Journal of Safety Research 86 (2023) 311–317

Contents lists available at ScienceDirect

Journal of Safety Research

journal homepage: www.elsevier.com/locate/jsr

Determinants of the duration of sick leave due to occupational injuries: Evidence from Spanish manufacturing

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ARTICLE INFO

Article history:
Received 28 November 2022
Received in revised form 14 March 2023
Accepted 17 July 2023
Available online 26 July 2023

Keywords:
Work-related injuries
Working days lost
Moral hazard
Absenteeism
Recovery time

ABSTRACT

Introduction: Despite the significant economic impact of occupational injuries on companies and society, studies focused on analyzing the determinants of workdays lost due to sick leave remain scarce and incomplete. This paper contributes to this issue by (a) analyzing the drivers of sick leave duration, distinguishing factors that explain the health recovery time from those that could lead workers to a voluntary extension of the absence period, and (b) formulating and empirically testing the effect of gender, citizenship, temporary work, job tenure, amount of disability benefit, and size of the injured worker's firm on the number of days the employee is off work after the injury. *Method:* Hypotheses are tested on a comprehensive dataset that includes all nonfatal occupational injuries causing sick leave that occurred in the manufacturing sector in Spain during 2015–2019, with more than 400,000 injuries. We conduct ordinary least squares and count data regression models in which the number of days off work is regressed on employees and work characteristics while accounting for a set of variables to control the injury's nature and severity. *Results:* The results show that after considering the intrinsic characteristics of the injury and the severity of the worker's injuries, women, native workers, workers with more seniority, workers with higher salaries, and those working in larger companies have longer periods of sick leave. The results suggest that moral hazard considerations significantly impact the time to return to work after an occupational injury. *Practical applications:* Based on the findings, several insights for company managers and public decision-makers are discussed. Specifically, interventions aimed at improving the organization of work and the working conditions of workers in manufacturing industries are highlighted, as well as the need to improve control and supervision mechanisms during the recovery process of injured workers.

1. Introduction

According to the European Statistics on Accidents at Work (ESAW, 2019), in 2018, there were approximately 3.3 million nonfatal injuries in the EU-28 that resulted in at least four calendar days of absence from work. In the United States, according to the National Safety Council (NSC, 2019), work-related injuries totaled 4.65 million in 2019, resulting in 105 million production days lost, and it estimated total work injury costs of $171 billion.

The costs of an injury are directly associated with the duration of the worker's sick leave: the longer the incapacity period, the higher the economic costs to the company and society. The total number of working days lost due to injury-related sick leave is the result of two types of absence: involuntary and voluntary, each having different origins. The involuntary absence is determined by the worker's natural medical recovery time, that is, the time that the injured worker needs to complete healing after the injury. It is, therefore, an unavoidable absence once the worker has been injured. However, the duration of sick leave may be prolonged by the voluntary absence behavior of the injured worker, which refers to the decision of delaying the return to work motivated by reasons under the worker's control. Determining the actual level of recovery of an injured worker's health, and whether he or she fits to perform safely the tasks required by the job, is often difficult and costly to verify accurately by an outside observer, even a physician. Such imperfect and asymmetric information creates a situation of moral hazard, which facilitates the worker's ability to extend the time off work beyond the natural recovery time. Fortin and Lanoie (2000) refer to this as a duration moral hazard. Thus, the

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https://doi.org/10.1016/j.jsr.2023.07.009
0022-4375/

observed duration of sick leave is determined not only by medical and health factors that motivate a 'legitimate' absence as a result of work-related ill health but also by factors that motivate an 'illegitimate' absence from work.

