0.293**	0.010
log tenure	**0.157**	0.003
log experience	0.001	0.001
Female	**-0.440**	0.012
Foreigner	**-0.339**	0.011
illness rate	**-0.311**	0.017
part time job	**0.234**	0.017
log firm size	**-0.031**	0.002
Growing firm	**0.067**	0.008
Shrinking firm	**-0.072**	0.009
log age firm	**-0.018**	0.004
north east	**0.029**	0.008
Centre	**-0.040**	0.010
South	**-0.057**	0.010
Constant	**-1.547**	0.359

Notes:

- Dependent variable: I (w_i>w_f), i.e., the individual wage of injured workers is higher than the average wage their firm pays to workers with similar qualification (blue-collar workers).
- Bold characters indicate 90% confidence level.
- Additional controls: year, 2-digit industry.
- Benchmark: age at first job: < 20, male, native, working full time in a stable firm in the north western regions.

Table 4: Mean and standard error of days off work and share of severe occupational injuries by workers' age and firms' size quartiles.

	Age class	Firm size class 1	2	3	4
mean days of absence	1	25.250	22.125	21.231	19.965
s.e.		0.402	0.347	0.376	0.327
share serious injuries		**0.009**	0.005	0.004	0.003
s.e.		0.001	0.001	0.001	0.000
mean days of absence	2	28.511	25.168	24.145	22.269
s.e.		0.460	0.385	0.385	0.308
share serious injuries		**0.010**	0.005	0.004	0.003
s.e.		0.001	0.001	0.001	0.000
mean days of absence	3	32.028	28.780	26.410	25.931
s.e.		0.548	0.482	0.439	0.375
share serious injuries		**0.015**	0.010	0.007	0.006
s.e.		0.001	0.001	0.001	0.001
mean days of absence	4	40.073	34.878	31.272	28.742
s.e.		0.689	0.583	0.560	0.364
share serious injuries		**0.029**	0.021	0.016	0.011
s.e.		0.002	0.002	0.001	0.001

Notes:

- Age quartiles cuts: 28, 36, 45 years old.
- Firm size quartiles cuts: 10, 36, 199 employees.

Table 5: Probability of experiencing a serious injury: Probit model

	Coef.	Robust Std. Err.
log of firm size	**-0.057**	0.005
Wound	-0.019	0.035
Bruise	**-0.127**	0.048
Dislocation	**0.872**	0.032
Fracture	**1.395**	0.058
anatomic loss	0.023	0.064
Lesion	**-0.217**	0.064
foreign body	**-0.249**	0.119
Trunk	**0.540**	0.062
Head	**0.354**	0.061
Back	**0.107**	0.057
lower extremities	-0.077	0.057
Log of worker age	**0.656**	0.042
Constant	**-4.930**	0.175

Note:

Bold characters indicate 90% confidence level

Table 6: Estimated hazard ratios of returning to work. Discrete time proportional hazard model with fully flexible baseline hazard and normally distributed random effects.

