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Mass shootings, investors' panic, and market anomalies

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Abstract

Do mass shootings exacerbate investors' sentiments towards the stock market? We empirically examine this question using 1,947 cases of mass shootings in the US from February 2014 to May 2023. We document that investors react negatively to mass shootings, as evidenced by the drop in market index immediately following the incidence. Further analysis indicates that the impact varies by sectors and the impact of the shootings on market performance is correlated with the intensity of internet-related search about the event.

1. Introduction

Extant studies in the literature have identified several factors that cause stock market anomalies, including macroeconomic, fundamental, and non-fundamental factors (Jansen & Nahuis, 2003; Girard & Biswas, 2007; Sherif & Chen, 2019). In recent times, a thread of research has shifted attention to demonstrate how sentiment-based indicators also sway market outcomes (Sakariyahu et al., 2021; Dosumu et al., 2023). However, the impact of mass shootings on investors' sentiments and the consequence on market anomalies is yet to be explored, particularly in the context of the US where there is a prevalence of gun violence.

Over the years, gun violence has become a recurring cause of anguish for the American people and the perpetrators typically involve people with mental health problems or psychological trauma who gain access to firearms due to weak gun laws and then use them to kill random people. Anecdotal evidence suggests that the United States has a higher rate of gun-related mortality and gun ownership per capita than any other OECD country. While there are many different types of gun violence in the United States, mass shootings are the most distressing and prominent (Gopal & Greenwood, 2017). Indeed, mass shootings instil fear in society, and because financial investors are part of the societal structures in which weapons are embedded, the impact of such shootings could be transmitted to the stock market, thus creating a market anomaly.

Market anomalies are psychologically driven phenomena that challenge the assumptions of the efficient market hypothesis[1] (Avramov and Chordia, 2006). Anomalies occur when the expected market results, given a set of empirical models, differ from the actual results due to prevailing conditions. While anomalies do

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[1] Efficient market hypothesis postulates that security prices reflect all classes of information (past, public and present) and that no investor can devise a trading strategy to consistently outwit the market.

provide possibilities for arbitrageurs to earn abnormal returns, those opportunities typically vanish once they become common knowledge. Various forms of market anomalies have been documented including calendar effect, day of the week effect and announcement effects (Avramov & Chordia, 2006; Sakariyahu et al., 2021). Nonetheless, we are unaware of any research that has examined market anomaly from the perspective of mass shootings. The occurrence of mass shootings in the US provides a veritable ground to analyse such crucial interplay, given that anomalies frequently originate from events that have an impact on investors' attitudes towards the market.

Consequently, we employ data for 1947 cases of mass shootings in the US from February 2014 to May 2023. Our findings contribute to the behavioural strand of economic literature and resonate with similar existing studies (such as Dosumu et al., 2023; Karan, 2019). In this regard, we show that negative sentiment creeps into the market during incidence of mass shooting and impacts negatively on the return of the market, particularly for Dow-Jones index. When we further consider how internet search affects the market, our findings reveal a significantly negative correlation between market performance and internet-related search about the event. Additional analysis also reveals that the impact of mass shooting on market performance only lasts few days and varies by sector. The implications of our study also proffer relevant guidance to regulators and participants in the capital market.

2. Data and estimation strategy

The sample for this study covers the period from 3 February 2014 to 31 May 2023. To explain the impact of mass shootings on market anomalies, we use

daily price data of the US market indices and sectors[2], sourced from Centre for Research in Security Prices (CRSP) of US Stock Database. We convert the price data into returns and generate abnormal returns. CRSP is the world's largest and most comprehensive historical stock market dataset, and it has been extensively used in previous work (Gopal and Greenwood, 2017). It allows us to compute the daily movement of market indices and sectors by providing the stock price of every publicly traded company in the United States.

Our independent variables consist of 1,947 mass shootings that occurred across the United States within the sample period, sourced from the Gun Violence Archive. The main variables of concern are the number of deaths and injured due to the mass shooting. Our primary empirical method is an event study methodology of market movements which is widely used in the fields of economics (Jacob et al. 2015) and finance (Loon and Zhong, 2014). Using a market movement event research provides us with numerous substantial benefits. First, because the dependent variable (stock price or returns) exhibit a random walk, we alleviate concerns about serial correlation of the error terms. Second, the mass shootings are unpredictable events and exogenous in nature, hence the impact of the event on market outcomes are measured in the short term and do not require several covariates. Specifically, we apply this method to the 1,947 mass shootings and evaluate the effect of the explanatory variables on the anomalous returns using the market-adjusted model across a 1-, 2-, 5-, and 10-day timeframe. Below are empirical models for returns and abnormal returns:

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[2] The indices included in our analysis are S&P, Dow-Jones, and NASDAQ. For the sectorial return, our analysis covers the 11 sectors of the US market. These are Communication services, Consumer staples, Consumer discretionary, Information technology, Energy, Finance, Health care, Materials, Real estate, Industrials, Utilities.

