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Linking occupational accidents and construction firm survival

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ABSTRACT

Introduction: This paper examines the relationships between the reported accidents of workers in construction firms and the probability of those firms' survival. *Method:* Between 2004 and 2010, a sample of 344 Spanish construction firms from Majorca were selected. The study built panel data with the reported official accidents from the Labor Authority records and the firm survival or mortality from the Bureau van Dijḱs Iberian Balance Sheet Analysis System database. The hypothesis is that a higher number of accidents directly affects the probability of the company surviving in the sector. By using a probit regression model with panel data, the relationship between these two variables were explored to test the hypothesis. *Results:* The study found evidence that an increment in accidents decreases the probability of the company continuing to operate, or worse, going bankrupt. The results can be useful to highlight the importance of defining policies to control those accidents effectively, since this may be a key factor in the sustainability, competitiveness, and growth of the construction sector for the economy of a region.

1. Introduction and literature review

The construction sector is widely known for its poor performance in health and safety (H&S) matters. Data have shown that construction is one of the sectors with the highest accident rate (Ahn et al., 2022; Jin et al., 2019). In 2018, more than 2.78 million people died due to an accident or disease at work (ILO, 2019).

On the one hand, there is a broad consensus on the need for investing in H&S in organizations. The high cost of the failure in prevention investment was expressed in the XXI World Congress of Health and Safety at Work, when the Director of the International Labour Organization stated that "The economic impact of failing to invest in worker safety and health is nearly equal to the combined gross domestic product of the 130 poorest countries in the world" (Ryder, 2017, 3:55). The evidence has shown that a higher investment in prevention reduces occupational accidents by diminishing the level of risk (Forteza, Carretero-Gómez, & Sesé, 2017; Sousa et al., 2021). However, it is not known to what extent the relationship between prevention investment and accidents can affect the company's performance or its eventual survival. Many studies have pointed out that the construction sector is characterized by a high number of small companies that operate with few resources and poor safety management systems (Segarra et al., 2017; Wang et al., 2019). The evidence shows that these kinds of companies tend to ignore any safety costs as well as the final impact that these have on their economic results, and ultimately on their survival (Cagno et al., 2011). Therefore, it seems relevant to study to what extent the survival of these companies can be explained by their workers' accidents, due to their H&S management. A recent study claims that a better financial performance can be obtained by increasing the occupational safety measures (Sousa et al., 2021). Going a step further, this study aimed to examine whether fewer accidents decrease the probability of a firm failure. This evidence can be a strong argument to persuade practitioners to view effective H&S measures not just as a cost, but as an investment with important returns, such as the survival of a firm.

It seems that the impact of H&S on the companies' costs and incomes has been analyzed separately. On the one hand, there is literature examining the economic impact of H&S in the workplace, mostly aimed at estimating its total cost, which is composed of prevention costs and accident costs (Chen et al., 2021; Feng et al., 2015; Ibarrondo-Dávila et al., 2015). However, assessing the safety costs is a difficult task, as the current assessment tools are not able to include all their components (Ahn et al., 2022). One of the drawbacks regarding the estimate of the total costs of occupational accidents is the lack of visibility of the H&S costs, since more than 90% are not considered in the accounting system of the firm (Ibarrondo-Dávila et al., 2015; Sousa et al., 2015).

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Therefore, those are hidden costs that impact the business without previous notice, and they are only perceived as relevant when something unexpected happens. Even though there is general agreement about the importance of investing in H&S, in terms of social welfare, the evaluation of safety costs at firm level is still an open research question (Cagno et al., 2013; Toutounchian et al., 2018).

Furthermore, some studies have found evidence for the link between lower accidents and higher earnings in firms and a higher GDP in countries (Li et al., 2021). According to ILO (2019), work accidents represent 4% of the world's GDP and there is a positive correlation between several economic indicators and the reduction of workplace accidents.