This paper focuses on both types of driving factors. Specifically, it analyzes the duration of sick leave due to work injuries while helping to uncover several elements that may be behind an undue extension of the injured worker's recovery time. Thus, we formulate a number of hypotheses on the association of sick leave days with certain variables related to the employee's personal and working conditions that may influence his or her willingness to return to work. These hypotheses, along with factors related to injury severity and other control variables, are tested in a comprehensive empirical analysis based on a sample of more than 400,000 nonfatal work injuries that occurred in the manufacturing industries in Spain during 2015–2019. This is a distinctive feature of our work, as previous studies tend to present partial statistical analyzes with small samples, often based on self-reported surveys in specific industries, or focused on the individual impact of a specific type of injury or variable on sick leave duration, without adequately including other relevant variables. From the theoretical discussion and empirical findings, we draw implications for managers and policymakers to mitigate the scope of both voluntary and involuntary absences due to work-related injuries.

2. Hypotheses development

2.1. Gender

The manufacturing sector is a male-dominated context. The traditional gender imbalance that prevails in manufacturing industries, with women being a minority, contributes to internalizing gender stereotypes and propagating discriminatory norms that negatively affect women at work (e.g., Kanter, 1977; King, Hebl, George, & Matusik, 2010). Likewise, many empirical studies have found that in predominately male organizations sexual harassment occurs relatively more often than in more gender-balanced workplaces (e.g., Gutek, Cohen, & Konrad, 1990; Willness, Steel, & Lee, 2007). Further, it is a fact that women are more involved in household and family care activities than men (e.g. Eurostat, 2019). Thus, working women face a double burden (i.e., a higher workload because they spend significantly more time than men on household chores and caring work, such as childrearing or caring for sick family members). Such pressure may act as an incentive to extend the period of paid sick leave, as women are often unable to shirk their responsibility for domestic and family duties. Furthermore, women are affected not only by stressors common to both sexes but also by stressors unique to women, such as their lower social position and active role in private life (Casini, Godin, Clays, Mahieu, & Kittel, 2013). As a result, women usually face higher levels of work stress and lower well-being and morale (García-Herrero, Mariscal-Saldaña, García-Rodríguez, & Ritzel, 2012), which increases the probability of wanting to be out of the workplace for more days. Previous studies show that women tend to present higher levels of labor absenteeism than men (e.g., Johnson & Ondrich, 1990; Mumford & Bridges, 2001; Fontaneda, Camino, González, & Ritzel, 2019).

In summary, the traditional gender roles and gender discrimination that persist in both the private and professional spheres may influence the duration of women's sick leave, which leads us to postulate the following hypothesis:

H1. The duration of work-related injury absence is longer for women than for men.

2.2. Sickness benefit

In the event of a work injury, the injured worker is entitled to receive a disability benefit (subsidy) during the time she/he is on sick leave. Thus, the employee receives a daily allowance, which is calculated according to the worker's earnings. However, there is a monetary cost or penalty for being on sick leave, as the benefit is usually lower than the worker's base salary and sometimes workers do not receive income during the first few days of their sick leave. The penalty is relative. For a worker with a low wage perceiving a disability allowance that only covers part of it, each day that he or she is on sick leave is clearly costlier than for a worker with a high salary who receives the full amount for the entire period of sick leave. In this regard, the level of the sickness benefit can be a source of moral hazard: a worker decides to prolong the period of sick leave when the increase in welfare associated with leisure offsets the reduction in income. Previous evidence suggests that increased sickness benefits can increase absence rates and the duration of absences (e.g., Johansson & Palme, 1996; Henrekson & Persson, 2004). This leads us to postulate the following hypothesis:

H2. The value of the sickness benefit for temporary disability is positively associated with sick leave duration.

