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Workplace safety events and firm performance

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Abstract

Purpose – The purpose of this paper is to address a deficiency in the literature by exploring the impact of negative workplace safety announcements on firm performance. The authors analyze the issue from a corporate social responsibility perspective and explore ways supply chain managers can contribute to improve firm performance through the development of safe working environments.
Design/methodology/approach – Utilizing a sample of 227 negative workplace safety announcements, this paper explores the implications of negative workplace safety announcements on the stock price of a firm using event study methodology.
Findings – The authors find that negative workplace announcements are associated with an abnormal decrease in shareholder value. Furthermore, the authors find evidence that negative workplace safety announcements have a more pronounced negative effect on firm value in the present environment than in any previous time period.
Practical implications – Operations managers need to play leading roles in ensuring safe working environments. The results provide the support needed to acquire the financial resources necessary to mitigate exposure to unsafe working conditions.
Originality/value – This study explores the impact of negative workplace safety announcements on a firm's stock performance. It is the first large-scale study to look at public announcements of workplace incidents and to explore the impact of such announcements in the context of time.

Keywords Risk management, Workforce, Sustainable production, Standards, Corporate social responsibility, Business performance, Triple bottom line, Liability, Workplace safety, Safety systems

Paper type Research paper

Introduction

Due to strict government regulations, consumer awareness, and market forces, business firms in the current environment cannot be strictly motivated by profit, they must be concerned with the natural environment and the society as well (Marshall *et al.*, 2015). That is, firms today need to actively manage a triple bottom line (Elkington, 1998), as opposed to only economic profit. Astute management of social equity and human capital necessitates that a firm ensure a safe and healthy working environment for its employees. In this manner, a firm can fulfill its obligation to society in general and its employees in particular.

Operations managers are increasingly concerned with workplace safety since it can have a significant impact on cost, delivery, and quality (Brown *et al.*, 2000). Beyond its impact on employee morale and internal operations, a negative workplace safety incident may also cause significant damage to a firm's reputation. Government agencies and financial markets have the potential to punish a company for a failure to provide safe working conditions. In addition, customer expectations regarding workplace safety have recently become an important issue in the context of social responsibility. It is therefore imperative that firms ensure workplace safety as part of their overall operational improvement program.

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Doing so, the firm can develop in a sustainable way – increasing profit while boosting workforce motivation and morale.

To ensure a safe and healthy work environment, the US Congress created the Occupational Safety and Health Administration (OSHA) in 1970. OSHA has the authority to create workplace safety standards and to penalize employers for safety incidents, noncompliance, or situations where inspectors find the workplace unsafe or hazardous for employees. Despite a limited enforcement budget and historically minimal penalties, compliance with OSHA regulations is typically high (Weil, 1996). To address situations where compliance is lacking, a handful of studies investigated firm performance subsequent to OSHA-levied sanctions (e.g. Davidson *et al.*, 1994; Fry and Lee, 1989; Viscusi, 1979). However, these studies use data that predate significant increases in the value of OSHA-levied fines in 1990; furthermore, they focus on the market's reaction to the OSHA-levied fine rather than the initial announcement of a negative workplace safety event. This is an important gap in the literature since OSHA's power to regulate, inspect, and penalize firms was significantly increased again in 2016 (Berzon, 2015; Hilton, 2016; Paranac, 2016).

This paper explores the impact of negative workplace safety announcements on firm performance with particular emphasis on the evolving view such incidents have on stock performance. We will analyze the issue from the perspective of corporate social responsibility (CSR) and explore ways supply chain managers can contribute to improve firm performance through the development of safe working environments. We begin with a review of the workplace safety literature. We then describe the methodology followed to collect and analyze the data. Results from our analysis are then presented and discussed. We conclude with a discussion of the results in the context of social responsibility and sustainable operations.

Literature review and hypotheses development

According to Despeisse *et al.* (2012), the concept of sustainable development tackles three encompassing dimensions: economic, social, and environmental. As an integral component of both SA8000 and ISO 26000, providing a safe and healthy working environment is now widely considered an integral part of the sustainable development (Chiarini and Vagnoni, 2017). Sureeyatanapas *et al.* (2015) considers health and safety to be a key indicator of firm social performance. However, in spite of the growing importance of workplace safety for the sustainability effort of a firm, the supply chain literature is quite sparse on this issue.

A majority of the workplace safety research has been conducted in psychology and human resources management. Brown (1996) was among the first to identify a workplace safety research gap in the operations and supply chain literature; however, this call for research remains largely unanswered in spite of the fact that workplace accidents can cause major supply chain disruptions (Cantor, 2008; Das *et al.*, 2008; de Koster *et al.*, 2011). The research that has been conducted on occupational safety from a supply chain perspective has focused on prevention of errors to reduce safety risks (e.g. de Koster *et al.*, 2011), ergonomic changes to worker tasks to reduce workplace injuries (e.g. Singh and Kumar, 2012), and the impact of management systems on workplace safety (e.g. Bamber *et al.*, 2000; Srinivasan *et al.*, 2016). However, this is beginning to change as researchers address workplace safety issues as part of a firm's CSR.