Some authors have also claimed theoretically that H&S is a relevant factor that affects the managers' success as well as the economic results of the firms and, consequently, their competitive advantage (Rechenthin, 2004; Teo & Ling, 2006). Understanding how the economic evaluation of H&S performance in a firm is related to the company results is a relatively recent issue in the literature, although it is a research priority (Cagno et al., 2013). Some other authors have suggested that H&S at work is mainly seen more as a blind accomplishment of rules and regulations than a managerial issue with an economic return for the company (Fernández-Muñiz et al., 2016; Njå & Fjelltun, 2010). Due to the apparent practitioner disregard of the benefits of H&S investment, it seems relevant to find out how H&S costs affect the economic performance of a company by connecting the "safety" argument with the "productivity" goal (Biddle et al., 2005; Sousa et al., 2021). This study offers a step in this direction.

In a recent literature review on the relationship between safety investment and financial performance, Sousa et al. (2021) concluded that there is a positive relationship between promoting occupational safety measures and the firms' financial benefits. This benefit is also stated in the International Social Security Association report, which highlights a positive economic return ratio of 2.2 of the company's occupational safety and health investment (ISSA, 2011, p. 7).

Summing up, as Rechenthin (2004) concluded, effective safety management can help construction companies to achieve a sustainable competitive advantage through good safety performance. Also, there is general agreement in the literature that bad performance in H&S issues, such as a high number of accidents per worker, can generate such significant costs that all benefits of the firm may vanish, thus threatening its financial stability and even its survival in the mid or long-term (Kim & Park, 2021; Sousa et al., 2021).

Based on the previous discussions and in line with the theoretical insights from Rechenthin (2004) and Teo and Ling (2006), this study proposes to empirically test whether a high number of accidents per worker is associated with a higher mortality in construction companies. Thus, the hypothesis to be tested is the following:

H1. A higher number of accidents per worker of a construction company is associated with a higher probability of failure of that company.

Following, the study describes the most relevant aspects of this empirical strategy and methodology. Then, the authors report the results of the estimation strategies and discuss them in detail. Finally, the paper presents the conclusions and final remarks.

2. Methodology

2.1. Model specification

The hypothesis is aimed at modeling the probability of a company's failure. Table 1 summarizes the names, codes, and definitions of all the dependent and independent variables considered in this paper. Probit and logistic regressions are adequate statistical techniques for modeling the impact of a set of independent variables on a dependent variable that takes the values of 0 and 1 (Long, 1997). Since probit and logit yield similar results, the election of the method to use depends on the researcher's preference, and one of the interesting aspects of these techniques is that predicted probabilities can be computed based on the estimation results for given values of the independent variables (UCLA: Statistical Consulting Group, 2017). Model specifications for testing the hypothesis are as follows:

Model specification:

$$STATE_{i,t} = \alpha + \beta_1 \cdot ACCIDENTSW_{i,t-1} + \beta_2 \cdot. ROA_{i,t} + \beta_3 \cdot SALESW_{i,t} + \beta_4 \cdot ASSETURN_{\ i,t} + _{i,t} \text{ (model 1)}.$$

$$STATE02_{i,t} = \alpha + \beta_1 \cdot ACCIDENTSW_{i,t-1} + \beta_2 \cdot ROA_{i,t} + \beta_3 \cdot SALESW_{i,t} + \beta_4 \cdot ASSETURN_{i,t} + _{i,t} \text{ (model 2)}.$$

The dependent variable in model 1, *STATE*, is a discrete variable with three levels, adding to the values of *STATE_0_2* another intermediate situation in which companies may fall between going bankrupt and running with normal activity. This intermediate situation is called the state of "concurso de acreedores" according to Spanish regulations. It is the legal situation of a business with serious problems of continuity in which a new CEO is appointed by the Courts and has to either relaunch the firm or dissolve and wind it up. Depending on how critical the situation is for the company, it could continue with its committed activities under this state. In this situation, the firm cannot be classified clearly as a failure or

Table 1
Codes and definitions of variables regarding occupational accidents, construction firm survival and economic indicators.

Variable	Code	Values/Description
Event of firm survival	*STATE*	0 Firm went bankrupt 1 Firm went in an insolvency procedure[a] 2 Firm is up and running
	STATE_0_2	0 Firm went bankrupt 1 Firm is up and running
Firm accidents per worker	*ACCIDENTS_W*	Total number of accidents divided by total number of workers
Return on assets	*ROA*	Measure of firm profitability calculated as the net income of the firm divided by the average total assets of the firm
Sales volume per worker	*SALES_W*	Indicator of firm activity which is computed as the revenue obtained by the selling of products or services divided by the total number of workers of the firm
Asset turnover	*ASSETURN*	Proxy of organizational efficiency which is equal to the firm sales volume divided by its total assets

[a] "Insolvency procedure" is the translation of the firm state "*concurso de acreedores*".

a survival case. Therefore, this study proposes model 1 to test for any different impact that accidents would have on each of these three operation states.