2.3. Temporary workers

Data from the European Working Conditions Survey consistently shows that compared with permanent workers, employees with temporary contracts are more exposed to worse working conditions and suffer more health problems (e.g., Eurofound, 2021). Picchio and Ours (2017) argue that temporary workers are more likely to be assigned dangerous tasks because they usually have less bargaining power. Additionally, a short duration of the contract may reduce incentives to invest in specific human capital and build worker expertise, As Núñez and Prieto (2019) show, firms tend to invest more in the occupational safety and health of the workforce with a higher stock of human capital. These authors find a direct relationship between firms' investment in internal human capital creation (training) and their investment in occupational safety and health. Koene and van Riemsdijk (2005) suggest that low levels of investment in training and skills mean that temporary workers are less likely to identify with the firm where they work. In this context, the lower degree of employer commitment to temporary employees may lead them to reciprocate with a lower level of commitment than full-time employees. As Arocena, Villanueva, Arévalo, and Vázquez (2010) note, reciprocal behavior is at the core of several psychological and sociological theories regarding equity, relative deprivation, and social exchange.

From a different perspective, if the injured worker's contract terminates while on sick leave, he or she will continue receiving the temporary disability benefit until the end of the incapacity period. The temporary worker could seek to extend the period of absence to continue obtaining the financial subsidy. It is likely that due to the fear of losing labor income, some workers seek to prolong their sick leave in order to receive compensation for some extra days. This incentive may even be greater because the unemployment benefit is traditionally smaller and often more complicated to obtain than the subsidy for incapacity. For instance, in Spain, the worker must have made social contributions for at least 12 months in the previous six years to be entitled to unemployment insurance benefits. Further, as worker's disability compensation is usually more generous than unemployment benefits, an insurance substitution moral hazard could exist (Fortin & Lanoie,

1992, 2000). The above discussion leads us to postulate the following hypothesis:

H3. Employees with temporary contracts have a longer duration of absence due to work injuries than employees with permanent contracts.

2.4. Job tenure

Tenure refers to the length of time that an individual has served in the same job. Tenure can confer greater status, rank, or precedence to an employee who has served for a shorter period. In addition, tenure often means that more senior employees earn more money than other employees doing the same or very similar work. Furthermore, severance pay generally increases with tenure, so it is more expensive for a company to dismiss an employee who has been with the company for a long time than an employee who has been with the company for a short time. Tenure can help to keep the job when the company is forced to cut staff. In other words, tenure reduces workers' vulnerability. Thus, the lower the tenure, the greater the pressure to return to work and avoid undue sick leave duration. Therefore, we posit that:

H4. The seniority of the worker is positively associated with the duration of sick leave.

2.5. Immigrant workers

It is well known that immigrant workers are more exposed to adverse and unstable working conditions than native employees. As Porthé et al. (2010, p. 417) argue, immigrants' employment is "characterized by high job instability, a lack of power for negotiating employment conditions, and defenselessness against labor demands." Furthermore, immigrants typically face greater difficulties in entering the labor market in the host country, while they are relatively helpless as regards the threat of unemployment, and are critically dependent on their jobs and incomes (Khan & Rehnberg, 2009; Sterud et al., 2018), In short, immigrant workers are in situations of greater social and economic vulnerability than native workers, so they are more fearful of the possibility of losing their jobs as they face greater difficulties in finding a new one. Consequently, it seems reasonable to expect that an immigrant worker will feel more pressure to avoid the time it takes to return to work after an injury at work being perceived as excessive, and thus minimize the risk of having his or her job threatened. We summarize the arguments above into the following hypothesis:

H5. Immigrant workers exhibit a shorter duration of sick leave than native workers.

2.6. Firm size

In general, the intensity of monitoring and control is inversely related to the size of the organization. In small companies with shorter and more direct hierarchical structures, absenteeism from work does not go unnoticed. In smaller organizations, interpersonal relationships are usually closer, which translates into a higher level of involvement and commitment to both the sustainability of the company and the repercussions of absenteeism for workmates. By contrast, larger companies have higher rates of job rotation and employee turnovers and have more resources to replace employees on sick leave quickly, and workers at such companies have less of a direct perception of the consequences of their absenteeism. As the company grows, relationships become more impersonal, and organizational control is weaker, so employees may feel more tempted to take advantage by trying to prolong sick leave duration. In this vein, several previous studies show that the size of the organization is positively correlated with absence rates (e.g., Barmby & Stephen, 2000; Dionne & Dostie, 2007). Thus, our final hypothesis is as follows:

H6. Employees of larger firms have longer periods of sick leave than those of smaller firms.

