EMPIRICAL ANALYSIS OF THE INCIDENCE OF ACCIDENTS IN THE WORKPLACE ON FIRMS' FINANCIAL PERFORMANCE

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1. Introduction

The academic attention given to accidents in the workplace has been matched by that examining their economic impact. Some authors report the negative economic consequences of workplace injuries for individual workers (e.g. Reville and Schoeni, 2001; Breslin et al., 2007; Woock, 2009; Crichton et al., 2011), while others report the negative consequences for the economy as a whole. Thus, Weil (2001), for example, undertakes a review of previous studies examining the economic consequences of work injury and illness. In the main, the studies he reviews focus on the economy as a whole and consider expenditures on medical costs and loss of earnings in the households of injured workers, finding significant divergences between theoretical and actual valuations. More recent studies have adopted a similar approach (e.g. Corso et al., 2006; Lim et al., 2011). Barth et al. (2007) report that a rising gross domestic product rate is associated with a decline in occupational injuries. Mainardi (2005) analyzed earnings differentials in the mining industry across various countries, and accounts for them in relation to different variables, including the occurrence of severe accidents. Adnett and Dawson (1998) point out that the conventional approach to the economic analyses of industrial accidents relies upon a simple compensating wage premium. In a similar vein, Martinello and Meng (1992) and Gunderson and Hyatt (2001) report the existence of a wage premium associated with workplace risks.

However, very few studies examine the economic consequences of accidents in the workplace for firms; moreover, the empirical findings of those that do provide uncertain conclusions. Kaminski (2001) analyzed the impact of new organizational practices on productivity and injury rates, but finds no clear relations between a firm's performance and its safety objectives. For instance, and somewhat surprisingly, more hours worked was associated with a lower injury rate and lower productivity, while performance-based pay induced higher injury rates and lower productivity. By contrast, the number of training hours was negatively related to the injury rate and positively related to one specific measure of productivity. Similarly, Saurin et al. (2004) find contradictory evidence when examining the integration of production and safety plans in two industrial building projects in Brazil. Taking a qualitative approach, Smallman and John (2001) conducted in-depth interviews with eight business leaders of FTSE 500 organizations. On the basis of these responses, they report that poor occupational health safety performance would appear to lead to competitive disadvantage, but they offer no quantitative evidence to support this. According to the business leaders, this competitive disadvantage is the result of the impairment of a firm's status in the eyes of one or more of its stakeholders. The authors report that the companies have little idea of their on-going outlay on safety-related items or of the financial return on their investment in safety.

Elsewhere, Kjellén et al. (1997) analyzed a Norwegian aluminum plant that implemented a quality control system and a safety, health and environment management system over a ten-year period. They report a reduction in the plant's operation expenditures, in parallel with an improvement in quality control, safety, health and environment indicators, but the authors do not perform any statistical tests. Moreover, the study only includes one manufacturing plant, which impedes the drawing of any statistical inferences. Fernández-Muñiz et al. (2009, 2012) report a significant positive relation between safety management and firm performance, but their studies have several limitations. As their findings are based on the responses to a questionnaire conducted with the firms' safety officers, the ultimate sample reflects the willingness of these officers to take part, a fact that could originate biases, with the firms with the best safety culture (and presumably the lowest accident rates) being more predisposed to participate. Similarly, the authors measured the firms' safety management systems in the light of participant responses, but presented no data for the firms' actual accident rates. Moreover, while the authors test the incidence of safety climate and safety management on company performance and competitiveness, they do not examine the incidence of accidents in the workplace on financial performance. In addition, as the authors themselves stress, they do not conduct a time-series data analysis in these studies.

Multiple circumstances influence the incidence of occupational accidents, and many factors have been proposed as contributing to such hazards (e.g. Cheng et al., 2010). While the most important factors influencing accident rates would appear to be economic

(Wooden, 1989), they are typically ignored in most analyses. The provision of new data on the interaction between accident rates and firms' financial performance at the microeconomic level should provide important information to prevent accidents in the workplace. Indeed, a precondition established by firms for promoting safety is that the economic benefits of such measures should be visible and quantifiable. Yet, the costs and losses attributable to unsafe work are usually not visible in a firm's accounting, and the potential gains of promoting safety are uncertain. As such, safety is likely to be sacrificed when management makes a trade-off between the costs and benefits of workplace safety. However, to the best of our knowledge, no single study has analyzed the incidence of occupational accidents on firm performance. Here, therefore, we seek to contribute to the literature by undertaking an empirical study of this relationship. While we find no significant influence of accident rates on the short-term financial performance of Spanish firms, we do find a significant negative influence of accidents in the workplace on one-year-ahead financial performance. Occupational accidents are unexpected events that entail a disruption to a firm's daily operations and which ultimately detract from strategic, value-adding activities and long-term financial performance.

The rest of the paper is organized as follows: the next section outlines the methodology employed, section 3 presents our main findings and section 4 concludes.

2. Methodology

2.1. Hypothesis development

Rechenthin (2004) claims that safety can provide a sustainable competitive advantage, since it has an impact on morale, profitability, turnover, and productivity, and reflects a well-run operation. Zacharatos et al. (2005) argue that sound human resource practices that encourage participative decision-making, the sharing of information and high-quality training are significantly associated with occupational safety. Therefore, if we assume that such human resource practices ensure firms obtain greater productivity, a plausible link should exist between safety and firm performance. Thus, safety would be the outcome of a sound human resources policy entailing a participative and motivating setting, which in the end would boost a firm's profitability. The contrary would be the case for a lack of safety: accidents in the workplace undermine workers' motivation and participation, and threaten well-run operations and firm performance. Accidents interrupt the production process, generating financial and opportunity costs, disrupt production quantity and quality, and diminish a firm's productivity. Accidents can also cause firms to miss delivery dates and suffer delays that lead to economic losses and a deterioration in customer perceptions of the firm, etc. As far as the workers are concerned, unsafe conditions can undermine their motivation and productivity, with the result that skilled workers choose to leave the firm. When an accident occurs in the workplace, many additional, uncalculated, yet potentially substantial, costs are incurred (Harshbarger, 2001). Work accidents are unplanned and unwanted events that result in a whole series of undesirable events: damage to property, unscheduled halts in production, a loss of workers' skills, etc. In contrast, the careful introduction of safety measures should lower the number of accidents in the workplace, and contribute to a reduction in the costs and losses associated with these unwanted events. Weber and Weber (2004) report that reductions in inefficiency in the US trucking industry not only enhance real income, but also reduce traffic fatalities. This empirical evidence points to the existence of what would appear to be a highly plausible positive effect of a reduction in a firm's accident rate on profitability.

