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**Article**

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## GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

# Shareholder response to mass shootings in the United States firearms industry

Geoffrey Steeves<sup>1</sup> and Newton da Costa Jr.<sup>1\*</sup>

**Abstract:** Mass shootings are an all too common event in the United States. While these tragedies are universally condemned, the extent to which they affect markets is less understood. Using event study methodology, this study analyzes how three publicly traded small arms companies, Smith & Wesson, Sturm Ruger, and the Brazilian manufacturer Taurus, react in the aftermath of six mass shootings from 2007 to 2013. Taurus is included in the sample given its heavy dependence on the US market, as well as to increase sample size given the dearth of publicly traded arms companies worldwide. The aggregate results suggest that these events do significantly disrupt returns in the arms industry, suggesting that shareholders are influenced by these events. The evidence for market disruptions is particularly strong when the sample is limited to the deadliest Virginia Tech and Sandy Hook shootings.

**Subjects:** Violent Crime; Economics; Finance

**Keywords:** firearms companies; mass shooting; event study; abnormal returns; multifactor model

### 1. Introduction

The extent to which mass shootings shape public opinion and affect companies in the small arms industry remains uncertain. On one hand, these shooting events could be construed by markets as a

#### ABOUT THE AUTHORS

Geoffrey Steeves earned his PhD in economics while studying as an Olmsted Scholar, a United States Department of Defense exchange program, in southern Brazil. He maintains an affiliation with the Economics Department at the Federal University of Santa Catarina where he continues to collaborate with colleagues, including Newton da Costa Jr., to explore patterns, perceptions and effects of violence in Brazil and the United States. Armed violence continues to exact a great toll on these nations. This research endeavors to develop methods and provide insights to understand more clearly the burden armed violence imposes on society.

Newton da Costa Jr. is a full professor in the Economics Department at Federal University of Santa Catarina in Brazil. He holds a PhD in Business Administration from Getulio Vargas Foundation, and was a Fulbright visiting scholar at Columbia Business School (1999-00). He has been an associate editor of the *Brazilian Journal of Finance* since 2006. His main areas of interest are in behavioral and experimental finance.

#### PUBLIC INTEREST STATEMENT

While mass shootings are universally condemned, the extent to which they affect markets is less understood. Do these events persuade arms company shareholders to sell based on the prospect of stricter gun control legislation or ethical disapproval? Or rather, do they rally the formidable pro-gun lobby to stick to their guns and counter legislation that infringes upon constitutional rights guaranteed by the Second Amendment, possibly buoying shareholder confidence? This research is the first to apply an event study methodology to assess the market's reaction to mass shootings. By analyzing how publicly traded small arms companies react in the aftermath of six mass shootings in the United States from 2007 to 2013, it finds that these events have little impact on generating abnormal market returns for individual firms. However, when companies and mass shootings are considered collectively, results suggest that these events may significantly disrupt returns in the arms industry.

galvanizing force for the anti-gun lobby to pass stricter gun control legislation and encourage shareholders to sell shares based on ethical disapproval.<sup>1</sup> On the other hand, these tragedies could rally the formidable pro-gun lobby to stick to their guns and ensure these events do not lead to legislation that would infringe upon Second Amendment rights and restrict access to weapons.

The polarization of the arms debate in the United States is well known. And while this research remains agnostic about whether society is made safer or more vulnerable by increased restrictions on access to weapons, it endeavors to understand the extent to which markets are influenced by these shootings. However, given impassioned and competing dialogs that frame both sides of the arms debate, it remains uncertain how, or if, shareholders will react to these shootings. Do these violent episodes increase the likelihood of passing stricter gun control measures and stock selloffs causing significant decreases in equity prices? Or instead, have the markets already *priced-in* the high premium society places on second amendment rights, and therefore fail to respond to these events?