3. Empirical analysis

3.1. Data and variables

Our dataset contains data for all nonfatal injuries that occurred in the manufacturing sector in Spain during 2015–2019 and resulted in absence of more than one day from work. The 417,680 occupational injuries recorded in the period under review caused more than 13 million lost work days, resulting in a total expenditure on disability benefits of 618 million euros (calculated as the sum of the allowances received by the injured workers while they were on sick leave). It should be noted here that sick leave due to work-related disease is not considered. Injuries on the way to/from work, and those suffered by self-employed workers are also not included in our dataset.

Another important concept is the notion of incapacity, which is defined as a situation in which a worker is unable to work, temporarily or permanently, as a consequence of a common illness or an injury at work. In this case, the worker receives health care from the social security system, and the maximum duration of the incapacity period is 365 days. This period can be extended by 180 days when there are reasons to presume that the worker's situation can be cured medically during that time. The decision on when the worker is fully recovered to carry out the usual tasks of his or her job depends on the assessment of a medical professional and must be strictly based on medical criteria. Temporary and permanent incapacity for work is protected by an economic benefit within Spain's social security system. The financial benefit consists of a daily allowance calculated based on the regulatory base (mainly the wage earned in the previous months) and the origin of the disability. For injuries at work, a minimum of 75% of the regulatory base is recognized from the first day after the work injury. This allowance is paid either by a mutual insurance company or the National Social Security Institute. Supplementation of the allowance at the company's expense either by collective agreement or agreement between the company and the workers is a widespread practice (López-Tarruella, 2006).

The data used in this study come from the official records of occupational injuries provided by the Statistics of Work Accidents (Estadística de Accidentes de Trabajo, EAT), published by the Ministry of Labor and Social Security of Spain. The EAT data are drawn from the occupational injury reports, which is the official document by which the employer notifies the occurrence of an occupational injury, how it occurred, the place, and the consequences of the injury. Specifically, the files record data on the firm where the injury occurred, personal and professional characteristics of the injured employees, and the type and medical diagnosis of the injuries. It should be noted that our sample contains anonymized data for injuries occurring over five years. This is pooled data, not panel data since the observations in each year do not necessarily refer to the same employee (in fact, it is most likely that the workers injured each year are different).

As shown in Table 1, the average and median length of sick leave are 30.7 and 13 days respectively. Women account for 13.8% of the injured workers, while foreign workers and workers

Table 1
Description of study variables regarding the duration of work-related sick leave in the manufacturing industry in Spain.