We can thus formulate the following hypothesis:

Hypothesis 1. Accidents in the workplace have a negative influence on firm performance.

Corcoran (2002) suggests that the true economic incidence of work accidents is not in fact realized until the future, because when an accident occurs employees must refocus their efforts to deal with the incident while simultaneously ensuring that production continues. All employees involved have to set aside the work they are then engaged in so as to deal with the unanticipated event. Often daily operations and production suffer very little as it is strategic and planning activities that are typically postponed in order to ensure operations are maintained. Thus, for instance, a supervisor might step in to run a machine, or a quality meeting might be postponed to complete the production run. Indeed, the time of supervisors and managers is typically spent on bureaucratic procedures, such as seeking to replace the injured employee, undertaking an accident investigation, and generally dealing with the paperwork generated by the problem, etc. In practice, therefore, it is strategic tasks, including those related to quality assurance, product development, process improvement, recruitment and upgrading the resource planning system, that are set aside. In short, efforts are redirected from value-added to operational activities and so a company's losses are incurred primarily in the area of competitive advantage. Thus, the incidence of accidents in the workplace does not show up immediately in the profit and loss statement, but becomes apparent in the future.

There is a widely held perception among managers of the importance of strategic planning and the need to devote sufficient time to it (e.g. Trachtman, 2012, Bradford, 2012); this concern is also expressed by academics. Despite some debate concerning the degree to which business planning should be formalized (Titus et al., 2011) and its actual impact on certain performance items such as new product development (e.g. Song et al., 2011), there is broad body of empirical evidence highlighting the beneficial effects of such planning. For instance, Delmar and Shane (2003) found that business planning enhances product development and new ventures. Brinckmann et al. (2010) performed a meta-analysis of 46 studies finding overall evidence that business planning increases firm performance, and that it is generally a value-creating activity. More specifically, Kim and Sung-Choon (2013) report empirical evidence that strategic human resource management improves firm performance. Thus, despite some doubts concerning the extent to which strategic planning should be formalized, it seems beyond question that such planning increases performance.

Given the fact that work accidents disrupt a firm's activities, distracting attention away from value-adding activities, and considering the extant empirical evidence for the beneficial effects of business planning on firm performance, we formulate the following hypothesis:

Hypothesis 2. The true incidence of accidents in the workplace on firm performance tends to be in the long- rather than in the short-run.

2.2. Empirical design

Starting with the parsimonious models widely used in business studies for estimating and/or predicting firm performance (e.g. Carnes et al., 2003, Kim and Kross, 2005, Dechow et al., 1998, Argilés et al., 2011), we assume that a firm's profitability depends on its profitability in a previous period. Past profitability captures an array of firm and management characteristics that have to be taken into consideration when explaining future firm performance. Cheng (2005a) used a basic model for predicting future profitability where the dependent variable is profitability in year *t*+1 and the independent variable is profitability in year *t*, and found significant positive coefficients in all estimations performed. This basic model has been used efficiently in other studies (e.g. Bandyopadhyay et al., 2010). Profitability in a given year depends not only on past profitability, but also on recent management decisions, which elicit changes in firm efficiency, as well as on industry specific circumstances. Thus, we test the incidence of accidents in the workplace on firm profitability by applying the following model:

$$ROA_{i,t} = \beta_0 + \beta_A \cdot ACRATE_{i,\tau} + \beta_R \cdot ROA_{i,t-1} + \beta_T \cdot CHASSETURN_{i,t} + \sum_{m=1}^{m} \beta_{Sm} \cdot SECTOR_{m,i} + \varepsilon_{i,t} \quad (1)$$

where each observation refers to firm *i* in a given year *t*, *ROA* is return on assets, *ACRATE* is accident rate, *CHASSETURN* is the change in efficiency experienced by the firm during the year, and *SECTOR* are dummy variables controlling for industry characteristics. Given that our purpose is to test our hypotheses on the incidence of accident rate in a given year to firm profitability in the same year and to profitability in the following year, τ may be either *t* or *t*-1.

We use *ROA* as a measure of firm profitability. It is widely used in business and academic research as the main indicator of firm financial performance (e.g. Tan and Wang, 2010, Al-Tuwaijri et al., 2004), especially in non-listed firms. It is the ratio of income before leverage to total assets in percent, indicating firm profitability before leverage relative to its size. We expect to find a positive relationship with firm profitability in the previous and the current year.

While firm profitability in a given period depends on previous profitability, it also depends on organizational features prevailing in the same period. Management decisions can introduce certain changes in firm efficiency. Here, we approach this efficiency via asset turnover: the ratio of firm sales to total assets. It is a measure of firm efficiency commonly used in business by practitioners and academics (e.g. Fairfield and Yohn, 2001, Singh and Davidson III, 2003). It indicates how efficiently a firm uses its assets in generating sales to the company. More precisely, the variable used in our model (*CHASSETURN*) is the change in efficiency experienced by the firm during the period: the difference between its asset turnover in a given year and in the previous year, relative to asset turnover in the previous year. This variable summarizes the effects of current management decisions in a given period. An improvement in firm efficiency results in an increase in firm profitability, and vice versa; thus, we expect a positive sign for this variable.

Economic theory suggests that firm performance is influenced by specific industry patterns. For instance, barriers to entry, industry concentration and cyclical effects are important determinants of firm profitability. Dechow et al. (1999) and Cheng (2005a, 2005b) found that industry characteristics help to predict future earnings. We use the dummy variables *SECTOR*, indicating, with a value of 1, that the firm belongs to a given sector, and 0 otherwise.