Understanding this complicated trade-off between society's willingness to continue to endure these tragedies and its desire to preserve the constitutional right to bear arms motivate this study. In order to understand more clearly shareholder reaction to mass shootings, we employ an event study methodology that analyzes three publicly traded firearms companies for abnormal stock returns (defined as significantly unusual price changes) in the wake of six massacres in the United States between 2007 and 2013. We argue that the presence of abnormal returns in the wake of these tragedies is a proxy measure for shareholder's belief about whether significant change in arms control legislation is a likely outcome of these mass shootings. In this regard, abnormal returns may reflect whether shareholders believe future arms sales are likely to be jeopardized by the prospect of future anti-gun legislation. Alternatively, a post-tragedy absence of abnormal returns may imply that investors do not actually believe additional arms-control restrictions, or possibly ethical selloffs, are a likely outcome of mass shootings.

This paper, which is the first to apply an event study analysis in the context of mass shootings, finds that the extent to which the small arms industry is affected varies with the severity of the massacre and the extent to which shooting events are collectively viewed in aggregate. For example, when stock returns are analyzed in the aftermath of a single mass shooting, it seems that these events have little impact on generating abnormal returns on the day of a massacre. However, when arms companies are considered collectively, and when the massacres are grouped by their perceived severity, there is stronger evidence of a negative impact on the small arms industry. These abnormal returns are most pronounced when only the deadliest shootings in the sample, Virginia Tech and Sandy Hook, are considered. Furthermore, the cumulative effects found in the days following these shootings suggest that these massacres continue to affect the market for several days.

This paper is organized as follows: Section 2 provides background information of the mass shootings considered in this study. Section 3 presents our data-set and explains the inclusion of Brazilian arms maker Taurus in our data-set. Section 4 reviews the literature and methodology and explains the use of abnormal returns as a proxy for shareholder outlook on arms control. Section 5 presents and discusses the key results. The final Section 6 concludes by discussing the extent to which mass shootings may influence investors and the arms industry.

## 2. Context of mass shootings

Mass shootings are horrific tragedies experienced the world over. The United States, however, has the unenviable distinction of hosting an extremely disproportionate amount of these events. From 2006 to 2013, the US averaged one mass killing nearly every two weeks, registering 232 mass killings during the period.<sup>2</sup> The impacts of mass shootings have a proportionally much greater effect on society relative to individual homicides. Luca, Deepak, and Poliquin (2016) finds that a single mass

shooting leads to a 15% increase in firearm bills introduced in state legislatures and that these mass shootings have an 80 times greater impact in the generation of arms control legislation relative to individual homicides. Furthermore, the type and success of these bills depends greatly on the controlling party of the state legislatures. Generally, Democrat-controlled legislatures actually enact few laws that curb arms control, while a mass shooting actually increases the number of laws enacted to *loosen* gun restrictions in Republican-controlled legislatures. Enacting legislation in response to mass shootings at the federal level, which establishes the minimum level of gun control for the nation, is much rarer.

This study selected the six deadliest mass shootings from 2007 to 2013 where the death tolls ranged from 12 to 32 individuals. Several smaller scale killings that occurred that met the FBI's threshold of four victims for inclusion as a mass killing, but failed to generate a large-scale national dialog, are omitted. The media coverage following these selected events was robust and persistent. Background information on these events is presented below in chronological order:<sup>3</sup>