Variable	Description	Mean (Median)
Duration	Number of days off	30.7 (13)
Subsidy	Sick leave benefit (euros)	47.2 (43.5)
Size	Number of employees	280 (50)
Age	Age of the worker in years	41.2 (41)
Female	1 = Women, 0 = Men	0.138
Foreign	1 = Foreign, 0 = Spaniard	0.084
Temporary	1 = Temporary contract, 0 = Permanent contract	0.278
Tenure	1 = employee more than 3 years in the same job 0 = employee less than 3 years in the same job	0.521
Serious	1 = the medical qualification of the injury was serious 0 = the medical qualification of the injury was minor	0.006
Hospital	1 = injured worker required hospitalization 0 = injured worker required ambulatory care	0.067
Multiple	1 = more than one injured in the same injury, 0 = only one injured	0.005
Night	1 = the injury occurred during the night shift, 0 = otherwise	0.109
Weekend	1 = the injury occurred over the weekend, 0 = otherwise	0.048
Type	Dislocations sprains and strains	0.424
	Superficial wounds and injuries	0.388
	Bone fracturesTraumatic amputations	0.075
	(loss of body parts)	0.062
	Burns scalds and frostbite	0.020
	Multiple injuries	0.005
	Psychic trauma, traumatic shock	0.003
	Drowning and suffocation	0.001
	Effects of extreme temperatures light and radiation	0.001
		0.001
	Effects of noise vibration and pressure	0.001
	Poisonings and infections	0.001
	Heart attacks strokes and other non-traumatic pathologies	0.019
	Other	
Occupation	Craftsmen and skilled workers	0.477
	Plant and machinery operators and assemblers	0.242
	Elementary occupations	0.235
	Technicians; support professionals	0.019
	Catering, personal, protection and sales service workers	0.013
		0.008
	Accounting, administrative, and other office employees	0.005
		0.002
	Scientific and intellectual technicians and professionals	
	Directors and manager	
Sector	Food, beverages and tobacco (NACE 10,11,12)	0.234
	Textile, leather and footwear	0.035
	(NACE 13,14,15)Wood and cork	0.037
	(NACE 16)Paper and graphic arts	0.042
	(NACE 17,18)Coke and refined petroleum products	0.001
	(NACE 19)Chemical products	0.031
	(NACE 20)Pharmaceutical products	0.010
	(NACE 21)Rubber and plastic	0.050
	(NACE 22)Other non-metallic products	0.056
	(NACE 23)Basic metals and metallic products	0.250
	(NACE 24, 25)Electronic and electrical equipment	0.084
	and machinery	0.088
	(NACE 26–28)Transport equipment	0.036
	(NACE 29,30)Furniture and others	0.046
	(NACE 31,32)	
	Repair and installation of machinery and equipment (NACE 33)	
Region	Dichotomous variables for 17 Spanish autonomous communities	

with temporary contracts account for 8.4% and 27.8%, respectively. Finally, the average benefit received by injured workers is 47.2 euros per day.

We use several proxies to control for the factors that influence the recovery time of an injured worker discussed above. First, the medical assessment of the seriousness of the injury, which is defined according to the doctor's criteria at the time of certifying the sick leave (SERIOUS). Second, the type of care required by the injured worker (inpatient or outpatient care) is a good control variable for injury severity. Logically, inpatient care (HOSPITAL) is indicative of an injury with more far-reaching health consequences, requiring a longer recovery time than an injury requiring outpatient medical care. Third, the age of the employee is included to proxy the worker's health status and recovery capacity. As argued above, we expect a positive association between the variable AGE and our dependent variable (i.e., the consequences of an injury are more severe for mature workers than for younger workers, which usually translates into more days off work). Fourth, we have included the variable MULTIPLE, which indicates whether the injury caused more than one injured worker. In general, when several people are injured in the same incident, it is because it is a major incident (e.g., a violent explosion) that causes more serious injuries.

Likewise, injury dichotomous variables control for differences in the extent and consequences associated with different types of injuries, which are listed in Table 1 in the way they are reported in the EAT. More than 80% of the injuries fall into two broad categories (dislocations, sprains, and strains; and superficial wounds and injuries), which are the typical injuries that occur in manufacturing activities. The occupation and industry dichotomous variables control for specific features associated with the worker's activity. As expected, Table 1 reveals that most injuries occur in blue-collar jobs. Regional dichotomous variables are included to account for additional unobserved characteristics that may influence the recovery time, such as differences in the effectiveness of medical assistance protocols and inspection activity among regional health authorities.

Finally, we note that weekend and night shifts are common in many manufacturing firms. There is ample evidence that night work and lack of sleep, as well as altered circadian rhythms, constitute a potentially dangerous combination of factors. Nightshift workers are often tired and sleepy due to their shift work schedule. Excessive fatigue reduces concentration, which increases the likelihood of making mistakes and the occurrence of more serious injuries. The night shift is considered to be more prone to unsafe work behaviors (Larson, 1998) and shift work can be stressful and detrimental to workers' health conditions (Rosa & Colligan, 1997). Furthermore, the time the injury happens can also determine how quickly and accurately first aid is administered. For instance, in many companies and jobs, there is a shortage of staff working during night shifts and weekends. Thus, prevention and medical assistance services may not be fully operational, delaying and reducing the effectiveness of the first response to the injury. Therefore, the variables NIGHT and WEEKEND are included to account for their potential impact on the recovery time.