Our variable of interest is the accident rate (*ACRATE*): the percent of workers injured with respect to the firm’s total workforce in a given year. In order to test our hypotheses we perform estimations relating the accident rate in a given year to firm profitability in the same year and to profitability in the following year.

While the above model tests the incidence of accidents on firm profitability we also build an additional model to analyze their incidence on abnormal firm profitability. We argue that labor accidents are unexpected events that interrupt a firm’s daily operations and, as such, they can have an unexpected impact on firm profitability. We analyze the incidence of the work accident rate on unexpected changes in firm profitability controlling for industry characteristics and firm size. We then formulate the following model:

$$ABNROA_{i,t} = \delta_0 + \delta_A \cdot ACRATE_{i,\tau} + \delta_z \cdot LNASSET_{i,t-1} + \sum_{m=1}^{m} \delta_{Sm} \cdot SECTOR_{m,i} + \varepsilon_{i,t} \qquad (2)$$

where *ABNROA* is abnormal firm profitability, meaning unexpected changes in firm profitability. We consider firm size in terms of the value of their assets held at the beginning of the accounting period. We then use the Spanish consumer price index to deflate this value to correspond to that of the first year for which we have data. Size presents a non-normal distribution, as there are usually a comparatively large number of small firms competing with just a few big firms. Therefore, we use the natural logarithm of assets (*LNASSET*) as the independent variable in the model. It is usually used as independent variable controlling for size in empirical research in business (e.g. Tan and Wang, 2010, Klein, 2002). Large firms can exploit scale economies, favorable credit market conditions and better management and planning activities, while small firms' advantages are dependent on their flexibility, allowing them to respond to changing circumstances or specific requirements (You, 1995). Small firms are thus better able to cater to customers' needs, to respond to changing consumer tastes and to satisfy specific market niches (Piore and Sabel, 1984; Salais and Storper, 1992). Such firms also have a "thinner" organization, which facilitates a lower span of control and ensures a quicker response time and decision-making process (Jensen and Meckling, 1976; Knight and Cavusgil, 1996). In this regard, Bonaccorsi (1992) and Jolly et al. (1992) specifically report evidence of the earlier and quicker internationalization of small, technology-intensive firms. Big firms tend to manage their activity through more carefully planned and stable patterns than is the case of small firms. The former are less able to supply unexpected increases in market demand; yet, they are less flexible to adjust their resources and to avoid costs when activity unexpectedly falls. Therefore, we expect a negative incidence of size on abnormal firm performance.

Likewise, we assume that there are specific industry facts and characteristics that can influence the occurrence of unexpected profitability. For instance, the building industry is highly volatile and accounted for unexpectedly high profit levels in Spain during the period studied.

As in equation (1), our variable of interest is the accident rate (*ACRATE*), and we perform estimations relating the accident rate for a given year to abnormal firm profitability in the same year and to abnormal profitability in the following year.

In order to calculate the abnormal firm profitability, we first estimate a model to forecast the expected return on assets. We start from the basic model proposed by Cheng (2005a) and formulate the following equation to estimate the firm's predicted profitability:

$$ROA_{i,t} = \gamma_0 + \gamma_1 \cdot ROA_{i,t-1} + \gamma_2 \cdot CHASSETURN_{i,t} + \varepsilon_{i,t} \tag{3}$$

where firm profitability depends on previous profitability and current changes in efficiency. As in Equation (1), current firm profitability depends on past and current management decisions. The former are summarized in last year's profitability, while the relative changes in asset turnover, with respect to the previous year, capture new facts, decisions and technical and organizational changes applied within the firm.

We then post-estimate the firm's predicted profitability (*PREDROA*) and calculate the abnormal firm profitability as follows:

$$ABNROA_{i,t} = ROA_{i,t} - PREDROA_{i,t} \tag{4}$$

2.3. Sample and data

Our study requires data on accidents in the workplace from individual firms, but such information is not available in any published form. We therefore contacted the Labor Department of the Catalan Government who provided us with data on accidents that had occurred in firms operating in Catalonia. In a first instance we selected the wider available periods of data where labor accidents would not be influenced by Government regulations. The last main Spanish regulations of labor accidents were issued in November 1995, December 2003 and October 2006. We refused data from 2008 on, because the financial crisis entailed a harsh economic downturn in Spain, especially in the building industry, with its subsequent decrease in accidents in the workplace, as well as in firm income. The Catalan Government provided us with data on labor accidents of the three industries with the highest accident rates in Catalonia (and in Spain for that matter) between 1998 and 2003, where results are not likely distorted by changes in regulations and/or by the recent economic downturn. The building (Spanish activity code number 45), retail & household repairs (code number 52) and metallurgical manufacturing -except machinery- (code number 28) industries reported the highest number of accidents in the workplace in Catalonia (with 21.04, 6.81 and 6.06% of all occupational injuries respectively in 2013). We then selected 100 firms operating in each of the three industries according to the following criteria: in the first instance, we included all firms reporting fatal accidents; then firms reporting serious accidents; and, finally, the sample was completed with firms reporting minor accidents.

Financial data for these firms were obtained from the Spanish SABI data base, which contains financial statements and other basic details for around a million Spanish firms. Note that as these financial statements refer to the assets and activities of firms operating throughout the whole of the Spanish state and our data on accidents in the workplace refer solely to Catalonia, the firms included in the eventual sample had to satisfy the following requirements: the firm's headquarters and at least 90% of its workforce had to be located in Catalonia. As such, many big firms operating in the whole of the state were excluded and so there is an unavoidable sample selection bias in favor of small firms (affecting especially the building industry, see discussion below). However, this bias does not affect the main conclusions offered by our study. The sample selection was also subject to the availability of financial data in the SABI database.