According to Sethi (1995), CSR refers to the activities of a corporation and the effect those activities have on the well-being of different social groups. CSR is an integration of social, environmental, and economic responsibilities (Carter and Rogers, 2008), and is receiving increased attention due to an awareness of its impact on financial performance. Similar to the shifting paradigms in quality control (Crosby, 1979; Deming, 1982; Juran, 1962) and environmental performance (Klassen and McLaughlin, 1996; Melnyk *et al.*, 2003; Porter, 1991), the perspective on workplace safety is moving away from a cost focus toward the potential to develop competitive advantage. Initially, shareholders perceived OSHA's creation as detrimental to profitability, assuming firms would incur additional costs to achieve compliance with OSHA regulations (Fry and Lee, 1989). Billger (2007) found durable manufacturing and mining industry stocks, two industries with substantial exposure to workplace injury risk, suffered significant market valuation declines immediately following OSHA's creation. This stands in contrast with an emerging perspective that sees similarities among safety, lean, and quality practices in creating improved productivity and flexibility (Gambatese *et al.*, 2017; Srinivasan *et al.*, 2016). Thus, the emphasis is moving from seeing OSHA compliance in terms of reducing negative workplace events to possibly enhancing competitive position whereby a safe workplace protects employees, reduces injuries and lost time boosting productivity and profitability (Balderson, 2016; Mitchell, 2003; Pashorina-Nichols, 2016; Srinivasan *et al.*, 2016).

Many workplace accidents, injuries, and negative health effects are directly related to the operations of a firm (Brown, 1996). This has significant implications for metrics of operational and financial performance. There were a total of 4,836 fatal workplace injuries in the USA during 2015 (Statistics, BoL, 2016b), along with approximately 2.9 million nonfatal injuries, a rate of 3.0 per 100 FTE employees (Statistics, BoL, 2016a). This resulted in the loss of more than 1.1 million work days, an average of eight lost days per incident (Statistics, BoL, 2016c). Each injury and resultant lost workday represents lost capacity and flexibility to the employer and lost wages, increased healthcare cost, and diminished quality of life to the worker. A study of 2007 data, with an injury/illness rate of 4.2 per 100 FTE, found medical and indirect costs associated with negative workplace incidents total approximately $250 billion; worker compensation covers less than 25 percent of these costs (Leigh, 2011).

Beyond the direct and indirect costs associated with workplace injuries, there is evidence that differing worker and management perspectives on workplace safety can have consequences on operational and competitive performance. Das *et al.* (2008) showed that performance is adversely affected if operations employees perceive workplace safety differently than managers. Additionally, negative workplace safety events are likely to affect public perception about the company. Safety incidents can damage a firm's reputation, imperil goodwill, and imped the firm's ability to perform well in the marketplace. While indirect, it appears likely that stock price may be adversely affected as well. Such adverse effects are increasingly likely as customers become more concerned about the conditions under which their purchased products are produced, including consideration for the environment and employee safety (Brown, 1996). Consequently, the company's stock price is likely to be adversely affected immediately following the occurrence of a negative safety incident. So, it is expected that:

H1. The announcement of negative workplace safety incident will adversely affect the stock price of the concerned firm.

Two factors seem to play important roles in increasing the significance of workplace safety on a firm's financial performance. The first is the increased visibility and perceived power of OSHA. Since its inception, OSHA has been in a central position regarding issues of workplace safety in the USA, conducting workplace inspections each year and issuing fines for unsafe conditions. Inspections raise OSHA's visibility and awareness of safety issues resulting in two favorable outcomes. First, increased rates of inspection result in greater rates of compliance (Gray and Jones, 1991). Second, Levine *et al.* (2012) found that inspected firms had a 9.4 percent decline in injuries and a 26 percent reduction in injury-related cost with no adverse impact on a firm's survival (e.g. no reduction in employment, sales, or credit rating of the firm).

During inspections, OSHA is authorized to issue citations if an inspector finds the workplace unsafe or hazardous for employees. OSHA-imposed penalties have historically been low relative to the cost of mitigating workplace hazards (Gray and Mendeloff, 2005). Initially, shareholders had little to be concerned about when a firm received an OSHA penalty due to the small size of penalties. From 1971 to 1975, the average penalty for a violation of OSHA regulation was only $25.68 (Viscusi, 1979). Since safety mitigation investment returns are slow to accrue and difficult to measure (Cohn and Wardlaw, 2016), it is unsurprising that penalties had no significant impact on industry health and safety investments (Viscusi, 1979). However, by the late 1970s, OSHA changed its focus by increasing the size of penalties, regularly imposing penalties worth millions of dollars, and removing trivial but burdensome regulations (Fry and Lee, 1989). Consequently, OSHA penalties began to jeopardize the financial performance of a cited firm. Taking data for the period from 1979 to 1989, Davidson *et al.* (1994) showed that an OSHA-imposed penalty adversely affected a firm's stock price. Additionally, a study of imposed penalties between 1979 and 1991 found significant reduction in the number of workplace accidents over the subsequent three years (Gray and Scholz, 1993; Scholz and Gray, 1990). Increases in the rate of inspections and substantial increases in the size of fines OSHA levies for infractions of safety rules should have a positive impact on both visible and perceived power.

The second factor likely driving increased emphasis on workplace safety is the ease of access to information due to the rapid growth of information technology and the 24-hour news cycle. Instantaneous access, the need for additional content, and user-created content have all increased the visibility of almost all types of news events. Industrial accidents that were once covered by local or regional newspaper are now immediately broadcast internationally. This may have significant implications for firm reputation as demonstrated by the *This American Life* broadcast of "Mr Daisey and the Apple Factory" on January 6, 2012. The story, retracted on March 16, portrayed working conditions at Apple contract manufacturer Foxconn Technology Group in a very negative light. While Apple's shares were seemingly unaffected (up approximately 50 percent), Foxconn's flagship shares, Hon Hai Precision, rose by only 23 percent during the same period. This happened despite significant increases in sales and the launch of a new Apple iPad built at the Foxconn facility. Based on increased availability of information and the substantial size of OSHA penalties levied in more recent periods, it is expected that:

H2. The impact of negative workplace safety events on the stock price of a firm has significantly increased over time.