$$R_{i,t} = (P_{i,t} - P_{i,t-1})/P_{i,t-1} \qquad (1)$$

$$AR_{i,t} = R_{i,t} - R_{m,t} \qquad (2)$$

Where $R_{i,t}$ represents the returns of the index/sector i over the relevant event window. $AR_{i,t}$ refers to the abnormal returns of the index/sector due to mass shooting event i at time t. $R_{m,t}$ refers to the overall sector return during the period of the mass shooting event and $P_{i,t}$ refers to the price. We therefore estimate the effect of mass shootings on both the returns and abnormal returns using the following OLS estimator:

$$AR_{i,t} = \alpha + \beta_1 Returns_{t-1} + \beta_2 Deaths_t + \beta_3 Injured_t + \varepsilon \qquad (3)$$

Death is the number of deaths due to the shooting and injured represents number of people injured in the incident. β_1 and β_2 represent the estimated parameters. The constant and error terms are represented by α and ε. Our empirical model is motivated by Gopal and Greenwood (2017).

3. Findings

We present the summary statistics of the variables in table 1. The results indicate that since 2014, the US has averaged more than one mass shooting a day, with at least one fatality and four injuries. Next, we report the outputs of the regression results. We generate four different outputs from our estimations. First, we examine the immediate impact of mass shooting on the returns of the sampled indices. Second, we assess if the returns of the indices vary materially by the level of internet search. Third, we explore the impact of the mass shooting on abnormal return of the US market for different days after the event. Lastly, we examine how mass shooting affects returns of various sectors of the US market.

Starting with the results of the sampled indices in table 2, we find that

mass shooting events have negative impact on the return of the market. In other words, negative sentiment creeps into the market during incidence of mass shooting. Our finding however reveals that the effect is more pronounced for Dow-Jones index. We infer from the results that investors' reaction to mass shooting significantly transmit to these indices, because of the fear of safety. Furthermore, we split the timeframe into different internet-related search and check whether the effect of mass shooting on market outcome is modulated by the intensity of search. Our findings in table 3 show that an occurrence of mass shooting leads to increased search on the internet and has a significantly negative impact on market performance.

In table 4, we consider the abnormal returns of the market for days after the event occurred. A trade-off exists when deciding on the window of investigation for event studies. The market and the return fluctuate, and a shorter window may not be long enough for the model to capture that, while a longer window may allow for other events to pollute the outcomes, leading to identification issues. To address this worry, we calculate the impact over a variety of time frames while holding the window size constant both before and after the occurrence. Since the shootings are completely at random, one would expect that a comparison of market prices before and after the incident would clearly reveal the impact of the gunshot on market behaviour. The likelihood of confounding events increases as the study time window grows larger. Our results reveal that the abnormal returns of the market were adversely affected in the first few days but later showed signs of recovery.

Finally, we evaluate whether the effect of mass shooting on market outcome differs by sector. The results in table 5 confirm our conjecture that the effect of mass shooting on the market varies with sector. The outputs

indicate that the negative impact of mass shooting on market behaviour is only significant for utilities, consumer staples, and finance. Other sectors such as health care, materials, real estate, industrials, and utilities produced mixed and insignificant results. Our result resonates with prior works such as Karan (2019).

4. Conclusions

We investigate whether mass shootings in the US have significant effects on stock market anomalies. The findings indicate that market indices react negatively to mass shootings and the impact also varies across sectors. The findings also reveal that the impact of the shootings on market performance is more pronounced as internet search increases. Lastly, we report that the impact of mass shooting takes immediate toll on the market up to few days before the effect begins to subside. Our findings are informative and provide significant guidance to portfolio managers in designing appropriate trading mechanisms to insulate their portfolio from unpredictable events. We also believe governments at all levels can also adopt our findings as a policy yardstick towards enacting strict gun laws.

References

Avramov, D., & Chordia, T. (2006). Asset pricing models and financial market anomalies. *The Review of Financial Studies*, *19*(3), 1001-1040.

Dosumu, O. E., Sakariyahu, R., Oyekola, O., & Lawal, R. (2023). Panic bank runs, global market contagion and the financial consequences of social media. *Economics Letters*, 111170.

Girard, E., & Biswas, R. (2007). Trading volume and market volatility: Developed versus emerging stock markets. Financial Review, 42(3), 429−459

Gopal, A., & Greenwood, B. N. (2017). Traders, guns, and money: The effects of mass shootings on stock prices of firearm manufacturers in the US. *PloS one*, *12*(5), e0177720.

Jacob, B.A., Kapustin, M., Ludwig, J. 2015. The Impact of Housing Assistance on Child Outcomes: Evidence from a Randomized Housing Lottery. The Quarterly Journal of Economics. 130(1) 465- 506

Jansen, W. J., & Nahuis, N. J. (2003). The stock market and consumer confidence: European evidence. Economics Letters,79(1),89−98.