The dependent variable in model 2 is dichotomous. The variable *STATE_0_2* takes the value of 0 if the company went bankrupt and 1 if it is up and running, both at the end of the period.

2.2. Independent variables

The accidents per worker (*ACCIDENTS_W* in models 1 and 2) is defined as the total number of accidents in a company in one particular year divided by the total number of employees from that firm in that year. Obviously, the authors recognize that the occurrence of either an accident or the company failure can be affected and explained by many other factors beyond the H&S conditions. For this reason, in the two models, some control variables are added that are usually considered in the empirical business literature to account for financial and operational/managerial performance (Fairfield & Yohn, 2001; Tan & Wang, 2010). One of these variables is the return on assets (ROA), which is an index of the firm's financial performance. *ROA* in this study's models is computed as the net income of the firm divided by the average total assets of that firm, and it explains how profitable the set of assets of a company is for generating revenues. Another variable usually considered in empirical studies to measure the volume of activity is the revenue obtained from the selling of products or services. In this study's models, *SALES_W* is included, which is the sales volume divided by the total number of firms' workers. Additionally, the variable asset turnover (firm sales volume divided by its total assets) is frequently used as a proxy of organizational efficiency, therefore this variable (*ASSETURN* in our expressions) is introduced in the same way as in Argilés-Bosch et al. (2014, 2020) and Forteza et al. (2017).

2.3. Sample and data collection

This study sampled 344 construction companies from Majorca (Balearic Islands). This is a random subsample extracted from a total sample composed of the 627 construction companies that registered 957 work site opening notifications (this refers to a compulsory notification by which all contractors have to notify the Labor Authority each time that they are going to start a new project) from the Labor Authority database. Therefore, many of these companies and sites were operative. From the list of companies registered, the authors randomly selected 1 out of 2 to 5 opening notifications, depending on the notification level in each particular year. Once the sample of the 957 sites was built, the authors randomly selected the final sample using a computer algorithm selection (subsample error = 3.55 % at 95% of statistical confidence). This database was crossed with the reported accidents of construction companies database from the Balearic Islands Labor Authority and with the Bureau van Dijk's SABI database, which contains financial and economic data of a number of companies.

2.4. Methodological issues

It is plausible to assume that the observations of a variable for a firm have certain inter-dependence across time (i.e., for a firm the observed value of a variable in period t will be related to the observed value of that variable in period $t + 1$). In other words, the variables might be generated under a particular time process. This would be related to the non-stationarity of the variables, and it opens the possibility of co-integration between them. With long panels and linear models, a test for co-integration must be performed to check if the variables have a stable relationship in the long term. Without testing for non-stationarity and co-integration, the estimation results can capture common trends if the variables are co-integrated. This can be an issue when researchers want to discuss some causal relationship between variables.

In order to deal with the possible interdependence of observations of a variable across time for the same firm, the authors propose to estimate the models by calculating the standard errors forming clusters, where those clusters are the observations of each firm; due to the fact that this panel covers a short time span (2004–2010), it is unbalanced and these models are non-linear. For robustness checks, the authors also proposed to perform robust estimations for all models.

Another methodological issue is related to causality. With the current data set, the authors cannot perform quasi-experimental methods to make causal inferences such as, for example, difference in differences or instrumental variable analysis. Consequently, the empirical method is developed upon hypotheses of associations between variables instead of cause-and-effect theories. In this hypothesis, the authors are interested in analyzing the relationship between the accidents per worker and the probability of a firm failure. It is quite plausible that the impact of accidents on the ability of a firm to survive takes a certain time to occur. This delayed impact would be consistent with recent evidence on the relationship between the accident and the firm economic performance found by Argilés-Bosch et al. (2014, 2020). These authors found a significant negative effect of occupational accidents on the firm profitability, with a greater effect of accidents on the firm performance after one year. Based on this finding, the probability that a company survives in period t depends on the accidents reported in period $t\text{-}1$. Despite this specification, this study takes any causality interpretations very cautiously.