Sample selection and description

Event studies are effective in estimating the market reaction to announcements, while adjusting for both industry and market-wide influences on share prices (Brown and Warner, 1980, 1985; Hendricks *et al.*, 2009). The event study methodology has been widely used to conduct operations and supply chain management research, allowing researchers to observe the impact of corporate announcements or events on stock price (e.g. Hendricks *et al.*, 2007). Klassen and McLaughlin (1996) used an event study to show that a firm can improve its financial performance by being environmentally responsible. Adams *et al.* (1999) used an event study to analyze the impact of quality awards on stock prices. Hendricks and Singhal (2008) used an event study to estimate the effect of supply chain disruption on shareholder wealth. In accordance with the event study method, a negative workplace safety incident announcement is considered as a public signal of a firm's cumulative performance. Such an event, therefore, is hypothesized to affect the stock price of the concerned company.

To collect data relevant to our two research questions, we searched the LexisNexis Academic database to identify newspaper and wire service announcements related to workplace safety incidents over a period from 1970 to 2010. Key words used in our search include OSHA, industrial accident, worker death, worker injury, industrial accident fine, industrial accident lawsuit, and other relevant phrases. We read the content of the full announcement text and collected data for relevant events. Data collected include the date of announcement, date of occurrence, company name, country of occurrence, source of the announcement, involvement of OSHA, type of industry, type of occurrence, number of workers affected, number of outsiders affected, and amount of the fine (if any). It should be noted that OSHA requires employers with more than ten employees to report workplace fatalities within 8 hours and serious workplace injuries within 24 hours (OSHA, 2016); therefore, additional data are available. However, as an exploratory study, we chose to do an analysis based on public announcements of negative workplace safety incidents. This had the added benefits of allowing capture of international incidents involving US traded companies not covered by OSHA and providing a degree of control for incident size.

In total, we identified more than 683 unique events over the period analyzed. We filtered the announcements to exclude:

- News stories not directly related to a specific incident, citation, fine, or lawsuit. This includes removal of opinion or editorial articles and stories not directly linked to coverage of a new citation, accident, fine, or resolution/judgment of a lawsuit. This includes repeat announcements of a particular event.
- Earnings announcements mentioning the impact of a particular industrial accident.
- Announcements relating to firms not covered or with insufficient data coverage available from Center for Research in Security Prices (CRSP).

After filtering the data, we identified 227 usable data points. Table I provides a sector-wise distribution of the sample for this study; as shown, approximately 67 percent of identified events were manufacturing based. The manufacturing sector is generally perceived as being a hazardous work environment and sample construction required publically traded firms; thus, the dominance of manufacturing in the sample is somewhat to be expected.

Table II provides basic financial information for the sample taken from the Compustat database. The financial information is from the quarter the negative workplace safety incident was announced. As shown in Panel A of Table II, the sample has an average revenue of $19,935 million and an average net income of $157.11 million. The minimum and maximum revenues of the firms in the sample are $171 and $124,993 million, respectively. These statistics suggest that the sample represents a wide range of public companies. We therefore believe that the findings may be generally applicable to most large-scale businesses.

Panel B shows the distribution of announcements by decade. An interesting trend identified in the data is the change in yield of usable vs identified events by decade. During our survey, we identified a large number of workplace safety events in each decade under investigation. However, as we filtered the data to identify publically traded companies, the yield of usable events dropped from no less than 45 percent from 1970 to 1990, to 25 and 30 percent for the period from 1990 to 2010. While shifting priorities in terms of OSHA

Table I. Distribution of the type of industry for the sample

Industry sector	Number of announcements
Manufacturing	157
Mining and refining	26
Service	17
Utility	9
Food processing	9
Logistics	6
Construction	5
Other	4

Panel A: descriptive statistics for health and safety incident announcements	Total assets (mill. $)	Revenue (mill. $)	Net income (mill. $)	Earnings per share ($)	Market value (mill. $)	Debt ratio
Mean	30,662.4	19,935.7	157.1	1.28	17,048.8	0.2617
Median	8,556.0	4,877.0	88.7	1.20	3,611.5	0.2433
SD	50,631.5	39,64.3	1,703.5	3.57	43,717.5	0.1309
Maximum	168,960.0	124,993.0	4224.3	7.28	306,466.3	0.8207
Minimum	280.9	171.1	−4,992.0	−8.85	61.2	0.0099

Panel B: distribution of announcements by decade

Period	Number of announcements	% of announcements
1970-1980	40	17.62
1981-1990	76	33.48
1991-2000	73	32.15
2001-2010	38	16.74
1970-2010	227	100.00

Table II.
Sample description

enforcement or management trends (e.g. outsourcing) may explain this, we believe that further analysis of this phenomenon is warranted due to ethical, strategic, and financial considerations arising from the use of smaller, non-publically traded firms to perform dangerous tasks more likely to incur a negative workplace safety event.