All firms reporting fatal and serious accidents during the period, and complying with the aforementioned criteria, were included in the sample. Firms reporting minor accidents were selected randomly to reach a total of 100 firms for each of the three industries. Our final sample included 299 firms (a building sector firm had to be excluded as it presented two different activity code numbers) with 1,517 year-data observations and a total of 12,189 workers reporting work-place related injuries during the period studied (see Table 1). The number of injured workers in each of the three industries is conditioned by the average firm size, there being fewer injuries in the building industry (see Table 1) as the firms in this sector tend to be smaller (in terms of number of workers, but also total assets) than those in the other two sectors (see Table 2). However, the number of fatalities was higher in this industry as was the overall accident rate (see Table 2).

(Insert Table 1 about here)

Significant differences were recorded in the size, profitability, efficiency and accident rates of the three industries (see Table 2), which justifies our decision to include dummy variables in our models controlling for industry characteristics. However, no significant differences were found in the relative change of efficiency. We use the dummy variables *BUILDING* and *METAL* indicating, with a value of 1, that a firm belongs to the building and metallurgical manufacturing (except machinery) industries respectively, and 0 otherwise. The default variable, therefore, is the retail & household repairs industry. The firms in this last sector tend to be less profitable, but report a higher turnover, than those in the other two industries in the sample. The Spanish real estate sector flourished during the period of study giving abnormal returns for firms in the building industry. By contrast, the lower abnormal returns, as well as the lower returns on assets, recorded by the retail & household repair firms in our sample reflect the growing competitive pressure in this sector.

(Insert Table 2 about here)

As the Pearson correlations between the independent variables included in the models were low (see Table 3), collinearity is unlikely to affect our estimations. The highest coefficient (-0.5223) is between the dummy variables indicating sector characteristics. A significant negative correlation was found between firm size and accident rate, suggesting that bigger firms adopt more preventive measures than their smaller counterparts. The correlation between the relative change in asset turnover and profitability was significant, but very small (0.0452). A possible explanation is that the first of these variables refers to the variation in just one year, while the second contains a wider span of accumulated information on the firm's past management decisions. Our subsequent multivariate analysis revealed that when controlling for previous profitability, relative changes in efficiency had a significant influence on current profitability. This correlation was higher when we considered variables expressing relative changes in both: efficiency and profitability (a significant Pearson correlation of 0.1879). Note, however, that these data are not shown in Table 3, because the variable change in return on assets is not included in our equations.

(Insert Table 3 about here)

3. Results

Table 4 displays descriptive statistics concerning accident rates for different percentiles of *ROA* and *ABNROA*. Overall, this first approach suggests the existence of a negative relationship between labor accidents and financial performance. Despite it is not perfectly linear, firms with the lowest financial performance present higher labor accidents with respect to those with the highest financial performance, for the building and retail and household repairs industries. The relationship is stronger for accident rates in previous year. On the contrary, the relationship is slightly positive for the metallurgical industry, but differences are just (and scarcely) significant for accidents in previous year between firms above and below abnormal return on assets (see panel D). Mean values offer similar results (not displayed). These results provide a preliminary support for our Hypotheses 1 and 2, but also suggest different behaviors across industries, which are also reflected in Pearson correlations: ranging from -0.1311 (significant with $p<0.01$) to 0.0297 (non significant with $p<0.1$) between accident rate in previous year and *ROA* for the building and metallurgical industries respectively.

(Insert Table 4 about here)

Table 5 shows our estimations for Eq. (1), in which the accident rate and the dependent variable refer to the same year. As the value of the Breusch-Pagan/Cook-Weisberg test (26.42) indicates the existence of heteroskedasticity ($p<0.05$), the table (as well as Tables 6-8) includes estimates of robustness. Given that our sample presents the typical autocorrelation pattern for panel data, we performed panel data estimations. The commonly used Hausman test (Hsiao 2005) rejects the null hypothesis of no correlation between the individual effects and the explanatory variables. As the individual effects are correlated with the regressors, the fixed effects estimator is more consistent and efficient than that of random effects. The value of the Hausman test (582.49) is significant at $p<0.05$ (with three degrees of freedom). Fixed effects estimators are included in column B of Table 4. As the firms in the sample operate in the same industry across all periods, with fixed effects, collinearity affects estimations and the corresponding dummy variables are omitted.

(Insert Table 5 about here)

Given that there are significant differences between all three industries in almost all their variables (see Table 2), our results are not reliable when control variables for industry characteristics are not included in the model. Consequently, we focus on the random effects estimations, controlling for these dummy variables, and thus reinforce our results with the additional estimations shown in Table 5. The estimated coefficients for variables in Eq. (1) for analyzing the incidence of accident rate, in a given year, on the financial performance in the same year are (see data displayed in column A in Table 5):

$$\begin{aligned} ROA_{i,t} = 2.556386 - 0.0207392 \cdot ACRATE_{i,t} + 0.5089918 \cdot ROA_{i,t-1} + 3.658144 \\ \cdot CHASSETURN_{i,t} + 1.879864 \cdot BUILDING_i + 0.9797245 \\ \cdot METAL_i \end{aligned} \quad (5)$$

Random effects estimations (column A) fit cross-sectional time-series data producing a matrix-weighted average of the between and within results. Newey-West estimations (column C) assume the error structure to be heteroskedastic and possibly autocorrelated up to the lagged data. Generalized estimating equations (GEE - column D) fit population-averaged panel-data models. All estimations present a significant goodness-of-fit. These three estimations (columns A, C and D) provide similar and expected results with respect to the control variables: profitability of previous year and the increase in asset turnover, while operating in the building sector significantly influences higher current profitability. Previous management characteristics and changes in management decisions influence a firm's profitability. Thus, the coefficients of *ROA*, *CHASSETURN* and *BUILDING* are positive and significant at $p<0.05$ for all three estimations. Random effects estimations when controlling for the dummy variable of year characteristics also reinforce these results (column E). If we focus on our variable of interest, the *ACRATE* coefficient is found to be persistently negative, albeit not significant at $p<0.1$ in all four estimations (columns A, C, D and E). The variable is also not significant in the fixed effects estimation (column B). As such, all the results in Table 5 fail to support Hypothesis 1 when the incidence of the labor accident rate on profitability is analyzed in the same year.