3.2. Methods

The focus of our analysis is to test H1–H6 stated above. For this purpose, our econometric analysis is based on the estimation of the following equation:

$$\begin{aligned} y_i = {} & \beta_0 + \beta_1 FEMALE_i + \beta_2 SUBSIDY_i + \beta_3 TEMPORARY_i \\ & + \beta_4 TENURE_i + \beta_5 FOREIGN_i + \beta_6 SIZE_i + \gamma_1 AGE_i \\ & + \gamma_2 SERIOUS_i + \gamma_3 HOSPITAL_i + \gamma_4 MULTIPLE_i \\ & + \gamma_5 WEEKEND_i + \gamma_6 NIGHT_i + \mu TYPE_i + \varphi OCCUPATION_i \\ & + \theta SECTOR_i + \rho REGION_i + \delta t + \varepsilon_i \end{aligned} \quad (1)$$

where the dependent variable y_i is the number of days absent from work for individual i; the next six variables refer to the key variables of interest for testing H1–H6 the rest of variables account for the characteristics of the context and severity of the injury; t is a time trend with $t = 1,..,5$ corresponding to the years from 2015 through 2019; and the Greek letters are the parameters to be estimated.

First, we have estimated Eq. (1) with an ordinary least square regression (OLS). In a second model, the dependent variable is considered a count variable, as it is measured as a non-negative integer and represents the number of times (days) that the person is on sick leave due to an injury at work. A negative binomial distribution is widely used to describe data that are too heterogeneous to be fit by a Poisson distribution, as the former has an extra parameter to adapt the variance independently of the mean (e.g., Arocena, Núñez, & Villanueva, 2008). However, there are many cases in which the number of individuals falling into the zero class cannot be determined; in these cases, it is necessary to truncate the model (Sampford, 1955). The resulting restriction of the domain gives rise to a conditional distribution. Given the characteristics of our data, the truncated negative binomial (TNB) distribution is the appropriate approach to estimate [1], as it allows for overdispersion, combines event counts with the Poisson distribution and unexplained variation with the Gamma distribution, and considers that the zero value cannot occur.

Table 2
Coefficients estimated through the OLS regression and the Truncated Negative Binomial (TNB) model for the duration of sick leave after an injury at work.

Variable	OLS	TNB
Female	2.634 (0.221)***	0.091 (0.006)***
Subsidy	0.059 (0.005)***	0.002 (0.0001)***
Temporary	0.397 (0.020)	0.002 (0.005)
Tenure	1.095 (0.185)***	0.040 (0.005)***
Foreign	−1.413 (0.261)***	−0.047 (0.007)***
Size	0.001 (0.0001)***	0.0004 (0)***
Age	0.434 (0.007)***	0.016 (0.0002)***
Serious	114.259 (0.926)***	1.244 (0.023)***
Hospital	16.644 (0.288)***	0.447 (0.007)***
Multiple	3.801 (1.042)***	0.114 (0.027)***
Weekend	1.575 (0.334)***	0.065 (0.009)***
Night	0.394 (0.229)*	0.016 (0.006)***
Time	0.329 (0.050)***	0.010 (0.001)***
Constant	7.971 (1.581)***	2.496 (0.041)***
Injury variables	yes	Yes
Occupation variables	yes	Yes
Industry variables	yes	Yes
Regional variables	yes	Yes
alpha	-	1.348 (0.004)***
F(62, 417613)/ LR chi2	1010.03	60516.48
Prob > F/chi2	0	0
Number of observations	417,680	417,680

Notes:
Robust standard errors are in parentheses.
*, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

4. Results

Table 2 reports the parameter estimates of the OLS and TNB models. First, in the TNB model, we note that the dispersion parameter alpha (which reflects the fact that the conditional variance exceeds the conditional mean) is significantly greater than zero, strongly indicating that the data are over-dispersed and are better estimated using the negative binomial model than the Poisson model (where alpha is constrained to be zero). A glance at the estimated coefficients in Table 2 reveals that both models provide similar conclusions. We note that all occupation, injury type, sector, and regional dichotomous variables listed in Table 1 are included in the estimates, although their coefficients are not shown in Table 2.