Research methodology

To measure the stock market's reaction to negative workplace safety incidents, we employed the event study methodology as made popular in the operations and supply chain literature by Klassen and McLaughlin (1996) and Hendricks and Singhal (1996). Using stock return data from the CRSP, abnormal returns for our sample companies were compiled. Consistent with numerous event studies, we selected the CRSP equally weighted index to adjust for market influences. We then estimated abnormal returns for the market model, market-adjusted returns model, and comparison-period mean-adjusted returns model.

The market model assumes a linear relationship between the return of an individual stock and the return from the broader market. The market model calculates the abnormal return by means of the following formula:

$$A_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt} \quad (1)$$

where A_{it} is the abnormal return for the sample company stock i on day t; R_{it} is the total return on the stock i on day t, and R_{mt} is the return on the CRSP equally weighted index on day t; $\hat{\alpha}_i$ is the intercept from estimating the ordinary least squares regression of a sample company's daily return on the daily return of the market during the estimation period; and $\hat{\beta}_i$ is the slope coefficient from the same estimated equation.

The mean-adjusted model calculates the estimated abnormal return based on the difference between the total return for the stock on day t and the mean of the stock's daily return during the estimation period as calculated by:

$$A_{it} = R_{it} - \overline{R}_i \quad (2)$$

$$\overline{R}_i = \left(\frac{1}{D_{est}}\right) \sum_{t \in EstP} R_{it} \quad (3)$$

where R_i is the simple average of stock i's daily return during the estimation period and D_{est} is the number of trading days in the estimation period.

The market-adjusted returns model estimates the abnormal return based on the difference between the total return for the stock on day t and the market return on day t as calculated by:

$$A_{it} = R_{it} - R_{mt} \tag{4}$$

The cumulative abnormal return (CAR) for a given time period is calculated as the sum of the mean daily returns during the period and is expressed as follows:

$$CAR(t_1, t_2) = \sum_{t=t_1}^{t=t_2} \overline{A}_t \tag{5}$$

To test the statistical significance of returns, we selected a parametric and nonparametric test statistic from the literature. The parametric test selected is the portfolio time series standard deviation test. This test, referred to as the crude dependence adjustment (CDA) test (Brown and Warner, 1980, 1985) compensates for a potential dependence of returns across events by using a single variance estimate for the entire portfolio. The test statistic for day t in event time is:

$$t_{CDA} = \frac{\overline{A}_t}{\sigma_A} \tag{6}$$

Assuming time series independence, the test statistic for mean CAR from day T_1 to T_2 is:

$$t_{CDA_{(t1,t2)}} = \frac{\overline{CAR}_{(t_1,\, t_2)}}{\sqrt{(T_2 - T_1 + 1)\sigma_{\overline{A}_t}}} \tag{7}$$

We can make no assumptions about the distribution of the security returns and therefore selected the generalized sign test as a nonparametric test of significance. The generalized sign test uses a null hypothesis that the fraction of day t abnormal returns having a particular sign is equal to the fraction in the estimation period. The generalized sign test was selected because it is less sensitive to the extreme returns in comparison to the rank test (Cowan, 1992). The number expected is a fraction of the positive returns in the estimation period for a sample of N events:

$$\hat{p} = \frac{1}{N} \sum_{i=1}^{N} \frac{1}{M_i} \sum S_{it} \tag{8}$$

where M_i is the number of non-missing returns in the estimation period for event i and:

$$S_{it} = \begin{cases} 1 & \text{if } u_{it} > 0 \\ 0 & \text{otherwise} \end{cases} \tag{9}$$

The generalized sign test uses the normal approximation of the binomial distribution with a parameter $\hat{p}$ and a test statistic of:

$$Z_G = \frac{w - N\hat{p}}{\sqrt{N\hat{p}(1-\hat{p})}} \tag{10}$$

where w is the number of stocks in the event window for which the abnormal return or CAR is positive.

For the purpose of this study, we used a 255-trading-day estimation period. The estimation period ends ten trading days prior to the announcement date, allowing a two-week buffer between the end of the estimation period and the event announcement date. A two-week buffer is generally assumed to be sufficient for conducting an event study, as this is generally sufficient to prevent leakage of information concerning the event. For event announcements taking place on a non-trading day, the event date is established as the next trading day.

Results and analysis

To address our initial research question, does the announcement of negative workplace safety event adversely affect the stock price of the concerned firm; we tested all 227 data points collected between 1970 until 2010 using Eventus (Cowan, 2007). Table III shows the results of this analysis for all three models (market model, market-adjusted model, and mean-adjusted model). The table presents the mean abnormal return for the day prior to the event announcement (day−1), the day of the event announcement (day 0), and the day after the announcement (day+1). The table also presents the p-value for the portfolio time series (CDA) test, the number of positive and negative stocks from the sample for each day, and the p-value for the generalized sign test. All the p-values reported are one-tailed tests, which is befitting our hypotheses which stipulate that the announcement of a negative workplace safety event would have negative effect on stock prices of the concerned firm. Table IV presents the same statistical information for the mean CAR for various event windows.

As shown in Table III, both the parametric and nonparametric tests show significant negative returns for day−1 for all three models. We also see a significant (at the 0.1 level) negative abnormal return for the mean-adjusted return model on day 0; although all of the models show a negative mean abnormal return on this day, only this model is statistically significant. When the generalized sign p-value is considered, this result is found to be questionable.