- Virginia Tech Shooting, Blacksburg, VA; Date: 16 April 2007, Monday; Time: 7:15–9:51 am EDT; Number of Victims: 32; Perpetrator: Seung-Hui Cho; Description: Seung-Hui Cho, an “angry and disturbed” Virginia Tech senior, killed two students in a dorm before entering classrooms and shooting others. Thirty-two people died. A review found that Cho’s mental health history should have prevented him from buying guns.
- Binghamton Shooting, Binghamton, NY; Date: 3 April 2009, Friday; Time: 10:30 am–2:33 pm EDT; Number of Victims: 13; Perpetrator: Jiverly Wong; Description: Wearing a bulletproof vest, Jiverly Wong, 41, entered a citizenship class and fired 98 shots from two handguns. Wong killed 13 people and injured several more before shooting himself.
- Fort Hood Shooting, Fort Hood, TX; Date: 5 November 2009, Thursday; Time: 1:34–1:44 pm CDT Number of Victims: 13; Perpetrator: Maj. Nidal Malik Hasan; Description: Maj. Nidal Malik Hasan, an Army psychiatrist, has been sentenced to death in the Fort Hood shootings. He entered a military medical center firing a semi- automatic pistol, killing 13 and injuring 32. The FBI has called it a case of workplace violence. He has been sentenced to death.
- Aurora (Batman) Shooting; Aurora, CO; Date: 20 July 2012, Friday; Time: 12:38–12:45 am MDT Number of Victims: 12 Perpetrator: James E. Holmes; Description: James E. Holmes was sentenced to life imprisonment in August 2015 for opening fire in an Aurora, Colo., movie theater, killing 12 and injuring 50.
- Sandy Hook Shooting; Newtown, CT; Date: 14 December 2012, Friday; Time: 09:35–09:40 am EST; Number of Victims: 27; Perpetrator: Adam Lanza; Description: Adam Lanza, 20, killed his mother at their Newtown, Conn., home, then drove to nearby Sandy Hook Elementary School. He forced his way in and killed six adults and 20 children with a rifle, firing 154 shots. He killed himself with a handgun.
- Navy Yard Shooting, Washington D.C.; Date: 16 September 2013, Monday; Time: 08:20–09:20 am EDT; Victims: 12 Perpetrator: Aaron Alexis; Description: Aaron Alexis, 34, killed 12 and injured eight in an office building at the Washington Navy Yard. The former Navy reservist was killed by police. Alexis worked for a base subcontractor.

### 3. Data

Given the dearth of publicly traded small arms manufacturers, our data is limited to the stock returns for three firms: Sturm Ruger, Smith & Wesson, and Brazilian manufacturer Taurus.<sup>4</sup> Although hundreds of weapons manufacturers exist in the United States and worldwide, the vast majority are privately held, making a robust data collection on stock returns impossible. Big name arms manufacturers, such as Marlin, Browning, Beretta, Glock, Colt, Mossberg, H.K., Savage, Bushmaster, Remington, and Winchester are all privately held.

The first company in our sample is Sturm, Ruger, and Company (NYSE: RGR), commonly known as Ruger. In 2010, Ruger was the largest firearms manufacturer in the US, specializing in rifles, shotguns, semi-automatic pistols and revolvers.<sup>5</sup> The next company in our sample is Smith & Wesson (NASDAQ: SWHC), which specializes in pistols and revolvers, and is the United States' second largest firearms producer. The final company is the Brazilian firearms company Taurus (IBOVESPA: FJTA4), which is Brazil's largest arms manufacturer and one of the few publicly traded firearms companies worldwide.

On the surface, including a Brazilian firm seems an unlikely fit for this study. However, the interconnectedness between the Brazilian and US arms industries justifies treating Taurus *as if it were* a US company. Dreyfus, Lessing, Nascimento, and Purcena (2010) details the dependence of the Brazilian small arms industry on the US market, citing that exports of small arms, parts, accessories and ammunition tripled between 1982 and 2007 to USD \$199 million. Furthermore, the US is the dominant importer of Brazilian firearms and parts, mostly Taurus handguns. Taurus secured a niche in the enormous US market for good quality pistols and revolvers making the company highly dependent upon the US market. Including Taurus in the sample is justified not only because of its high degree of dependence on the US market, but given the scarcity of publicly traded firearms manufacturing firms, in the US or elsewhere, another publicly traded company is a welcome addition.

#### 4. Literature review and methodology

Most event studies focus on deliberate decisions companies make to reorganize their businesses and improve profitability. For example, Dolley (1933), a seminal article in event study methodology, considered the effect of stock splits on equity prices. Further event studies endeavored to understand the effects of other types of financial announcements. In his survey of event studies, Weinberg (2007) finds some evidence that the equity prices of merging companies experienced abnormal returns in response to merger announcements and antitrust challenges. While these studies' simple and intuitive designs make them appealing, several considerations must be taken into account in order for their results to be considered valid and appropriate. One such consideration is to determine whether the informational content of an announcement could have offsetting or competing effects on equity prices. For example, it may be difficult to disentangle whether price increases are due to perceived increases of a firm's market or monopoly power, or instead, caused by efficiency gains resulting from the merger. Informational content also relates to a company's stock price after a mass shooting. Shareholders of arms industry firms may struggle to understand the effect of a massacre on future profits. On one hand, these massacres could be bad for business if investors believe future profits are jeopardized by prospects of future gun-restricting legislation, or possibly for ethical disapproval. On the other, it is conceivable that equity prices could see a bump due to spending sprees on weapons that tend to occur in the immediate aftermath of these crises.