Table 6 shows robust estimations when the dependent variable is the one-year-ahead profitability with respect to the accident rate. The estimated coefficients for variables in Eq. (1) for analyzing the incidence of accident rate, in a given year, on the financial performance in the following year are (see data displayed in column A in Table 6):

$$\begin{aligned} ROA_{i,t+1} = 2.673717 - 0.0335494 \cdot ACRATE_{i,t} + 0.5078374 \cdot ROA_{i,t} + 3.591106 \\ \cdot CHASSETURN_{i,t+1} + 1.937567 \cdot BUILDING_i + 1.022341 \\ \cdot METAL_i \end{aligned} \quad (6)$$

All the estimations in Table 6 present a significant goodness-of-fit, while the coefficient of the accident rate is not significant at $p<0.1$ for the fixed effects estimations (column B). However, in all the estimations controlling for industry characteristics (columns A, C, D and E), in line with the results in Table 5, we report significant coefficients for the control variables. Likewise, the coefficients for *ACRATE* are negative and significant at $p<0.05$, which supports both Hypotheses 1 and 2. Thus while our results indicate a negative incidence of accidents in the workplace on firm profitability, the actual incidence is recorded in the long term. According to our results, an accident rate of 1% entails a 0.03% fall in a firm's return on assets in the following year where the mean and median return on assets for firms in our sample are 7.4 and 6.5%, respectively (see Table 2).

(Insert Table 6 about here)

Table 7 shows robust estimations for the incidence of labor accidents on abnormal profitability in the same year. Here, we also focus on random effects, Newey and GEE estimations (columns A, C, D and E), and the control variables present the expected significant sign in most instances. The building industry presents a higher abnormal profitability than that of the default sector, reflecting the effects of the property boom during the period studied. The dummy variable for the metallurgical sector also presents a significant positive sign. Size, as expected, is inversely related to abnormal returns on assets. No estimation presents a significant sign for our variable of interest with p<0.05, a finding that is in accordance with the results in Table 5 (incidence of accident rate on profitability in the same year). In Newey-West estimations (column C) this variable is negative and significant with p<0.1. The estimated coefficients for variables in Eq. (2) for analyzing the incidence of accident rate, in a given year, on the abnormal financial performance in the same year are (see data displayed in column A in Table 7):

$$\begin{aligned} ABNROA_{i,t} = 5.569013 - 0.0110401 \cdot ACRATE_{i,t} - 0.6936211 \cdot LNASSET_{i,t-1} \\ + 2.574576 \cdot BUILDING_i + 2.362443 \cdot METAL_i \qquad (7) \end{aligned}$$

(Insert Table 7 about here)

Table 8 shows estimations when the dependent variable is the one-year-ahead abnormal profitability. All estimations present a significant goodness of fit at p<0.05. In the fixed effects estimation the coefficient of our variable of interest is not significant at p<0.1 (column B). However, as the Hausman test (3.82) is not significant at p<0.1 with two degrees of freedom, it did not reject the null hypothesis of no correlation between individual effects and the explanatory variable. Individual effects are uncorrelated with the regressors and the random effects estimator is consistent and efficient. As discussed, an additional advantage of the random effects estimation with respect to that of fixed effects is that it allows control variables for sector characteristics to be included in the model. The results of the random effects estimation, reinforced with the results of the Newey-West and

GEE estimations, show the expected significant coefficients for the control variables in most of the estimations that control for industry characteristics (columns A, C, D and E). These results are in line with those previously discussed in Table 7. The estimated coefficients for variables in Eq. (2) for analyzing the incidence of accident rate, in a given year, on the abnormal financial performance in the following year are (see data displayed in column A in Table 8):

$$ABNROA_{i,t+1} = 6.695355 - 0.0466398 \cdot ACRATE_{i,t} - 0.7703725 \cdot LNASSET_{i,t} + 2.635565 \cdot BUILDING_i + 2.446454 \cdot METAL_i \qquad (8)$$

The rate of accidents in the workplace has a significant impact (at $p<0.05$) on a firm's one-year-ahead abnormal profitability in the random effects estimation, the Newey-West estimation, the GEE and the enlarged model with random effects when controlling for the dummy variables for years (columns A, C, D and E, respectively, in Table 8). According to these results, an accident rate of 1% entails a 0.04% fall in profitability due to a firm's abnormal return on assets in the following year, and they provide further support for Hypotheses 1 and 2.

(Insert Table 8 about here)

R-squared values of each estimation displayed in Tables 5 to 8 are low, specifically those relating to abnormal profitability (Tables 7 and 8), thus indicating that financial performance, and more precisely abnormal return on assets, is affected by multiple factors that are difficult to capture with our models. Despite our results must be taken cautiously, they are obtained through models usually used in predicting financial performance (referred in section 2.2), and are strong across the different estimations performed.

We repeated the multivariate analysis for each three industry subsamples (data not shown). Despite the decrease in sample size, we also find significant negative influence of labor accidents in previous year on profitability and abnormal profitability, for the building and retail and household repairs industries. However, we find no significant influence with the subsample of the metallurgical sector. Therefore, results cannot be generalized to all industries and circumstances, and must be taken cautiously.

We do not obtain any significant coefficients for our variable of interest when conducting estimations with two-year lagged accident rates (data not shown), suggesting that the effect of accidents in the workplace does not persist in a firm's two-year-ahead performance or in its abnormal financial performance. The Wald test does not support the existence of a significant joint influence (at $p<0.05$) of the accident rate in a given year and the one-year lagged (or two-year lagged) accident rate on a firm's financial performance. As accident rates across periods present highly significant positive correlations, collinearity likely distorts estimations when accident rates from various years are jointly introduced as independent variables. The loss of observations with increased lags in accident rates is, of course, an additional problem. As such, the estimations included in Tables 5 to 8 are more appropriate for analyzing the incidence of accident rates on a firm's financial performance than are estimations that include various variables of lagged accident rates.

We also removed one case with extraordinary labor accident rate. Here, the results for all the estimation methods, with and without dummy variables for years (data not shown), were very similar to those reported above.