A review of Table IV shows statistically significant negative mean CARs for the parametric tests covering the event windows from −5 to +5, −5 to +1, and −1 to +1 for all models. We also see significant negative mean CARs for all of the nonparametric tests for the period −1 to +1 for each of the tested models, with none of the p-values exceeding 0.08.

Day	Portfolio time series (CDA) Mean abnormal return		Generalized sign Z Positive:Negative	
Panel A: market model				
−1	−0.32%	(0.011)**	96:131	(0.056)*
0	−0.12%	(0.185)	103:124	(0.254)
+1	0.11%	(0.219)	117:110	(0.115)
Panel B: market-adjusted model				
−1	−0.34%	(0.008)***	92:135	(0.029)**
0	−0.15%	(0.148)	101:126	(0.243)
+1	0.10%	(0.250)	111:116	(0.264)
Panel C: mean-adjusted returns model				
−1	−0.32%	(0.021)**	96:131	(0.074)*
0	−0.22%	(0.083)*	100:127	(0.181)
+1	0.10%	(0.267)	113:114	(0.207)

Notes: p-values in parentheses. *,**,***Significant at the 10, 5 and 1 percent levels, respectively

Table III. Performance results full sample

Event window	Portfolio time series (CDA) Mean cumulative abnormal return		Generalized sign Z Positive:Negative	
Panel A: market model				
−5, +5	−0.97%	(0.017)**	108:119	(0.499)
−3, +3	−0.32%	(0.192)	113:114	(0.252)
−5, +1	−0.63%	(0.043)**	103:124	(0.254)
−3, +1	−0.09%	(0.387)	113:114	(0.252)
−1, +1	−0.33%	(0.082)*	97:130	(0.072)*
−5, −2	−0.29%	(0.143)	107:120	(0.448)
Panel B: market-adjusted model				
−5, +5	−1.21%	(0.005)***	100:127	(0.203)
−3, +3	−0.48%	(0.098)*	102:125	(0.286)
−5, +1	−0.88%	(0.009)***	94:133	(0.052)*
−3, +1	−0.29%	(0.176)	106:121	(0.487)
−1, +1	−0.40%	(0.053)*	93:134	(0.039)**
−5, −2	−0.49%	(0.042)**	106:121	(0.487)
Panel C: mean-adjusted returns model				
−5, +5	−1.09%	(0.018)**	103:124	(0.304)
−3, +3	−0.48%	(0.126)	110:117	(0.339)
−5, +1	−0.92%	(0.014)**	98:129	(0.119)
−3, +1	−0.37%	(0.146)	103:124	(0.304)
−1, +1	−0.44%	(0.053)*	94:133	(0.044)**
−5, −2	−0.47%	(0.067)*	102:125	(0.259)

Notes: *p*-values in parentheses. *,**,***Significant at the 10, 5 and 1 percent levels, respectively

Table IV. Cumulative performance results entire sample

Based on the analysis, we believe that *H1* is at least partially supported; companies announcing a negative workplace safety incident will experience an abnormal negative return on their stock price. Announcement of a negative incident resulted in a decline of approximately 1 percent in stock value for the period from five days before to five days after the event with approximately half this decline happening within one day of the event announcement. While we would like to see stronger results on day 0, we believe that at least two issues are at play moderating the hypothesized effect. First, as indicated in our literature review, early studies based on limited data sets concluded that negative workplace safety events had a limited impact on firms during the first 10+ years of our study. Since we collected data for periods overlapping those studies, insignificant results for those periods would mitigate any significant effects today. Second, as hinted at by the significant negative returns for the −5 to −2 event window and the significant single day returns for day−1, we believe that at least some investors had access to information regarding an incident prior to the "announcement." Since we choose to identify the date of safety incidents using newspaper and newswire stories, a degree of asymmetrical information gathering capabilities is expected. During the first 20+ years under study, information about a specific event may have been less readily available to a mass audience mitigating the impact of early events.

H2 seeks to address these concerns by addressing the impact of negative workplace safety events in smaller time buckets. To carry out this analysis, we subdivided our sample into decade time buckets and tested each decade individually to determine whether workplace safety events had a negative impact on stock price returns. Tables V and VI show the analysis from 1970 to 1990.

For the period spanning from 1970 to 1980, the *p*-values shown in Table V indicate that there is no significant relationship between negative workplace safety events and stock price of a company. In Table VI, we see significant *p*-values for the mean CAR for days −5 to −2.

Day	1970-1980 Portfolio time series (CDA) Mean abnormal return		1970-1980 Generalized sign Z Positive:Negative		1981-1990 Portfolio time series (CDA) Mean abnormal return		1981-1990 Generalized sign Z Positive:Negative	
Panel A: market model								
−1	0.11%	(0.333)	21:19	(0.276)	0.20%	(0.181)	43:33	(0.050)**
0	0.02%	(0.463)	18:22	(0.361)	0.24%	(0.128)	40:36	(0.170)
+1	0.08%	(0.387)	23:17	(0.110)	−0.20%	(0.170)	35:41	(0.423)
Panel B: market-adjusted model								
−1	0.14%	(0.298)	20:20	(0.280)	0.23%	(0.141)	41:35	(0.152)
0	0.02%	(0.468)	15:25	(0.157)	0.25%	(0.121)	41:35	(0.152)
+1	0.04%	(0.444)	23:17	(0.062)*	−0.16%	(0.236)	36:40	(0.453)
Panel C: mean-adjusted returns model								
−1	0.31%	(0.149)	22:18	(0.130)	0.22%	(0.172)	41:35	(0.115)
0	0.05%	(0.431)	17:23	(0.323)	0.13%	(0.291)	40:36	(0.166)
+1	−0.10%	(0.365)	20:20	(0.311)	−0.13%	(0.285)	38:38	(0.304)