Beverley (2008) also considers how announcements affect equity prices and future profitability and provides an overview of several key considerations in the development of event study methodologies. One consideration is the selection of the appropriate event window. This period must be long enough to capture ongoing effects, but still sufficiently short to avoid including confounding variables that could "contaminate" the study. Another consideration is the development of sound selection criteria by which to the firms to include in the sample. The first discriminator on whether to include a company is whether or not equity price data is available. If the data is available, as is usually the case with publicly traded firms, the next step is to determine if the informational event would significantly impact the company. For example, this study opted not to include Olin Corporation, the manufacturer of Winchester ammunition, in the sample. Despite being publicly traded company with readily available equity prices, Olin Corporation is a diversified chemical manufacturer in which ammunition represents a small percentage of its overall revenues. Any price fluctuations resulting from a mass shooting could remain "undistinguishable from the usual background noise" (Beverley, 2008, p. 39).

Another significant consideration raised by Beverley (2008) is determining what qualifies as “normal” and, subsequently, “abnormal” returns. The two statistical methods typically used to determine normal returns are the constant-mean-return model and the ordinary least squares (OLS) market return model. Beverley suggests the market return model is “potentially superior” to the constant-mean-return model because it removes the portion of return related to market movement. To that end, this research utilizes the market return model. The key considerations of selecting an event window, choosing reasonable firms, and employing a sound method to identify abnormal relative to normal returns, are crucial to avoiding ambiguous results that are open to challenge.

Another study relevant to our methodology is Chen and Siems (2004), which uses the event study methodology to assess the effects of terrorism on global capital markets. They found that over time US capital markets became more resilient to the market disruptions caused by terrorism. This study suggests that mass shootings, like terrorist acts, are construed as bad for business if negative abnormal returns are realized in their aftermath. Likewise, an absence of abnormal returns may suggest these events failed to disrupt the markets.

Ultimately, we adopt the event study methodology from Brown and Warner (1985), which outlines the market return model, to determine if these small arms companies experienced abnormal returns in the wake of these massacres.

Returns for small arms companies are generally modeled in the following format:

$$R_{ij,t} = \alpha + \beta_j X_{j,t} + \varepsilon_{ij,t} \quad (4.1)$$

where  $R_{ij,t}$  designates the observed return for company  $i$ , from country  $j$  at time  $t$ .  $X_{j,t}$  is a vector of explanatory variables, and  $\alpha, \beta_j$  are company specific parameters, while  $\varepsilon_{ij,t}$  is the error term.

As in Brown and Warner (1985), abnormal returns are calculated using the OLS market model method<sup>6</sup> in the form:

$$AR_{ij,t} = R_{ij,t} - (a_i + b_j X_{j,t}) \quad (4.2)$$

where  $AR_{ij,t}$  are the abnormal returns for company  $i$ , in country  $j$ , during time  $t$ .  $R_{ij,t}$  continues to represent returns, while  $a$  and  $b$  are estimates for the parameters modeled in Equation (1).

The composition of the vector of explanatory variables,  $X_{j,t}$ , changes with the companies considered. First off, the returns of the two US companies, Ruger and Smith & Wesson, are modeled using a single explanatory such that:

$$R_{ij,t} = \alpha + \beta_j R_{mj,t} + \varepsilon_{ij,t} \quad (4.3)$$

where  $R_{ij,t}$  is company  $i$ 's return,  $j$  is the U.S, and  $R_{mj,t}$  is the market return represented by the S&P500. Abnormal returns for these US companies are thus modeled:

$$AR_{ij,t} = R_{ij,t} - (a_i + b_j R_{mj,t}) \quad (4.4)$$

where  $a$  and  $b$  are estimates for the parameters in Equation (3).