4. Discussion and conclusions

In this study we approach safety in the workplace as an outcome of a sound human resources policy, with an obvious motivational and performative setting. Work accidents disrupt business operations, undermine motivation, interfere with productivity, generate unforeseen costs and affect firm performance. Consequently, our first hypothesis postulates that accidents in the workplace have a negative influence on firm performance. When a labor accident occurs, employees refocus their efforts to deal with the incident, and apply urgent measures to ensure that daily operations continue, while strategic tasks are set aside. Above all, labor accidents affect value-added activities and strategic planning. Therefore our second hypothesis formulates that the true incidence of accidents in the workplace on firm performance tends to be in the long rather than in the short-run.

Our study provides empirical evidence of the negative influence of accidents in the workplace on firm profitability. This impact, however, does not make itself manifest immediately. Most estimations relating accident rates with firm performance in the same year provide a negative coefficient for this variable, but it is only significant with $p<0.1$ in the Newey estimation for abnormal return on assets. Therefore, with these results we do not find full support for our Hypothesis 1 relative to the influence of the accident rate on a firm's immediate performance. Labor accidents disrupt firms' operations, but managers and workers find the way to reinforce their efforts in order to minimize their incidence on immediate performance. Their main impact is on a firm's one-year-ahead profitability. Coefficients for accident rates are all negative and significant (with $p<0.05$) for estimations performed for one year ahead return on assets and abnormal return on assets, an controlling for sector characteristics. It is one year after an accident that a significant negative influence on firm profitability is recorded. Therefore we find support for our Hypothesis 2 stating that the true incidence of accidents in the workplace on firm performance tends to be in the long-term. Our results suggest that labor accidents disrupt mainly strategic and value added activities allowing firms to be in advantageous position to attain future performance and to build firm capabilities. Our results suggest that managers and workers redirect their efforts giving priority to urgent operational tasks when an accident occurs. The significant negative coefficients for accident rates provide indeed support for our Hypothesis 1. Our results are consistent across different estimation methods and control variables, as well as with two industry subsamples. However, they are not confirmed for one of the three industry subsamples included in our study. Moreover, the R-squared values of the estimated models are low, especially those relating accident rates to abnormal returns, and consequently the results and conclusions should be taken cautiously.

Our results have some interesting practical implications. For example, firms should see that it is in their own best interests to implement occupational health safety measures, hitherto enforced by legislative means. Hopkins (1999) argues that while it would appear entirely rational from an economic perspective to devote a considerable amount of resources to minimizing accident risks, organizations often fail to do so, showing an inability to act rationally. It is our belief that managers have considerable difficulty in quantifying the costs of accidents in the workplace and in calculating the gains to be made from operating a sound safety policy. Thus while they are typically ill-informed about the costs that are incurred in accident prevention, they have no understanding of the indirect consequences of accidents in the workplace. The British directors interviewed in Smallman and John's (2001) study claimed to be vaguely aware that a poor occupational health safety record might lead to a loss of reputation, but felt there was little to be gained from anything more than minimum compliance. The maintenance of their reputation was the sole benefit they associated with occupational safety. The British directors reported making only rough calculations of their health and safety expenditure, and reported that occupational safety costs were not listed as a specific item in their accounts. With these current management accounting techniques, it was therefore extremely difficult to assess these costs and to calculate the return on their investment. Similarly, Harshbarger (2001) claims that managers have little appreciation of the economic consequences of unsafe practices in the workplace. The subsequent recommendation is that firms devote resources and accurate cost accounting techniques for assessing the true economic consequences of labor accidents.

Information on accidents in the workplace contributes to provide a picture of the firm's social responsibility and its implication with occupational health safety. Moreover, given that labor accidents have a significant influence on firm financial performance, an additional practical implication of this study is that their disclosure provides relevant information for stakeholders. With respect to the specific investors' point of view, accidents in the workplace provide useful insights on future firm profitability. However, firms do not usually provide information on this issue in most countries, with the exception of specific voluntary disclosures, such as for example those included in the Global Reporting Initiative guidelines. An obvious recommendation in this respect is that disclosure of accidents in the workplace should be mandatory in accounting standards. In this vein, mandatory disclosure would elicit that firms loath to avoid labor accidents apply preventive safety measures.

This study contributes to the literature by providing a performance appraisal of accidents in the workplace. All efforts to shed further light on the mechanisms linking unsafe behavior in the workplace with its economic consequences for firms are valuable and provide guidelines for improving occupational health safety. The awareness among senior management that a poor safety performance has an incidence on financial performance should serve to promote health safety. Introducing appropriate economic incentives should, therefore, propitiate decisions that strengthen the management of safety performance. However, further research is needed to address this specific issue.

A limitation of this study is that the firms' financial performance is analyzed only in relation to data available from their financial statements. We have not addressed externalities and the whole array of indirect costs related to accidents in the workplace. As Cordier (2003) and Labelle (2000) stress, there are a whole series of indirect costs associated with such accidents that presumably exceed the direct costs recorded in a firm's financial statements and which are difficult to calculate and measure in economic terms. While some of these costs extend beyond the firm in which the accident occurs, affecting individual workers and society at large, other indirect costs do affect the firm. Our empirical study, though, does not identify these costs. However, our results suggest that while firms find a way of minimizing their negative influence in the short run, they are unable to do so in the long run. Further research is therefore needed on the incidence of both the direct and indirect costs of accidents in the workplace. As previously mentioned, an additional limitation of this study is that the R-squared values of the estimated models are low. More research is also needed for different industries, with wider samples and with models able to explain a major portion of variability of the dependent variables.