Finally, in all this study's estimated models, the authors added control variables for specific time effects using dummies for years as is usual in similar studies.

3. Results and discussion

Table 2 reports the frequency of observations in the sample for each level of the dependent variables, and Table 3 shows the sample descriptive statistics for the variables of these models.

Table 4 reports the Pearson correlation matrix for relevant variables of these models. As can be observed, the discrete dependent variable in model 1 (*STATE*) shows significant correlations with most of the control variables. The variable *STATE_0_2* is not included in the correlation matrix because it is a subsample of the variable *STATE*. However, for the hypothesized effects, the event of survival (*STATE*) does not show a significant correlation

Table 2
Frequencies of dependent variables: Construction firm survival (STATE and STATE 0_2).

Variable: Event of firm survival (*STATE*) (Discrete variable)	**Freq.**[a]	**Percent**	**Cum.**
0 Firm went bankrupt	759	33.85	33.85
1 Firm went in an insolvency procedure[b]	167	7.45	41.30
2 Firm is up and running	1,316	58.70	100.00
Total	2,242	100	
Variable: Event of firm survival (*STATE_0_2*) (Dichotomous variable)			
0 Firm went bankrupt	759	36.58	36.58
1 Firm is up and running	1,316	63.42	100.00
Total	2,075	100	

[a] For a given firm it can take one value per year from 2004 to 2010. It is an unbalanced panel.
[b] "Insolvency procedure" is the translation of the firm state "*concurso de acreedores*".

Table 3
Summary statistics of variables regarding occupational accidents, construction firm survival and economic indicators.

Variable	N	Mean	Std. Dev.	Min	Max
ACCIDENTS_W	2242	0.11	0.20	0	2.67
ROA	1734	−0.01	23.95	−429.19	68.19
SALES_W	1551	183.36	471.93	0.77	8291.01
ASSETURN	1662	4.27	116.23	0.00	4739.75

Note: *ACCIDENTS_W* is the total number of accidents divided by total number of workers; *ROA* is the percent of return on assets; *SALES_W* is the revenue obtained by the selling of products or service divided by the total number of workers of the firm; *ASSETURN* is the firm sales volume divided by its total assets.

Table 4
Pearson correlations of variables regarding occupational accidents, construction firm survival and economic indicators.

	STATE	***ACCIDENTS_W***	***ROA***	***SALES_W***	***ASSETURN***
STATE	1				
ACCIDENTS_W	0.03	1			
ROA	0.11***	0.07***	1		
SALES_W	−0.01	−0.05*	0.06**	1	
ASSETURN	−0.04*	−0.01	0.05*	0.00	1

*Significance level: $p < 0.1$; **Significance level: $p < 0.05$; ***Significance level: $p < 0.01$.
Note: *STATE* is the event of firm survival; *ACCIDENTS_W* is the total number of accidents divided by total number of workers; *ROA* is the percent of return on assets; *SALES_W* is the revenue obtained by the selling of products or service divided by the total number of workers of the firm; *ASSETURN* is the firm sales volume divided by its total assets.

with the accident per worker (*ACCIDENTS_W*). According to the significant correlations, having an accident in a company is positively correlated with the size and volume of the business. Regarding the firm survival event, which is measured by *STATE*, the significant correlations also suggest that bigger and more profitable businesses with less asset turnover are associated with fewer failure events. Even though the correlation between firm survival and the accident per worker is low and not significant, the sign for this relationship is positive, suggesting a pairwise behavior against the hypothesis.