In the case of the Brazilian company, Taurus, whose returns are driven by more than just the US market, we use a multi factor model:

$$R_{ij,t} = \alpha + \beta_j R_{mj,t} + \gamma_i R_{m,US,t} + \delta_i EX_{j,t} + \varepsilon_{ij,t} \quad (4.5)$$



In this case,  $R_{ij,t}$  are Taurus' returns in period  $t$ ,  $R_{mj,t}$  is the Brazilian market index IBOVESPA<sup>7</sup>  $m$  in period  $t$ ,  $R_{m,US,t}$  is the United States' market return (given by the S&P500) in period  $t$ , and  $EX_{j,t}$  is Brazil's exchange rate variation in period  $t$ .  $\alpha$ ,  $\beta$ ,  $\gamma$  and  $\delta$  are the parameters specific to company  $i$ ,  $j = \text{Brazil}$ , and  $\varepsilon_{ij,t}$  is the error term. Likewise, abnormal returns for Taurus are given by:

$$AR_{ij,t} = R_{ij,t} - (a_i + b_i R_{mj,t} + g_i R_{m,US,t} + d_i X_{j,t}) \quad (4.6)$$

where  $a$ ,  $b$ ,  $g$  and  $d$  are estimates for the parameters in Equation (5).

The OLS values are calculated in the estimation window  $(-266, -11)$ , which uses 250 days of returns prior to the event, where  $t = 0$  is the day of the event. The first 250 days of returns in the estimation window account for the factors that influence the general market and form the basis for determining *normal* returns for these companies. MacKinlay (1997) provided guidance to determine the length of estimation windows and was useful in developing methods to measure the size and significance of an event's effect on a firm's value.

To capture the general effect of a mass shooting event, we aggregate the abnormal returns ( $AR_{i,t}$ ) across events using an equally weighted portfolio of securities as specified in Costa, Leal, Lemme, and Lambranh (1997). As each event is weighted equally, this aggregated abnormal return ( $AAR_{i,t}$ ), represents the overall average effect of these shootings on the portfolio of securities. Additionally, to check for persistence in the period surrounding these shootings, we also calculate cumulative aggregated abnormal returns ( $CAAR_{i,t}$ ) in window  $(-3,+10)$ . As intense media coverage typically follows in the days after a shooting event there exists a strong possibility that these events continue to affect the market beyond the first day of the shooting.

The null hypothesis is that  $AR_{i,t}$ ,  $AAR_{i,t}$ , and  $CAAR_{i,t}$  are zero, which implies these company's returns after these shootings were within normal fluctuations. Failing to reject this null implies that these company's securities *did not* exhibit abnormal returns in response to a shooting event. On the other hand, rejecting the null hypothesis suggests that the market actually realized abnormal returns in the aftermath of these shootings. The statistical significance of the abnormal returns is computed for each using test statistics described in Brown and Warner (1985).

This research also posits that abnormal returns generated in the wake of a shooting event may reflect investor's beliefs on a firm's long-term profitability prospects. We follow Conte and Karr (2001, p. 44) and suggest that a company's stock price is a reflection of its perceived long-term earnings potential:

Investors are attracted to stocks of companies they expect will earn substantial profits in the future; because many people wish to buy stocks of such companies, prices of these stocks tend to rise. On the other hand, investors are reluctant to purchase stocks of companies that face bleak earnings prospects; because fewer people wish to buy and more wish to sell these stocks, prices fall.

In this context, if an event is viewed to negatively impact a company's future profitability, then its stock prices should fall. Likewise, events construed as positive information should improve prospects of future profitability and equity prices should correspondingly rise. Campbell and Ammer (1993), which examined factors that drive stock and bond markets and decomposed the variance for long-term assets returns, validated this approach. A key variable in their vector autoregressive model (VAR) to explain stock prices and long-term asset returns are "innovations," or surprise events sprung upon the markets. Because mass shootings are unanticipated, these events are likewise considered innovations, and play a role in explaining a company's stock prices, future long-run earnings potential and profitability.