Notes: *p*-values in parentheses. *,**,***Significant at the 10, 5 and 1 percent levels, respectively

Table V. Performance results 1970-1990

Event window	1970-1980 Portfolio time series (CDA) Mean abnormal return		1970-1980 Generalized sign Z Positive:Negative		1981-1990 Portfolio time series (CDA) Mean abnormal return		1981-1990 Generalized sign Z Positive:Negative	
Panel A: market model								
−5, +5	−0.76%	(0.194)	18:22	(0.361)	−0.14%	(0.420)	39:37	(0.234)
−3, +3	−0.34%	(0.315)	16:24	(0.162)	0.25%	(0.331)	41:35	(0.118)
−5, +1	−0.57%	(0.208)	16:24	(0.162)	0.15%	(0.397)	35:41	(0.423)
−3, +1	0.18%	(0.380)	21:19	(0.276)	0.57%	(0.118)	38:38	(0.310)
−1, +1	0.21%	(0.320)	18:22	(0.361)	0.23%	(0.263)	38:38	(0.310)
−5, −2	−0.79%	(0.069)*	13:27	(0.026)**	−0.09%	(0.419)	37:39	(0.395)
Panel B: market-adjusted model								
−5, +5	−1.24%	(0.082)*	12:28	(0.025)**	−0.01%	(0.493)	38:38	(0.367)
−3, +3	−0.60%	(0.197)	13:27	(0.050)**	0.39%	(0.251)	38:38	(0.367)
−5, +1	−1.07%	(0.066)*	13:27	(0.050)**	0.22%	(0.353)	38:38	(0.367)
−3, +1	−0.09%	(0.439)	17:23	(0.355)	0.65%	(0.091)*	40:36	(0.212)
−1, +1	0.20%	(0.332)	17:23	(0.355)	0.33%	(0.189)	39:37	(0.284)
−5, −2	−1.27%	(0.009)***	13:27	(0.050)**	−0.11%	(0.396)	38:38	(0.367)
Panel C: mean-adjusted returns model								
−5, +5	−0.61%	(0.268)	16:24	(0.219)	−0.36%	(0.325)	40:36	(0.166)
−3, +3	−0.67%	(0.197)	17:23	(0.323)	0.12%	(0.421)	37:39	(0.389)
−5, +1	−0.91%	(0.124)	13:27	(0.042)**	−0.24%	(0.350)	36:40	(0.479)
−3, +1	−0.21%	(0.377)	19:21	(0.431)	0.34%	(0.258)	35:41	(0.430)
−1, +1	0.26%	(0.308)	19:21	(0.431)	0.22%	(0.296)	38:38	(0.304)
−5, −2	−1.16%	(0.025)**	15:25	(0.137)	−0.46%	(0.165)	33:43	(0.262)

Notes: *p*-values in parentheses. *,**,***Significant at the 10, 5 and 1 percent levels, respectively

Table VI. Cumulative performance results 1970-1990

This relationship holds for both the parametric and nonparametric tests except for the generalized sign test for the mean-adjusted return model. Additionally, the nonparametric test shows significant, at the 0.05 level, negative returns for the market-adjusted model and the mean-adjusted model for the time period from −5 to +1. Considering the results of the previous studies, the apparent leakage of information around the occurrence of a negative workplace safety event, due to the slow speed of information dissemination and asymmetrical information gathering capabilities of various investors at this time, there would appear to be weak evidence of an impact on stock price performance for this time period. This conclusion appears to be buttressed by the persistence of the negative cumulative return through the event announcement in the mean-adjusted model and at least five days following the event announcement in the market-adjusted model.

For the 76 events captured between 1981 and 1990, we see no significance for negative impact of workplace safety events on stock returns for any of the models for either of the statistical tests as indicated by the p-values. The mean abnormal returns are not significant but they are positive for days −1 and 0. Looking at the mean CARs, we find only a single significant but positive test. In total, Tables V and VI indicate that negative workplace safety events did not have an adverse effect on the stock prices during the period from 1970 to 1990.

Tables VII and VIII show the analysis for the events occurring during the period from 1991 to 2010. As shown in Table VII, the mean abnormal returns for the day prior to the event are negative and significant at the 1 percent level for all three models for both the parametric and nonparametric tests. This indicates that a company experiencing a negative workplace safety event can expect a 0.7 percent reduction in the value of their stock on the day of the announcement. Furthermore, the CDA test for all three models indicates that a decline in stock price of slightly more than 1 percent should be expected to persist based on the values on day −5 and +5. We also see significant negative cumulative returns indicated for the −5 to +1 and −1 to +1 time frame for the market-adjusted model. Finally, we see no sign of information leakage during the period from five days to two days prior to the event; however, it would still appear that asymmetrical information gathering capabilities persist into the early phase of the information age as indicated by a negative abnormal return the day prior to the announcement date. While the data in the preceding two decades indicate either no or weak impact, these data clearly indicate that negative workplace safety events adversely affect the stock prices of the concerned companies.