model	selection	individual obs.	log individual age	illness rate	log real weekly wage	individual w > firm mean w of blue collars (dummy)	within firm wage growth above 75 pctile (dummy)	firm excess turnover	log tenure	female (dummy)	part time (dummy)	foreigner (dummy)	log firm size	growing firms (dummy)	shrinking firms (dummy)	log firm age	north eastern regions (dummy)	central regions (dummy)	southern regions (dummy)
A	none	166,448	**0.696**	**0.778**	**2.542**	**1.085**	**1.133**	**0.955**	**0.978**	**1.087**	0.968	**1.250**	0.998	**1.051**	1.004	**1.020**	**1.219**	**1.114**	**0.923**
B	males	142,938	**0.682**	**0.812**	**2.526**	**1.098**	**1.135**	**0.955**	**0.982**		**1.075**	**1.255**	0.997	**1.058**	1.009	**1.017**	**1.232**	**1.104**	**0.912**
C	females	23,510	**0.752**	**0.625**	**2.653**	0.992	**1.117**	0.968	**0.965**		**0.871**	**1.153**	**1.015**	1.005	0.988	**1.033**	**1.189**	**1.177**	**1.080**
D	natives	139,117	**0.687**	**0.749**	**2.439**	**1.100**	**1.126**	**0.955**	**0.978**	**1.096**	0.969		0.999	**1.055**	1.004	**1.029**	**1.199**	**1.104**	**0.925**
E	foreigners	27,331	**0.794**	**0.885**	**3.726**	0.962	1.188	**0.946**	**0.976**	0.953	0.958		0.990	1.016	0.986	0.975	**1.363**	**1.199**	**0.880**
F	firm size<=15	55,699	**0.647**	**0.866**	**3.424**	**1.041**	**1.061**	**0.947**	1.011	1.052	**0.909**	**1.289**	**1.045**	0.964	**0.941**	1.003	**1.296**	**1.206**	**0.819**
G	firm size>15	110,749	**0.709**	**0.752**	**2.345**	**1.103**	**1.159**	1.009	**0.961**	**1.094**	0.997	**1.214**	0.997	**1.070**	1.014	**1.020**	**1.187**	**1.078**	0.997
H	firm size<=50	92,080	**0.650**	**0.811**	**3.133**	**1.056**	**1.102**	**0.948**	0.997	**1.044**	**0.940**	**1.276**	**1.034**	0.995	0.974	0.999	**1.281**	**1.185**	**0.854**
I	firm size>50	74,368	**0.736**	**0.734**	**2.169**	**1.120**	**1.159**	**1.095**	**0.954**	**1.104**	0.983	**1.190**	0.996	**1.078**	1.007	**1.025**	**1.154**	**1.046**	**1.035**
J	wound	50,723	**0.617**	**0.811**	**1.853**	**1.107**	**1.089**	**0.966**	**0.976**	**1.189**	0.970	**1.108**	**1.014**	1.013	0.999	1.010	**1.200**	**1.080**	**0.924**
K	bruise	51,475	**0.605**	**0.808**	**1.728**	**1.147**	**1.134**	**0.955**	**0.991**	**1.048**	**0.915**	**1.190**	1.001	1.027	0.989	**1.015**	**1.152**	1.027	**0.949**
L	dislocation	27,936	**0.768**	**0.731**	**1.984**	**1.148**	**1.186**	**0.948**	**0.970**	**0.892**	1.023	**1.424**	0.994	**1.094**	1.007	1.020	**1.164**	**1.219**	0.962
M	fracture	20,055	**0.727**	0.936	**2.407**	**1.112**	**1.097**	**0.922**	1.000	1.053	**0.857**	1.049	**0.988**	0.969	0.964	1.003	**1.303**	**1.123**	**0.827**
N	anatomic loss	1,322	1.006	**0.305**	**5.275**	1.152	0.687	1.204	1.070	0.655	0.812	**0.452**	**0.852**	0.789	1.076	0.853	**1.688**	1.298	0.895
O	lesion	6,364	**0.619**	0.911	**1.934**	1.043	1.091	0.944	0.975	**1.231**	**1.209**	**1.313**	**1.026**	1.008	0.967	1.012	**1.349**	**1.216**	0.894
P	foreign body	5,904	**0.651**	**0.575**	**1.452**	**1.174**	1.047	**0.881**	1.027	1.039	1.080	1.110	0.980	0.998	0.960	0.995	**1.300**	1.012	**0.718**
Q	strain	2,669	**0.536**	**0.589**	**2.581**	1.125	**1.167**	0.943	**0.914**	**0.748**	0.885	**1.274**	0.976	1.056	0.925	1.002	**1.186**	1.072	**0.818**

Notes:

- Additional controls: time spline as in Figure 2, medical determinants (part of body injured, type of injury, degree of permanent disability), dummies on each calendar year 1994-2005, 10 industry dummies.
- Stata v. 12 “xtcloglog” estimation command.
- Full results available upon request.

Figure 1: Shares of injured workers by degree of permanent disability and by time off work.