As it related to this study, we consider a small arms company’s returns in the wake of a mass shooting as a reflection of that firm’s future profitability. Following a mass shooting, if shareholders believe that tougher gun laws will negatively affect future profits, or that holding shares in an arms company is unethical, companies may realize abnormal negative returns. Likewise, if investors do not believe these events will affect future arms sales and profitability, abnormal returns are not realized.

### 5. Results

Tables 1–3 summarize our results. Table 1 shows how each individual stock reacted to each of the six mass shooting events considered. Most notably, not a single company experienced a statistically significant abnormal return in the wake of a shooting. Despite the fact that 12 of the 18 security/shooting combinations exhibited negative returns immediately after a shooting event, it seems these downward adjustments were still within the bounds of normal market fluctuations. The security/event combination closest to being significant was Sturm Ruger, whose abnormal return of

**Table 1. Abnormal returns (AR) of deadliest mass shootings 2007–2013: Ruger, Smith Wesson, Taurus**

(1) Shooting	(2) Date of event	(3) Ruger	(4) S & W	(5) Taurus
Virginia Tech	16 April 2007	-0.797% (0.349)	-4.71% (-1.43)	4.87% (1.641)
Binghamton	3 April 2009	1.14% (0.282)	0.838% (0.155)	-1.63% (-0.576)
Fort Hood	5 November 2009	0.000% (-0.002)	1.951% (0.366)	-1.15% (-0.406)
Aurora (Batman)	20 July 2012	0.685% (0.231)	-0.282% (-0.085)	-2.25% (-0.813)
Sandy Hook	14 December 2012	-4.421% (-1.629)	-4.140% (-1.166)	-1.05% (-0.452)
Navy Yard	16 September 2013	-0.142% (-0.637)	-1.940% (-0.730)	0.070% (0.032)

Note: *t*-statistics are in parentheses.

**Table 2. Aggregated abnormal returns (AARs) for combinations of portfolios/events**

(1) Relative date	(2) AARs (All) (%)	(3) AARs (VT and SH) (%)	(4) AARs RGR & S & W (%)	(5) AARs RGR & S & W (VT & SH) (%)
-3	-1.10	-0.99	-0.80	-0.76
-2	-0.98	0.03	-1.36	-0.18
-1	0.46	-0.31	0.09	-0.49
0	-0.79	-1.71	-1.09	-3.52**
1	-1.39*	-3.44**	-1.33	-3.24**
2	-0.58	-3.06*	-0.49	-2.80
3	-1.59	-4.50	-2.13	-6.91*
4	2.10***	2.02	2.23**	3.28
5	-0.19	-0.64	-0.48	-0.89
6	0.70	1.68	1.20	2.14
7	0.19	-0.42	0.12	-0.77
8	-1.02***	-0.65	-0.88	-0.59
9	0.31	0.03	0.45	0.77
10	-0.45	0.35	-0.98	0.20

\*Statistically significant at the 0.10 level.

\*\*Statistically significant at the 0.05 level.

\*\*\*Statistically significant at the 0.01 level.



**Table 3. Cumulative aggregated abnormal returns measuring event persistence**

(1) Relative date	(2) CAARs (All) (%)	(3) CAARs (VT & SH) (%)	(4) CAARs RGR & S & W (%)	(5) CAARs RGR & S & W (VT & SH) (%)
-3	-0.52	-0.99	-0.80	-0.76
-2	-1.50	-0.95	-2.16	-0.94
-1	-1.04	-1.27	-2.07	-1.43
0	-1.83	-2.98	-3.16**	-4.95***
1	-3.22*	-6.42**	-4.50*	-8.19***
2	-3.80*	-9.48**	-4.99*	-10.99**
3	-5.39*	-13.97**	-7.13**	-17.90*
4	-3.29	-11.96***	-4.90*	-14.62**
5	-3.48	-12.60**	-5.38*	-15.51**
6	-2.78	-10.92*	-4.18	-13.37
7	-2.59	-11.34**	-4.05	-14.14*
8	-3.61	-11.98**	-4.93	-14.73*
9	-3.31	-11.96**	-4.48	-13.96*
10	-3.76	-11.60**	-5.46*	-13.76*

\*Statistically significant at the 0.10 level.