Let us focus first on the key variables of hypotheses H1–H6. The positive and highly significant coefficient for FEMALE provides evidence that women have a longer duration of absence after an injury at work than men. Likewise, the statistically significant positive sign for SUBSIDY indicates that higher levels of subsidy imply a longer duration of sick leave. We, therefore, accept H1 and H2. On the contrary, the estimated coefficient for TEMPORARY is not statistically significant, so H3 is not supported. As hypothesized in H4, the positive and statistically significant coefficient of TENURE indicates that injured workers with longer tenure are absent from work more days than less senior workers. On the contrary, the negative sign for the variable FOREIGN shows that the period of incapacity is shorter for immigrant workers than for national employees, and therefore provides support for H5. The positive and highly significant coefficient for SIZE supports H6, suggesting that extending sick leave is easier in large organizations.

All proxies for the injury severity behave as expected, showing a positive association with the duration of sick leave. Table 2 shows two further results of interest. First, occupational injuries occurring during the weekend and night shifts generate significantly longer sick leave. Second, the positive and statistically significant coefficient of the time trend variable shows that the duration of sick leave has increased over the period analyzed.

The findings are particularly significant for manufacturing industries, where, compared to the service sector, on average workers earn higher wages, have greater seniority in their jobs, firms have a larger average size and there is a higher percentage of large firms. Likewise, as Di Pasquale, Miranda, and Neumann (2020) note, there is a marked upward trend in the percentage of older workers employed in manufacturing and production environments. In Spain, according to the Economically Active Population Survey, the percentage of manufacturing workers over the age of 50 increased from 25.2% to 28.7% between 2015 and 2019, and the percentage of plant and machine operators and assemblers over the age of 50 increased from 27.8% to 33.4%. In addition, 6.1% of employees work more than half of their working days in night shifts (5.2% in the case of employees over 55 years old), while around 20% of employees work at least one Sunday shift per month (17.6% in the case of those over 55 years old).

Before discussing the managerial implications of these results, we perform a marginal analysis to provide an estimate of the magnitude of the effect on the dependent variable of each of the variables that were found to be statistically significant. To do so, we calculate the difference in expected counts between one category of the variable and the other, holding the rest of the variables at their median value.

The results indicate that female workers spend on average 2.37 days more sick leave than male workers when the other variables are kept at their median levels. Along the same line, the duration of sick leave for foreign workers is 1.24 days shorter than that of national workers, while that of employees with more tenure is 1.06 days longer than that of less senior workers. On the other hand, workers injured during the night and weekend shifts are respectively 0.41 and 1.7 days longer on sick leave than those injured outside these time shifts.

As firm SIZE and SUBSIDY are continuous variables, a different margin command is used. Specifically, the margin command gives the expected counts for the values of two previously defined categories of the variable while holding the rest of the variables at their median values. Thus, we first define two categories for firm size: small and medium firms, or SMEs (less than 250 employees), and large firms (with 250 or more employees). The average duration of the incapacity period in large firms is one day longer than in

SMEs. For the marginal analysis of SUBSIDY, the two defined categories of the variable are Low subsidy (below the first quartile) and High subsidy (above the third quartile). The mean duration of sick leave for employees receiving the high subsidy is five days longer than that for employees receiving the low subsidy. As shown in Table 1, the median value of sick leave duration is 13 days, so the marginal analysis reveals that the magnitude of the effect of most of the variables is substantial.