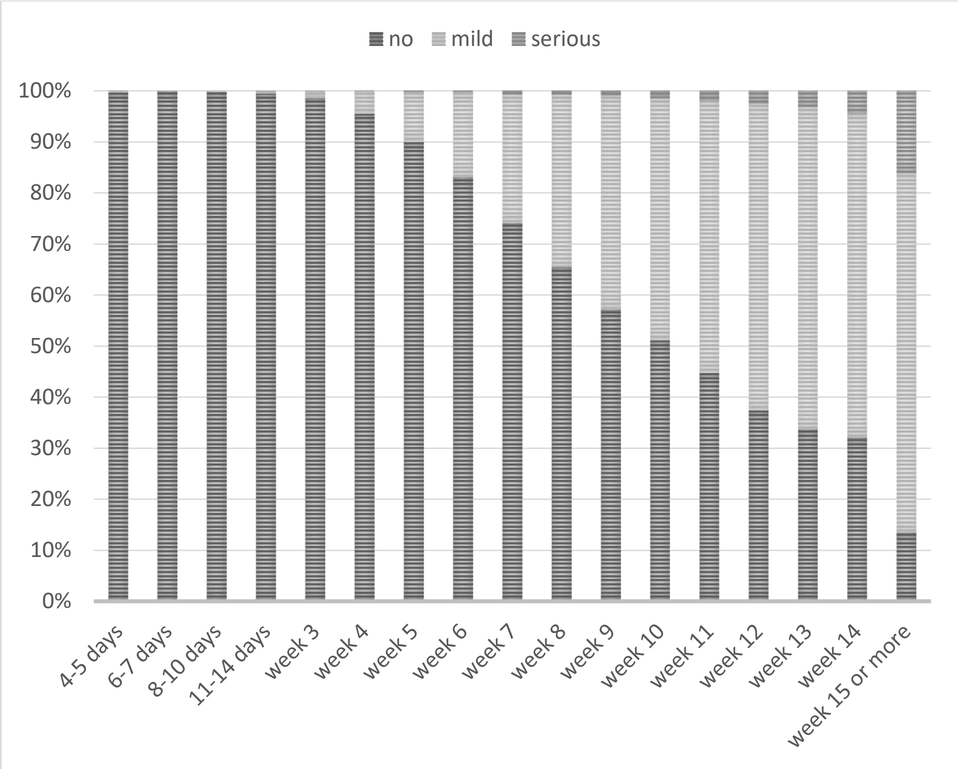
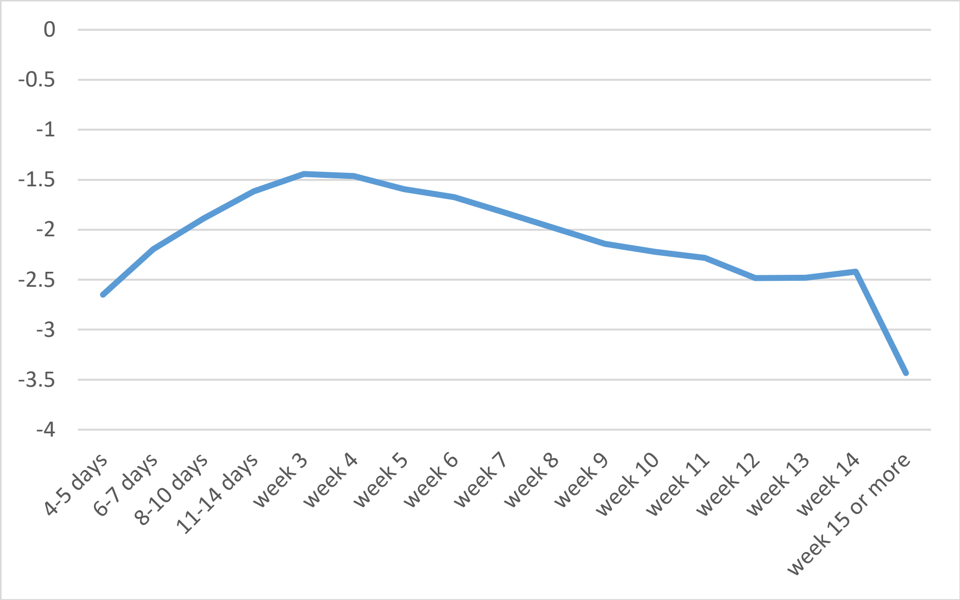


Figure 2: Estimated time profile: Hazard rate (Model A).



Footnotes

[i] In theory, workers' compensation insurance could be considered a form of mandated benefits, the cost of which firms can transfer on workers over time both in terms of lower wages and lower employment (Gruber and Kruger, 1991). The incidence of such transfer on Italian workers remains an empirical question that goes beyond the scope of this study. However, economic theory predicts that the magnitude of this transfer will be affected by the elasticity of the labor supply. Italy is characterized by a high rate of unionization and by an industry-wide and firm-wide centralized wage bargaining system (Devicienti *et al.,* 2008). Such institutional features are likely to hinder a quick transfer of workers' compensation insurance costs on workers. In fact, even if we assume that centralized wage bargaining accounts for the insurance premiums paid by firms, Italian employers have to assume the marginal monetary cost caused by any new injury. This is because they need to pay for the difference between the INAIL benefits and 100% of the injured worker's wage.