Several appropriate empirical strategies were used for testing the hypothesis with the data set. For model 1, ordered probit regression method was used to fit regression models with discrete dependent variables (*STATE*). Finally, probit regressions (pooled) were used for model 2 as there was a binary dependent variable (*STATE_0_2*). As explained above, in models 1 and 2 the study regressed the corresponding dependent variable of the event of the firm survival on the independent variable "accident per worker" with one period lag, including other control variables. Models 1 and 2 cannot fit as panel data (random effects), as the with-in variance in the dependent variable for most cases in the sample is low. As mentioned above, due to the plausible interdependence that can exist between observations of a variable for a given firm across time, the models were fit specifying that the standard errors allow for intragroup correlation, considering each firm as an independent cluster. All the results in Table 5 follow that cluster estimation procedure, with the exception of the results reported in columns (2a) and (4b) of Table 5, where the Huber-White robust standard errors estimations were used to control for heteroskedasticity. To detect multicollinearity, after the regression analysis, the authors performed the mean variance inflation factor (vif) analysis of variables, obtaining 1.40 for the models, which is lower than the tolerable limit of 10 (Wooldridge, 2009).

In addition, dummies for the years from 2005 through 2010 were included, considering that 2004 is the default year. STATA 14.2. was used to fit the models.

The hypothesis of this paper is to analyze whether H&S results affect the survival of the construction firm. The study proposes to test this hypothesis by using two alternative specifications, model 1 and 2. In model 1, the dependent variable *STATE* can take three values (0 = when the firm went bankrupt; 1 = when it followed an insolvency procedure; and 2 = when the firm stays up and running). Due to the characteristics of this variable, the appropriate method that fits this model is an ordered probit regression. Model 2 is fit with the same data sample but excluding the 25 construction firms that went through an insolvency procedure during the analyzed period, that is, the dependent variable (*STATE_0_2*) takes two values (0 when the firm went bankrupt; and 1 when the firm is alive). The dependent variable of interest is *ACCIDENTS_W LAGGED*, which is the firm accident per worker of the previous year.

Table 5 shows the results of estimations after fitting model 1 for *STATE* and model 2 for *STATE_0_2*. Columns (1) and (3) display the baseline models, and columns (2) and (4) show the full models estimated using clusters. Finally, columns (2a) and (4a) include the full model with standard Huber-Wright errors robust estimations. As it can be seen, Table 5 shows similar results for both models supporting the hypothesis and confirming the predicted effect that more accidents per worker harm the probability of a firm to survive one year later.

The overall evaluation of the models is quite good according to the confirmation of the goodness of fit of all the specifications. Table 5 reports the Likelihood-ratio tests, which are all significant at the confidence level of 99%. Both baseline specifications showed in column (1) and column (3) of Table 5 yield significant parameter estimates for *ROA* and significant coefficients for some years of the panel. Therefore, these results support the expected positive impact of profitability (measured by *ROA*) on survival. Although the fitted models give small estimated parameters of the *ROA* variable (0.01) (see Table 5 columns (2) and (4) respectively), the effects are strongly significant with *p-values* < 0.01. The variables sales per worker (*SALES_W*) and asset turnover (*ASSETURN*) have a negative estimated effect on the ability of a firm to survive, although their parameters are not significant. In the case of sales per worker (*SALES_W*) that are usually used as a proxy of firm activity, the coefficient in model 1 is −0.35e-04 (see column (1) in Table 5) with a *p-value* of 0.761. For model 2 the *SALES_W* coefficient has an estimated value of −0.41e-04 with a *p-value* of 0.719 (see column (3) in Table 5). Concerning *ASSETURN*, usually considered as a proxy of firm efficiency, the coefficient has a non-significant value of −0.04 (model 1, column (1) in Table 5), and a similar result is obtained in model 2 (column (4) in Table 5). There is not a clear explanation for this last counterintuitive result. One possible explanation is that the negative sign of this coefficient might show certain consequences of some years of the economic

Table 5
Model 1 and model 2 – Hypothesis 1: Effect of the accidents per worker of a firm (*ACCIDENTS_W*) on the event of construction firm survival (*STATE* and *STATE_0_2*).