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Table 1

Data Sample

	Building	Retail & household repairs	Metallurgical except machinery	Total
Number of firms in 1998	82	85	89	256
Number of firms in 1999	89	84	89	262
Number of firms in 2000	87	81	83	251
Number of firms in 2001	88	81	90	259
Number of firms in 2002	88	75	86	249
Number of firms in 2003	85	70	85	240
Total number of year data observations	519	476	522	1,517
Total number of firms	99	100	100	299
Number of workers with minor injuries	1,699	6,287	3,928	11,914
Number of seriously injured workers	87	44	102	233
Number of fatalities	30	5	7	42
Total number of injured workers	1,816	6,336	4,037	12,189

Table 2

Descriptive statistics

	Building		Retail & household repairs		Metallurgical except machinery		Total		
	mean	median	mean	median	mean	median	mean	median	
Number of workers	48.9	29.0	264.6	59.0	84.2	48.5	128.7	44.0	***
ACRATE	12.1	8.7	8.8	5.7	11.0	5.3	10.7	6.7	**
ROA	8.0	6.5	5.8	5.3	8.2	7.3	7.4	6.5	***
ABNROA	1.89	0.48	-3.79	-2.75	1.49	0.44	0.00	-0.22	***
Asset turnover	1.5	1.4	2.4	1.9	1.5	1.4	1.8	1.5	***
CHASSETURN	0.0384	-0.0178	0.0403	0.0090	-0.0019	-0.0085	0.0250	-0.0058	
Deflated assets	90,705.9	19,856.1	177,406.0	29,514.3	87,380.2	37,882.2	116,802.7	27,696.2	***

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01 (Kruskal-Wallis test).
ACRATE is the percent of workers injured with respect to the firm's total workforce, *ROA* is the percent of return on assets, Asset turnover is the ratio of revenues to assets, *CHASSETURN* is the difference between asset turnover in a given year and in the previous year relative to asset turnover in the previous year (in per-one basis), and deflated assets is the value of firm's total assets held at the end of the accounting period (in hundred €) deflated with the Spanish consumer price index.

Table 3

Pearson correlations between independent variables

	ACRATE$_{t-1}$	*ACRATE*$_t$	*ROA*$_t$	*CHASSETURN*$_t$	*BUILDING*	*METAL*	*LNASSET*$_{t-1}$
ACRATE$_{t-1}$	1						
ACRATE$_t$	0.4704***	1					
ROA$_t$	-0.041	0.0002	1				
CHASSETURN$_t$	-0.0075	0.0543	0.0452**	1			
BUILDING	0.0643**	0.0799***	0.0521**	0.0295	1		
METAL	0.0263	0.0169	0.0677***	-0.0595**	-0.5223***	1	
LNASSET$_{t-1}$	-0.2405***	-0.2518***	-0.1029***	0.0302	-0.1922***	0.1274***	1

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01
ACRATE is the percent of workers injured with respect to the firm's total workforce; *ROA* is the percent of return on assets; *CHASSETURN* is the difference between asset turnover in a given year and in the previous year relative to asset turnover in the previous year (in per-one basis); *BUILDING* and *METAL* are dummy variables indicating sector characteristics; and *LNASSET* is the value of firm's total assets held (in hundred €) deflated with the Spanish consumer price index.

Table 4

Median values of labor accidents for different percentiles of return on assets and abnormal return on assets (percent of workers injured with respect to the firm's total workforce)

	1st. perc.	2nd. perc.	3rd. perc.	4th. perc.	4rt. vs. 1st.	below median	above median	above vs below
Panel A: Labor accidents for different percentiles of return on assets in the same year								
Building	11.11111	10	7.692307	5.961265	***	11.11111	6.896552	***
Retail & household repairs	7.594937	5.256571	5.633803	5.063291	**	6.25	5.274751	
Metallurgical except machinery	6.122449	5.205108	7.236155	4		5.263158	5.357143	
Whole sample (all sectors)	8	5.961265	6.896552	5.263158	**	7.142857	5.961265	
Panel B: Labor accidents for different percentiles of abnormal return on assets in the same year								
Building	11.11111	8.333333	8.695652	6.024096	*	10.34483	7.692307	*
Retail & household repairs	8.490566	5.263158	6.077771	5.063291	***	6.776094	5.263158	
Metallurgical except machinery	6.266353	3.704974	7.889822	3.125		4.460322	5.555555	
Whole sample (all sectors)	8.5556	5.926251	7.430263	5.263158	**	6.451613	7.142857	
Panel C: Labor accidents in previous year for different percentiles of return on assets								
Building	11.11111	10.86957	8.391608	3.722677	***	11.11111	6.594203	***
Retail & household repairs	9.245014	4.761905	6.603812	4.819977	***	6.802118	4.944128	
Metallurgical except machinery	2.812795	4.290876	7.377345	5.882353		3.145358	6.818182	
Whole sample (all sectors)	8.054054	6.25	7.54717	4.819977	***	7.23169	6.060606	
Panel D: Labor accidents in previous year for different percentiles of abnormal return on assets								
Building	10.52632	11.11111	7.692307	4.166667	**	11.11111	6.594203	***
Retail & household repairs	9.160839	4.819977	4.737516	4.918363	***	7.124728	4.903813	*
Metallurgical except machinery	2.439024	2.380952	8.064516	4		2.424332	6.634897	*
Whole sample (all sectors)	7.750586	6.557377	6.896552	4.573171	**	7.23169	5.882353	

Significance levels: * $p<0.1$, ** $p<0.05$ and *** $p<0.01$ (with t-tests, and Mann-Witney when there are significant differences in variances). Financial performance ranked from low (1st percentile) to high (4th percentile).

Table 5

Incidence of labor accident rate and control variables on return on assets (ROA_t) in the same year. Parameter estimates with panel robust estimations.