[ii] During their disability workers receive 100% of their pre injury wage whether this is an "efficiency wage" or not. Hence, the fear of losing the efficiency wage premium should not affect the decision to return to work, unless workers fear retaliation in terms of future dismissals or lower raises.

[iii] This was the typical Italian work contract ─ without termination date and with Employment Protection Legislation (EPL) provisions upon termination ─ during the 90s (Garibaldi *et al.*, 2004; Berton *et al.,* 2009). As of 2001, about 85% of the stock of employees worked with this contract. Since then, however, new hiring is mostly done with temporary contracts, i.e., contracts with a termination date. By 2005 temporary contracts represented more than half of all new hires. Our data cover this transformation period because it covers the 1994-2005 years.

[iv] Leombruni and Costamagna (2013) review 52 collective contracts covering over 90% of Italian employees. They find that for the first three days of leave, when the compensation is entirely paid by the employer, there are only four contracts where the replacement rate is below 100%. For the remaining period of the leave – which is the one relevant to our study since we are considering injuries with a prognosis longer than three days – all national contracts set a top-up to the benefit paid by INAIL up to the 100% of the wage. The only exception to this is the national agreement for the shoe industry, which sets a top-up at 80% of the wage for leaves below 20 days and raises the top-up to 100% afterward. In our data only 1.85% of workers are employed in the shoe industry; being such a tiny group, including or excluding them from the estimates does not change our results.

[v] Data on paid overtime in Italy is extremely scant and imprecise. Labour Force Survey (LFS) is the only available source but it provides this measure: "overtime hours are those that attract enhanced compensation for the worker, in the form of either an increased rate of pay or compensatory time off" (Eurofound, 2003). For our study we are interested only in overtime resulting in enhanced compensation because this would represent an additional monetary loss for injured workers while off work. According to Eurofound (2003) the extent of overtime as a percent of total volume of hours worked in Italy in 2001 was 4.5% in manufacturing, and 6.0% in the service sector. Our own calculations with Italian Labour Force Surevy show that this figure varies a little with age, peaking at 35-44 years and averages to 5% overtime hours. But this figure is likely to be an overestimate of the potential lost compensated time because it includes increased rate of pay but also non-monetary compensations like compensatory time off (quite common indeed). An average 5% overtime hours would imply an increase of the wage by about 5% (as on the one side overtime is paid more than ordinary hours, but on the other side this figure includes also non-monetary compensations like compensatory time off . Referring to a gross median daily wage of 60 euro, this would imply a daily gross loss of about 3 euro for each day off work for the worker and of about 90 euro (total labour cost) for the firm and INAIL (forgetting all additional and non monetary costs discussed so far). We cannot be more precise than this, and of course those individuals working longer overtime hours than the average would lose more. However, we think that the cost for the firm is so much larger that we can safely focus on it, disregarding the cost for the worker.

[vi] We observe that it is the first occupational injury in the life of the worker only for those who enter the labor market in1994 or afterward (20% of our sample).

[vii] We use the number of recorded spells of absence due to illness since the first employment spell over the number of years in the labor market (both left-censored in 1985).

[viii] We use "Excess turnover" i.e., gross worker turnover minus job creation at the firm level

[ix] Corresponding to a 3% growth rate. The results are robust to different thresholds (i.e. 60th percentile or 90th percentile).

[x] Prior to 2000 there was only one legal threshold, set at 9% permanent disability, above which the worker was entitled to permanent disability benefits. After 2000, the threshold to be eligible for benefits was raised to 19%, but an additional lower threshold was set at 5%, to grant eligible workers a one-time payoff compensation for biological damage.

[xi] It might reflect the distribution of injuries by job title within the blue collar category that is unobservable to us. However, job titles are usually correlated to age and tenure.

[xii] The VIF is computed regressing each explanatory variable on all the other explanatory variables, such obtaining an R2 for each regressor and then defining VIF = 1/(1-R2). The rule of thumb accepted in the literature is to consider VIF>10 as problematic and VIF>30 as a real concern.