5. Discussion and conclusions

5.1. Practical applications: Managerial and policy implications

The diverse explanatory sources of the duration of sick leave suggest different interventions at different levels, from company management to public administration, highlighting the need to adopt a holistic approach for effective management aimed at reducing lost work time and its associated private and public costs.

The first type of intervention concerns factors related to the attendance motivation of workers who are most prone to duration moral hazard in the manufacturing sector. We find positive associations between the duration of sick leave and female workers. Improving the working conditions of these groups may facilitate their return to work after an appropriate medical recovery time. Various policies and actions to be considered may be related to personal, family, and work reconciliation so that any worker can maintain a full professional career while exercising their right to care for their family, undergo training, or enjoy their leisure and free time. Concrete examples are the implementation of flexible working hours, working from home, and continuous working hours for childcare, among others. Moreover, there is an opportunity for the companies to develop strategies that help employees gradually get back to their normal duties. A phased return to work may facilitate an effective transition of being back to the job and create a supportive environment in the workplace. In this sense, the role and responsibility of physicians might be also reviewed. For instance, to analyze whether physicians need more training on assessing gradual return to work while avoiding sending a worker back (too) early.

The second type of general intervention is related to the improvement of control and supervision mechanisms in the recovery process of injured workers. Our analysis shows that the threat of moral hazard is more intense for native-born workers, with longer job tenure and higher wages (and higher disability benefits), and who are employed in larger firms.

Third, several work-related circumstances that are largely manageable affect the severity of injuries and, therefore, the length of the medical recovery time. Better occupational health and safety prevention and protection help reduce the risk of serious injuries. Likewise, enhancing the quality and speed of primary care after the injury improves diagnosis and promotes quicker medical recovery. In this sense, our results suggest that firm management should consider strengthening safety and medical assistance when organizing work on more dangerous shifts (e.g., night shifts, weekends) and assigning and designing jobs for more vulnerable workers (e.g., older workers). In line with Katiraee, Calzavara, Finco, Battini, and Battaïa (2021), the results highlight the need to integrate age differences among workers into the design and management of production systems in manufacturing companies.

Similarly, public policy interventions aimed at improving social and labor conditions, increasing labor inspection capacity, and creating an appropriate regulatory context to require companies to adopt a robust occupational risk prevention system should be considered. Such policies should not be seen as an expense but as an investment that generates benefits that are reflected in the improved health of workers, increased productivity of companies, and savings of resources for the public insurance system.

5.2. Limitations and future research

Our empirical analysis is not without limitations. Fundamentally, some variables that influence the regular recovery time after an injury at work are not contemplated in our empirical analysis. For example, differences in the care received, information on whether the injured worker has any comorbidity, or a greater detail of the specific tasks and operations that the worker has to perform. Unfortunately, these variables are not available in the information provided. Likewise, the dataset does not contain firm identifiers, which does not allow us to incorporate firm-specific fixed effects. Addressing these issues would increase the accuracy of the estimates.

Finally, the findings indicate that the duration of sick leave has increased over the period analyzed, which were years of economic growth in Spain. Given that the regulation of sick leave did not change during the period considered, this result suggests a positive association between the duration of sick leave and the economic cycle, which might point to the propensity to abuse sick leave when the economic context becomes more favorable. On the other hand, as our work focuses on the analysis of absenteeism related to occupational injuries, we consider equally relevant the analysis of the magnitude and the determinants of presenteeism related to occupational injuries, which would lead the worker to return to work after an insufficient medical recovery time. These are issues that call for further and more in-depth research.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

The authors acknowledge financial support from the Spanish Ministry of Science and Innovation, Grant PID2020-114460GB-C32 funded by MCIN/AEI/ 10.13039/501100011033. We are also grateful to the Sub-Directorate General for Statistics and Socio-Labor Analysis of the Spanish Ministry of Labor and Social Economy for providing us with all the official data necessary for this work. Open access funding provided by Universidad Pública de Navarra.

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