\*\*Statistically significant at the 0.05 level.

\*\*\*Statistically significant at the 0.01 level.

-4.4% following the Sandy Hook shooting, nearly met the 10% significance threshold. Overall, when considering securities and events individually, we find little evidence that individual stocks react negatively to individual shooting events.

However, despite a lack of abnormal returns at the individual level, we find more evidence that suggests markets reacted to these massacres when the shooting events are aggregated. When these massacres are jointly considered across an equally weighted portfolio of the arms companies, the collective small arms industry seemed to respond in a negative and significant manner. Table 2 presents four combinations of the companies and shootings considered. For example, in Column 2, an equally weighted portfolio of Sturm Ruger, Smith & Wesson, and Taurus found an AAR of -1.39% (significant at the 10% level) in the day following the attack, when all six events were considered.<sup>8</sup> On the fourth day, the portfolio of arms stocks rebound by 2.10% (1% significance) and then fell again by 1.02% (1% significance) eight days after the shooting. Column 3 considers all three weapons makers, but limits its scope to the Virginia Tech and Sandy Hook massacres. These two events merit special consideration because they represent the deadliest massacres in the sample with 32 and 27 victims, respectively—more than double the number of victims of the next closest shooting. And despite reducing sample to two events, the results and significance remain valid. This combination of the deadliest shootings finds evidence of aggregated abnormal returns finding negative returns of -3.44 and -3.06% in the two days following these shootings (significant at the 5 and 10% levels, respectively). Column 4 considers all six shooting events, but omits Taurus from the sample leaving the two American arms companies, Sturm Ruger and Smith & Wesson. Although negative returns were found on the day of, and after the massacres, none of the negative returns were statistically significant. Column 5 presented results from the most limited portfolio considered, which includes only Ruger and Smith & Wesson's collective response to the Virginia Tech and Sandy Hook massacres. Of all the samples considered, this more limited combination still offered a sufficiently large sample to produce valid results and exhibits the greatest magnitude negative abnormal returns in the wake of these events. On the day of, and the day following the shooting, this portfolio experienced negative abnormal returns of -3.52 and -3.24% (both significant at the 5% level). The third day following the massacre revealed an abnormal return of -6.91%. The results presented in

Table 2 suggest that when these shootings are considered collectively, these events seem to generally have a negative effect on portfolios of arms producers. Furthermore, the reactions appear most acute when only US securities and the deadliest shootings are considered.

To consider the possibility that these shootings persisted in affecting the markets, Table 3 presents the cumulative aggregated abnormal returns (CAARs). Significant and sizable CAARs may be evidence that these events continue to affect returns in the days following a shooting. In all four scenarios, the CAARs were sizable, ranging from  $-3$  to  $-15\%$  and usually significant. When all securities and events are considered, as in Column (2), the CAARs in the three days following the event are  $-3.22$  to  $-5.39\%$  and significant at the 10% level. When a full portfolio of securities and only the deadliest shootings are considered, as in Column (3), CAARs in all 10 days following a shooting are significant ranging between  $-6$  and  $14\%$ . Results in Column (4) show that when only US securities are considered, the effects of these events seem to persist and range between  $-3$  and  $-7\%$  for up to five days. When the sample is restricted to only US companies and the deadliest Virginia Tech and Sandy Hook shootings, as shown in Column (5), for the 10 days after the event, nearly all CAARs were significant with returns from  $-5$  to  $-15\%$ . These results provide some evidence that the arms industry continues to be affected by these mass shootings for several days afterward.