Analysis of the data from 2001 to 2010 reveal mean abnormal returns for the day of the event (day−1) and the day of the announcement (day 0) that are negative and significant at no worse than a 5 percent level for the all three models for both the parametric and

Table VII.
Performance results 1991-2010

	1991-2000				2001-2010			
	Portfolio time series (CDA)		Generalized sign Z		Portfolio time series (CDA)		Generalized sign Z	
Day	Mean abnormal return		Positive:Negative		Mean abnormal return		Positive:Negative	
Panel A: market model								
−1	−0.73%	(0.003)***	22:51	(0.002)***	−0.99%	(0.006)***	10:28	(0.004)***
0	0.12%	(0.323)	35:38	(0.473)	−1.48%	(< 0.001)****	10:28	(0.004)***
+1	0.09%	(0.358)	36:37	(0.381)	0.78%	(0.023)**	23:15	(0.064)*
Panel B: market-adjusted model								
−1	−0.77%	(0.002)***	23:50	(0.007)***	−1.18%	(0.002)***	8:30	(< 0.001)****
0	0.04%	(0.434)	34:39	(0.458)	−1.49%	(< 0.001)****	11:27	(0.011)**
+1	0.02%	(0.467)	31:42	(0.274)	0.80%	(0.027)**	21:17	(0.166)
Panel C: mean-adjusted returns model								
−1	−0.70%	(0.004)***	34:49	(0.010)***	−1.36%	(0.004)***	9:29	(0.001)***
0	0.05%	(0.427)	33:40	(0.419)	−1.72%	(< 0.001)****	10:28	(0.002)***
+1	0.09%	(0.368)	36:37	(0.309)	0.79%	(0.061)*	19:19	(0.471)

Notes: p-values in parentheses. *,**,***,****Significant at the 10, 5, 1 and 0.1 percent levels, respectively

	1991-2000				2001-2010			
	Portfolio time series (CDA)		Generalized sign Z		Portfolio time series (CDA)		Generalized sign Z	
Event window	Mean abnormal return		Positive:Negative		Mean abnormal return		Positive:Negative	
Panel A: market model								
−5, +5	−1.19%	(0.083)*	32:41	(0.263)	−2.38%	(0.034)**	19:19	(0.411)
−3, +3	−0.21%	(0.379)	39:34	(0.157)	−1.62%	(0.059)*	17:21	(0.336)
−5, +1	−0.79%	(0.126)	35:38	(0.473)	−1.92%	(0.033)**	17:21	(0.336)
−3, +1	−0.20%	(0.367)	36:37	(0.381)	−1.47%	(0.047)**	18:20	(0.461)
−1, +1	−0.52%	(0.126)	30:43	(0.135)	−1.69%	(0.007)***	11:27	(0.009)***
−5, −2	−0.27%	(0.299)	37:36	(0.296)	−0.23%	(0.386)	20:18	(0.291)
Panel B: market-adjusted model								
−5, +5	−1.68%	(0.027)**	30:43	(0.202)	−2.70%	(0.025)**	20:18	(0.259)
−3, +3	−0.53%	(0.221)	33:40	(0.448)	−2.00%	(0.034)**	18:20	(0.499)
−5, +1	−1.27%	(0.033)**	28:45	(0.096)*	−2.14%	(0.026)**	15:23	(0.164)
−3, +1	−0.57%	(0.164)	32:41	(0.357)	−1.86%	(0.022)**	17:21	(0.371)
−1, +1	−0.71%	(0.059)*	27:46	(0.062)*	−1.88%	(0.004)***	10:28	(0.005)***
−5, −2	−0.56%	(0.141)	35:38	(0.367)	−0.26%	(0.377)	20:18	(0.259)
Panel C: mean-adjusted returns model								
−5, +5	−1.17%	(0.093)*	30:43	(0.182)	−2.94%	(0.041)**	17:21	(0.282)
−3, +3	−0.12%	(0.432)	40:33	(0.075)*	−2.18%	(0.053)*	16:22	(0.184)
−5, +1	−0.74%	(0.147)	34:39	(0.488)	−2.62%	(0.026)**	15:23	(0.110)
−3, +1	−0.11%	(0.424)	38:35	(0.166)	−2.48%	(0.015)**	11:27	(0.006)***
−1, +1	−0.56%	(0.113)	29:44	(0.127)	−2.28%	(0.005)*	8:30	(< 0.001)****
−5, −2	−0.18%	(0.367)	36:37	(0.309)	−0.34%	(0.370)	18:20	(0.401)

Notes: *p*-values in parentheses. *,**,***,****Significant at the 10, 5, 1 and 0.1 percent levels, respectively

Table VIII. Cumulative performance results 1991-2010

nonparametric tests. The CDA test is significant at no worse than a 6 percent level and negative for all three models for every time period except from day −5 to −2. The decline in stock value ranges between 2.38 and 2.94 percent from day −5 to +5 with a loss of between 1.69 and 2.28 percent occurring between day −1 and +1. Given the size of the decline, it is not surprising to see bounce in the stock price on day+1, but this appears short lived given the CAR data. These results are confirmed by the generalized sign for all three models for days −1 and 0, with further indication that more than 70 percent of stocks will decline in value from day −1 to +1 as indicated in Table VIII.

Comparing these results with those of previous decades, it is clear that negative workplace safety events have a more pronounced negative effect on firm value in the present environment than at any point since OSHA's inception. We therefore find that *H2* is supported. We also see evidence within the results indicating that information technology is speeding the dissemination of information to the general public. The widespread availability of mobile devices capable of delivering a range of information services appears to have increased the market's efficiency in reacting to workplace safety events. While alternative explanations are possible, there appears to be evidence that event announcements are now happening in real time, which is reflected in the significance and magnitude of the decline on the announcement date.