Variables	Model 1 Dependent variable = *STATE* (pooled ordered probit regression)			Model 2 Dependent variable = *STATE_0_2* (pooled probit regression)		
	(1)	**(2)**[a]	**(2a)**[b]	**(3)**	**(4)**[a]	**(4a)**[b]
ACCIDENTS_W LAGGED		**−0.25****	−0.25**		**−0.26**	**−0.26****
ROA	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
SALES_W	−0.35e-04	−0.41e-04	−0.41e-04	−0.41e-04	−0.48e-04	−0.48e-04
ASSETURN	−0.04	−0.03	−0.03	−0.04	−0.02	−0.02
YEAR						
2005	−0.04			−0.04		
2006	0.01	−0.04	−0.04	0.01	−0.06	−0.06
2007	0.13**	0.11*	0.11	0.14*	0.12	0.12
2008	0.34***	0.27***	0.27**	0.38***	0.30***	0.30**
2009	0.50***	0.44***	0.44***	0.56***	0.50***	0.50***
2010	0.67***	0.63***	0.63***	0.71***	0.67***	0.67***
/cut1	−0.56	−0.63	−0.64			
/cut2	−0.33	−0.41	−0.41			
_cons				0.48***	0.55***	0.55***
Goodness of fit	LR $Chi^2(9)$ = 68.55***	LR $Chi^2(9)$ = 70.27***	LR $Chi^2(9)$ = 55.41***	LR $Chi^2(9)$ = 63.00***	LR $Chi^2(9)$ = 65.89***	LR $Chi^2(9)$ = 53.27***
Pseudo R-squared	0.03	0.04	0.03	0.05	0.06	0.06
No. of observ.	1550	1269	1550	1437	1178	1178

*Significance level: $p < 0.1$; **Significance level: $p < 0.05$; ***Significance level: $p < 0.01$.
[a] Model with cluster estimation.
[b] Model with standard Huber Wright robust errors estimations.
Note 1: *STATE* is the event of firm survival (three level variable); *STATE_0_2* is the event of firm survival (binary variable); *ACCIDENTS_W LAGGED* is the total number of accidents divided by total number of workers one year before; *ROA* is the percent of return on assets; *SALES_W* is the revenue obtained by the selling of products or service divided by the total number of workers of the firm; *ASSETURN* is the firm sales volume divided by its total assets; *YEAR* is the dummies for years.

recession suffered during the period analyzed in this paper. This recession was especially harmful for the construction industry, where many firms liquidated their assets. Regarding year dummies, this study found significant effects in the second half of the panel, signaling the existence of such time contextual circumstances. Those effects are more clearly detected from 2008 on, and they increasingly expand in time, which is probably related to the global financial crisis that presumably had an impact on the survival of the firms during that period.

Full model 1 (see columns (2) and (2a) in Table 5) specifies that the effect of the accident per worker lagged one year (*ACCIDENTS_W LAGGED*) and other control variables over the three levels variable of survival (*STATE*). The marginal effect of the accident per worker on the probability of survival for a firm is negative, −0.25, and significant at 90% confidence using cluster estimation (column (2)) or at 95% confidence with robust estimations (column (2a)).

In full model 2 the authors limit the analysis to both alive and bankrupted firms, thus excluding those firms in the intermediate state of insolvency procedure (see columns (4) and (4a) in Table 5). By doing so, the authors regress the binary variable of survival (*STATE_0_2*) on the same set of independent variables used in model 1. As it can be seen, similar results are found in both models. For cluster estimation (column (4)), the estimated marginal effect of the accident per worker on the probability of surviving is negative, −0.26, but not significant (*p-value* = 0.122). However, by fitting the same model with the Huber Wright robust standard errors (column (4a) in Table 5), the coefficient takes the same magnitude, −0.26, but it is significant at an alpha of 0.05 (*p-value* = 0.040).

In short, these results support the hypothesis, and the evidence is stronger for robust estimation methods. It is concluded that, when a construction firm starts to suffer an increase of accidents per worker one year, it can be predicted that this increment will be associated with a higher probability of struggling to be operational the following year. For the company, this would mean falling into an insolvency procedure, or even worse, going bankrupt. Even though this analyses does not allow a claim for causality, it is assumed that the effect of a high number of accidents per worker may have an impact on the probability of surviving the following year. It is reasonable to consider that the transfer of the effects of accidents per worker on the firm's performance (and possibly its survival) will happen over a period of time. This interval can be associated with the time needed to conduct appropriate accident investigations and analyze reports for identifying the possible causes, errors, and responsibilities. As can be seen, the literature shows empirical evidence of a one year lag in the effect of accidents per worker on the firm's economic performance (Argilés-Bosch et al. 2014, 2020). Notwithstanding, this study checked the existence of a relationship between survival and the accidents per worker in the same year, and found similar results to those in Table 5 (these results are not reported in this paper for the sake of length; they are available upon request from the authors).