The results presented in Tables 1–3 suggest that the presence of abnormal returns varies with how events are aggregated as well as the severity of the shooting. When only individual security/event combinations are considered, as in Table 1, there is little evidence that the arms industry reacts negatively to news of a mass shooting in a manner significantly different than that of normal market fluctuations. Based solely on these results, one may be inclined to conclude that markets do not view these events as detrimental to the long-run health of a company. However, when these shootings are aggregated, as in Table 2, it seems these mass shootings may have a significant and negative impact on a portfolio of these securities when these shootings are considered collectively. Furthermore, the effects of these events tend to persist in the markets in the days following these events as shown in Table 3.

## 6. Conclusion

The robust press coverage surrounding mass shootings offer competing accounts on whether shareholders construe these events as likely to increase, reduce or remain neutral in regards to prospects for future firm profitability. This study aims to circumvent often contradictory media reports and political messaging to arrive at a clearer measure based on shareholder and market reactions to these tragedies. To this end, we analyzed three publicly traded small-arms companies for the presence of abnormal returns in the wake of these events. These abnormal returns serve as a proxy measure for shareholders belief on whether these events will negatively affect a company's future profitability, ostensibly through more restrictive future gun control legislation, and possibly stock selloffs for ethical reasons. Negative abnormal returns may imply that these events indeed dampened these company's long-term business prospects. Likewise, an absence of abnormal returns in the wake of these events may suggest that despite their horrific nature, society may place a high premium on weapons access or view weapon access as unrelated to these tragedies. In this scenario, shareholders may perceive that it is unlikely weapons access will be curbed in the future.

Our results suggest that shareholder response in the form of abnormal returns depends on the magnitude of the mass shooting and whether these events are analyzed individually or aggregated. When small arms companies and single events are considered individually, there is little evidence of abnormal returns in the wake of a mass shooting. Thus, a casual inspection of an individual stock return in the immediate aftermath of a shooting may lead one to conclude that market variations are within the bounds of normal market fluctuations, and that these events had minimal effect on a company's earnings prospects. However, when these shootings are aggregated, we find some evidence that that these companies reacted negatively to these shooting events. Shareholder reaction seems to be the most pronounced when the sample is limited to the deadliest shootings. Overall, these results suggest that individual shooting events are individually significant when considered

collectively, and that these tragedies may actually influence shareholders that stock selloffs or profit dampening arms control legislation is on the horizon.

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#### Notes

1. One of the nation's largest pension funds divested itself from firearm holdings for ethical reasons: <https://www.nytimes.com/2013/01/10/business/california-teachers-fund-to-divest-of-gun-stock.html>
2. The vast majority of these killings were shootings. The FBI defines a mass killing as the death of 4 victims, not including the perpetrator <https://www.fbi.gov/stats-services/publications/serial-murder/serial-murder-1#two>. The numbers of killings are largely based on the FBI's Supplemental Homicide Reports from 2006 to 2011. USA Today used local media reports and official records for 2012- 2013 [www.usatoday.com/story/news/nation/2013/09/16/mass-killings-data-map/2820423](http://www.usatoday.com/story/news/nation/2013/09/16/mass-killings-data-map/2820423).
3. Descriptions attributed to aforementioned USAToday article.
4. Daily stock prices for Ruger and Smith & Wesson were obtained through Yahoo! Finance. Historical prices for the Taurus, S&P500, IBOVESPA, as well as exchange rates were obtained through Eonomatica.
5. Rankings from [www.shootingindustry.com/u-s-fire-arms-industry-today-2012/](http://www.shootingindustry.com/u-s-fire-arms-industry-today-2012/).
6. Brown and Warner use the term "excess returns" in place of "abnormal returns" and conclude that the OLS market model outperforms simpler Mean Adjusted Returns and exhibit similar power and specification characteristics of more complicated procedures, such as Sholes-Williams and Dimson.

7. Taurus's beta coefficient, relative to the S&P 500 and IBOVESPA market indices were 0.57 and 0.58 respectively, from 29 March, 2006 until 31 December 2013, ( $T = 1954$  and 1911 observations. Both  $p$ -values = 0.00). These results imply movements in the price of Taurus stocks were just as correlated with the US market as with its own domestic market.
8. Calculations are based on the first day markets had the opportunity to react to the news of the shooting.

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