Discussion

This study explores the impact of a negative workplace safety announcement on a firm's stock performance. It is one of the first large-scale studies to explore the impact of public announcements of workplace incidents on firm performance and to evaluate the impact of such announcements in the context of time. Previous studies (e.g. Davidson and Worrell, 1995; Fry and Lee, 1989) contained substantially fewer incident announcements, focused on data related to OSHA-levied penalties, and only reviewed data prior to 1990 when penalties were substantially increased.

The results are significant; overall, we found that organizations should expect a decline in stock price of at least 1 percent following the announcement of a safety incident. Furthermore, we found that based on analysis of returns broken into decade buckets, the impact of an announcement of a safety incident is increasing in magnitude. Firms announcing incidents between 2001 and 2010 suffered two to three times the decline in stock price relative to any prior period. While it is hardly surprising that the announcement of a safety incident would result in a decline of a firm's stock price, the magnitude of the change is substantial, especially in the most recent period. It is evident that due to increased awareness regarding workplace safety facilitated by improved access to information, any negative announcement about workplace safety (irrespective of OSHA's involvement) is likely to adversely affect the stock performance of a company.

The implications of these results for supply chain managers are significant. Managers need to play leading roles in ensuring safe working environments; they have substantial power, in terms of both structural improvements and cultural support, necessary to achieve safety in the workplace. The results of this study provide them with necessary support to acquire the financial resources required to mitigate exposure to unsafe working conditions. Such improvements not only limit exposure to potential financial liability but also support operational initiatives supporting competitive advantage in terms of flexibility, responsiveness, time, and cost. Changing attitudes toward achieving high performance across a range of responsibilities, as advocated under CSR, will only increase the need to protect workers from unsafe working conditions.

The need to mitigate workplace safety risk is also highlighted by recent increases in the size of fines allowed by OSHA and changing attitudes regarding enforcement. OSHA announced that effective from August 1, 2016, penalties will increase nearly 80 percent, the first time the agency has raised fines since 1990 (Berzon, 2015; Paranac, 2016). This increase was necessary to increase the effectiveness of the agency. As stated by Dr David Michaels, then Assistant Secretary of Labor for OSHA, in testimony before Congress the "most serious obstacle to effective OSHA enforcement of the law is the very low level of civil penalties allowed under our law, as well as weak criminal sanctions […] OSHA penalties must be increased to provide a real disincentive for employers accepting injuries and worker deaths as a cost of doing business" (Hilton, 2016). New regulations will also allow OSHA to increase fines as needed to keep pace with inflation and allow the agency to increase the rate of inspections. Substantial increases in the number of inspections and the size of fines levied for infractions of workplace safety rules should have a positive impact on OSHA's visibility and perceived power. We therefore expect the magnitude of decline in stock price due to any future negative workplace safety announcement to increase, reflecting a rapid change in perceived importance of workplace safety in both the public and with shareholders.

The limitations on this research stem from its design as an exploratory investigation into market interpretation of negative workplace safety announcements. To explore whether an announcement of a safety incident had a negative impact on financial performance, our sample was created from publicly available newspaper articles or wire service releases rather than OSHA incident reports submitted by employers as required by law. While sample construction based on public announcements allowed capturing international incidents involving US traded companies not covered by OSHA and provided a degree of control for incident size, under the assumption that only large events would receive significant news coverage, standardized OSHA incident reports would contain a wealth of additional injury and illness data.

Having established the link between negative workplace safety announcements and firm stock performance and having identified a larger impact based on time, the next step is to enhance the analysis. To do so, the first step is to identify additional data points and to acquire both public and OSHA data regarding fatalities, number of injuries, extent of injury, industry, location, size of fine imposed, criminal liability, etc. With this information, we will be able to extend the analysis by looking at matched sets of companies, similar to the analysis carried out by Barber and Lyon (1996), and to determine how durable the results are, i.e. how long it takes a company's stock price to recover to the pre-incident level. The next step would be to create a regression, similar to that carried out by Hendricks and Singhal (2005), to determine what variables contribute the most to the abnormal loss identified in this analysis. Once significant attributes are identified, linking those attributes to operational metrics like quality, cost, reliability, and flexibility would provide additional value and further a framework necessary to incentivize investment into mitigation technology.

Conclusion

The results of this paper clearly show that negative workplace safety events can deeply impact the financial performance of a firm. While in earlier periods, the negative impact on firm value was muted, the magnitude of the impact is much greater today reflecting the changing reality of today's workplace. Operations and supply chain managers must seek ways to improve their workplaces and processes to make them safer. The analysis presented here should help managers to understand the negative financial consequences of failure to act and provide a framework to justify the expense necessary to enhance workplace safety in their organizations.

A safe working environment will not only help a firm avoid hefty penalties imposed by regulatory agencies, but will also avoid erosion of competitive position. Addressing worker safety reduces employee medial costs, reduces productivity loss due to workplace accident, and can have a significant impact on quality, responsiveness, flexibility among other competitive dimensions. Additionally, unsafe companies can have significant decline in corporate image and may be placed at a competitive disadvantage when hiring new employees, further imperiling firm performance and stock price. By identifying the importance of workplace safety and drawing attention to the negative consequences of a safety event, this paper helps to raise workplace safety as an important issue for the attainment of triple bottom line of a company.

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Further reading

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