Variables	(A) Random effects		(B) Fixed effects		(C) Newey		(D) GEE		(E) Random effects	
ACRATE$_t$	-0.0207392		0.0121013		-0.0207392		-0.0215746		-0.0215249	
ROA$_{t-1}$	0.5089918	***	-0.0048074		0.5089918	***	0.6202891	***	0.5092561	***
CHASSETURN$_t$	3.658144	**	2.276225	*	3.658144	***	4.066752	***	3.518995	**
BUILDING	1.879864	***	(omitted)		1.879864	***	1.695971	***	1.907885	***
METAL	0.9797245		(omitted)		0.9797245	*	0.666774		0.9959573	
*YEAR*2000									-1.309454	**
*YEAR*2001									-2.545163	***
*YEAR*2002									-0.9572519	
*YEAR*2003									-1.976846	***
intercept	2.556386	***	7.13543	***	2.556386	***	1.898082	***	3.913355	***
Goodness-of-fit	Wald chi2(5) = 129.25	***	F(3, 291) = 2.21	*	F(5, 1211) = 14.34	***	Wald chi2(5) = 221.91	***	Wald chi2(9) = 282.00	***
R-squared overall	0.2666		0.0002						0.2758	
Nº of observations	1,217.00		1,217.00		1,217.00		1,217.00		1,217.00	

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01

ACRATE is the percent of workers injured with respect to the firm's total workforce; *ROA* is the percent of return on assets; *CHASSETURN* is the difference between asset turnover in a given year and in the previous year relative to asset turnover in the previous year (in per-one basis); and *BUILDING*, *METAL* and *YEAR* are dummy variables indicating sector and period characteristics.

Table 6
Incidence of labor accident rate and control variables on one-year-ahead return on assets (ROA_{t+1}). Parameter estimates with panel robust estimations.

Variables	(A) Random effects		(B) Fixed effects		(C) Newey		(D) GEE		(E) Random effects	
ACRATE$_t$	-0.0335494	**	-0.0313531		-0.0335494	**	-0.0303982	**	-0.0317884	**
ROA$_t$	0.5078374	***	-0.004587		0.5078374	***	0.6145785	***	0.5081587	***
CHASSETURN$_{t+1}$	3.591106	**	2.224848	*	3.591106	***	3.987944	**	3.555817	**
BUILDING	1.937567	***	(omitted)		1.937567	***	1.748679	***	1.973148	***
METAL	1.022341		(omitted)		1.022341	*	0.7118476	**	1.034836	*
*YEAR*1998									1.79731	***
*YEAR*1999									0.5710026	*
*YEAR*2000									-0.5795109	
*YEAR*2001									0.9311647	
intercept	2.673717	***	7.599461	***	2.673717	***	2.006379	***	2.072614	***
Goodness-of-fit	Wald chi2(5) = 141.64	***	F(3, 291) = 3.22	**	F(5, 1211) = 15.39	***	Wald chi2(5) = 230.47	***	Wald chi2(9) = 286.00	***
R-squared overall	0.2681		0.0012						0.2761	
Nº of observations	1,217		1,217		1,217		1,217		1,217	

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01
ACRATE is the percent of workers injured with respect to the firm's total workforce; ROA is the percent of return on assets; *CHASSETURN* is the difference between asset turnover in a given year and in the previous year relative to asset turnover in the previous year (in per-one basis); and *BUILDING*, *METAL* and *YEAR* are dummy variables indicating sector and period characteristics.

Table 7
Incidence of labor accident rate and control variables on abnormal return on assets ($ABNROA_t$) in the same year. Parameter estimates with panel robust estimations.

Variables	(A) Random effects		(B) Fixed effects		(C) Newey		(D) GEE		(E) Random effects	
ACRATE$_t$	-0.0110401		0.0110977		-0.0357456	*	-0.0133773		-0.0107947	
LNASSET$_{t-1}$	-0.6936211	*	-2.706554	**	-0.7433602	**	-0.6856209	*	-0.5499598	
BUILDING	2.574576	**	(omitted)		2.896722	***	2.609434	***	2.717718	***
METAL	2.362443	**	(omitted)		2.745982	***	2.399271	**	2.40015	**
*YEAR*2000									-0.8494519	**
*YEAR*2001									-2.537807	***
*YEAR*2002									-1.741311	***
*YEAR*2003									-2.488507	***
intercept	5.569013		27.98508	**	6.183117	**	5.493406		5.50634	
Goodness-of-fit	Wald chi2(4) = 8.18	*	F(2, 286) = 2.93	*	F(4, 1154) = 5.38	***	Wald chi2(4) = 8.28	*	Wald chi2(8) = 20.81	***
R-squared overall	0.0311		0.0108						0.0398	
Nº of observations	1,159		1,159		1,159		1,159		1,159	

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01
ACRATE is the percent of workers injured with respect to the firm's total workforce; ROA is the percent of return on assets; *LNASSET* is the value of firm's total assets held (in hundred €) deflated with the Spanish consumer price index; and *BUILDING*, *METAL* and *YEAR* are dummy variables indicating sector and period characteristics.

Table 8
Incidence of labor accident rate and control variables on one-year-ahead abnormal return on assets ($ABNROA_{t+1}$). Parameter estimates with panel robust estimations.

Variables	(A) Random effects		(B) Fixed effects		(C) Newey		(D) GEE		(E) Random effects	
ACRATE$_t$	-0.0466398	**	-0.0355514		-0.0503127	**	-0.0471421	**	-0.0414286	**
LNASSET$_t$	-0.7703725	**	-2.645581	**	-0.7748796	***	-0.7599283	**	-0.620007	
BUILDING	2.635565	***	(omitted)		2.93372	***	2.66648	***	2.766009	***
METAL	2.446454	**	(omitted)		2.785925	***	2.478388	**	2.470446	**
*YEAR*2000									-0.8555706	*
*YEAR*2001									-2.504343	***
*YEAR*2002									-1.714359	***
Y*EAR*2003									-2.422581	***
intercept	6.695355	*	27.8451	**	6.641055	**	6.577671	*	6.495853	*
Goodness-of-fit	Wald chi2(4) = 11.34	**	F(2,286) = 3.03	**	F(4, 1154) = 5.89	***	Wald chi2(4) = 11.57	**	Wald chi2(8) = 22.17	***
R-squared overall	0.0345		0.0125						0.0426	
Nº of observations	1,159		1,159		1,159		1,159		1,159	

Significance levels: * p<0.1, ** p<0.05 and *** p<0.01
ACRATE is the percent of workers injured with respect to the firm's total workforce; ROA is the percent of return on assets; *LNASSET* is the value of firm's total assets held (in hundred €) deflated with the Spanish consumer price index; and *BUILDING*, *METAL* and *YEAR* are dummy variables indicating sector and period characteristics.