These results are also in line with many of the previous theoretical and empirical studies analyzing the economic effects of H&S, which have been reviewed above. It was found that the negative impact of a high number of accidents per worker on the probability of a company's survival reinforces Rechenthin's (2004) conclusion that effective safety programs have a relevant role in constructing a sustainable competitive advantage for companies. The evidence in favor of hypothesis 1 also provides empirical insights related to some of the propositions in Chen et al. (2021). For example, these authors proposed that the cost/risk perception ratio should be considered when studying and framing issues of safety economics. Since construction is characterized as a high-risk industry (Rechenthin, 2004, p. 307), one can assume that the managers of construction firms might be less risk-averse compared to other colleagues of less risk industries. Chen et al. (2021) proposed that risk-tolerant managers may underestimate the financial consequences of unlikely accidents and neglect the risk. It is expected that when the evidence that the consequences of underestimated accidents can eventually end with the failure of the company is given to this kind of person, they will see clearer incentives to invest in safety barriers or implement more effective safety measures. As Argilés-Bosch et al. (2014, 2020) found, labor accidents have a negative impact on financial performance, and therefore, their results are also consistent with those in this study. They studied a large variety of industries, not all of them with the same level of industry specific risk, nor with the same prevalent accident rate. Due to the high number of accidents that is prevalent in the construction sector, Argilés-Bosch et al. (2014, 2020) results imply that the negative impact on financial performance (i.e., in ROA) can be greater in this sector than in other safer sectors, and therefore more insolvency situations can be generated in the construction sector. It will be interesting to contrast this with crossed-industry studies to analyze the probability of company survival as a function of the occupational accidents of companies. Under similar arguments, the authors also find these results compatible with those from Forteza et al. (2017). Due to the high accidents per worker in construction companies, more companies will fall in the decreasing part of the quadratic function of ROA when explained by the number of accidents, and it is well known that less profitable companies are eventually more likely to fail.

The authors believe the evidence presented in this research represents a relevant contribution to the literature devoted to highlighting the relevance of effective and efficient H&S management. These results reinforce the message that investing in effective H&S measures reduces accidents per worker and, finally, contributes to the sustainability of construction companies. Therefore, managers can find from this study a solid argument to defend that investing in H&S measures to reduce the number of accidents at work is an attractive decision, if not a vital one.

4. Conclusions and final remarks

This paper analyzed whether the accidents per worker in a construction company is a determining factor in its survival. Although this hypothesis can be generalized to any other economic activity, the construction sector is an interesting setting for testing it, as it is one of the sectors with the highest number of accidents per worker, and consequently with economic and social losses. As was reviewed, there are not many empirical studies that prove how having a safer firm is a good alternative for helping it build a competitive advantage. Obviously, closing up the business because of financial insolvency is a consequence of losing the battle for competitiveness.

The authors believe this research provides sound empirical evidence of the potential strategic value of promoting, implementing, and maintaining effective H&S management that helps reduce accidents in an organization. A relevant sample of construction firms was built. Furthermore, the study rigorously applied appropriate methodologies for studying and testing the hypothesis.

The study did find significant evidence supporting that hypothesis. According to the results, it can be concluded that there is a significant effect of accidents per worker in a construction company on the probability of it failing as a business. When a construction firm that operates normally starts to suffer an increment in its occupational accidents, it can be predicted that its probability of struggling to continue operating (falling into an insolvency procedure, or worse, going bankrupt) will rise as well.

Future research can address some of the following topics to overcome the limitations of this research: (a) studying the process of a changing state from active to bankrupt by looking at individual cases; (b) introducing the organizational design variable as determinant for the probability of having accidents; (c) considering other periods outside the years of economic crisis (2008, 2009, etc.), as they may have a significant effect on the company failure, not because of H&S issues but due to low revenues or excessive debt. The authors hope these limitations will inspire future research that will focus on the connections between H&S performance and the economic results of construction firms.

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Declaration of interest statement

The authors declare that they have not any conflict of interest.

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