Karan, J. (2019). The Economics of Mass Shootings: How Investors React. *Journal of Accounting & Finance (2158-3625)*, *19*(7).

Loon, Y. C., & Zhong, Z. K. (2014). The impact of central clearing on counterparty risk, liquidity, and trading: Evidence from the credit default swap market. *Journal of Financial Economics*, *112*(1), 91-115.

Sakariyahu, R., Sherif, M., Paterson, A., & Chatzivgeri, E. (2021). Sentiment☐ Apt investors and UK sector returns. *International Journal of Finance & Economics*, *26*(3), 3321-3351.

Sakariyahu, R., Lawal, R., Oyekola, O., Dosumu, O. E., & Adigun, R. (2023). Natural disasters, investor sentiments and stock market reactions: Evidence from Turkey−Syria earthquakes. *Economics Letters*, *228*, 111153.

Sherif, M., & Chen, J. (2019). The quality of governance and momentum profits: International evidence. *The British Accounting Review*, *51*(5), 100835.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Price_ S&P	3067	3016.946	870.306	1741.89	4796.56
Return_S&P	3066	0.001	0.012	-0.012	0.014
Price_NASDAQ	3067	8658.689	3496.55	3996.96	16057.44
Return_NASDAQ	3066	0.001	0.014	-0.123	0.093
Price_Dow-Jones	3067	2,403.58	394.10	1,029.61	2517.91
Return_Dow-Jones	3066	0.004	0.011	-0.091	0.053
Victims_injured	1947	3.682	1.869	1.00	19
Victims_killed	1947	1.092	1.586	1.00	21

Table 2: Mass shooting and market reactions for different market indices

	S&P	NASDAQ	Dow-Jones
Return$_{t-1}$	0.310*	0.204***	0.129**
	(0.001)	(0.103)	(0.062)
Death	-0.001	0.007	-0.034*
	(0.041)	(0.004)	(0.009)
Injured	-0.102	0.004	0.015**
	(0.002)	(0.001)	(0.120)
R²	0.226	0.310	0.239

Table 3: Mass shooting and market reactions according to internet search

| | Google search | | | Twitter | | |
	S&P	NASDAQ	Dow-Jones	S&P	NASDAQ	Dow-Jones
Return$_{t-1}$	0.035*	0.106	0.285*	0.339*	-0.185**	0.420**
	(0.001)	(0.174)	(0.067)	(0.132)	(0.330)	(0.032)
Death	0.030	-0.021	0.033	0.041	0.020	-0.173*
	(0.119)	(0.002)	(0.004)	(0.001)	(0.012)	(0.000)
Injured	0.001	0.002	-0.021	-0.055	0.059	-0.038*
	(0.011)	(0.017)	(0.024)	(0.033)	(0.100)	(0.004)
Internet_search	-0.124*	-0.160*	-0.144	-0.103	-0.180*	-0.017*
	(0.103)	(0.001)	(0.012)	(0.030)	(0.112)	(0.001)
R²	0.301	0.249	0.422	0.250	0.281	0.209

Table 4: Mass shooting and stock market reactions days after event.

	1 day after	3 days after	5 days after	10 days after
Return$_{t-1}$	-0.021**	-0.047*	0.035***	0.068
	(0.000)	(0.026)	(0.009)	(0.022)
Death	-0.0178*	-0.053***	0.064	0.099*
	(0.006)	(0.008)	(0.001)	(0.033)
Injured	0.045**	0.041	0.039*	0.048
	(0.011)	(0.022)	(0.113)	(0.110)
R²	0.209	0.221	0.253	0.216

Table 5: Mass shooting and stock market returns across sectors

	Returns for different sectors										
	1	2	3	4	5	6	7	8	9	10	11
Return$_{t-1}$	-0.201 (0.001)	0.136* (0.057)	0.108 (0.007)	-0.239 (0.011)	0.108 (0.002)	-0.014* (0.012)	0.110 (0.056)	0.160 (0.011)	-0.119 (0.064)	0.168 (0.141)	0.212*** (0.105)
Death	0.032 (0.041)	-0.032* (0.100)	0.140 (0.204)	0.140 (0.102)	-0.200 (0.001)	-0.107* (0.031)	-0.192 (0.011)	-0.082 (0.091)	0.155 (0.001)	-0.201 (0.003)	-0.247* (0.211)
Injured	-0.001 (0.001)	-0.056* (0.034)	-0.331 (0.004)	0.145 (0.000)	-0.183 (0.014)	-0.043* (0.004)	0.073 (0.096)	-0.131 (0.001)	0.117 (0.009)	0.102 (0.107)	-0.148* (0.175)
R^2	0.129	0.168	0.102	0.230	0.221	0.309	0.374	0.302	0.253	0.246	0.229

1-11 represent the different sectors in the US market as follow: (1) Communication services (2) Consumer staples (3) Consumer discretionary (4) Information technology (5) Energy (6) Finance (7) Health care (8) Materials (9) Real estate (10) Industrials (11) Utilities
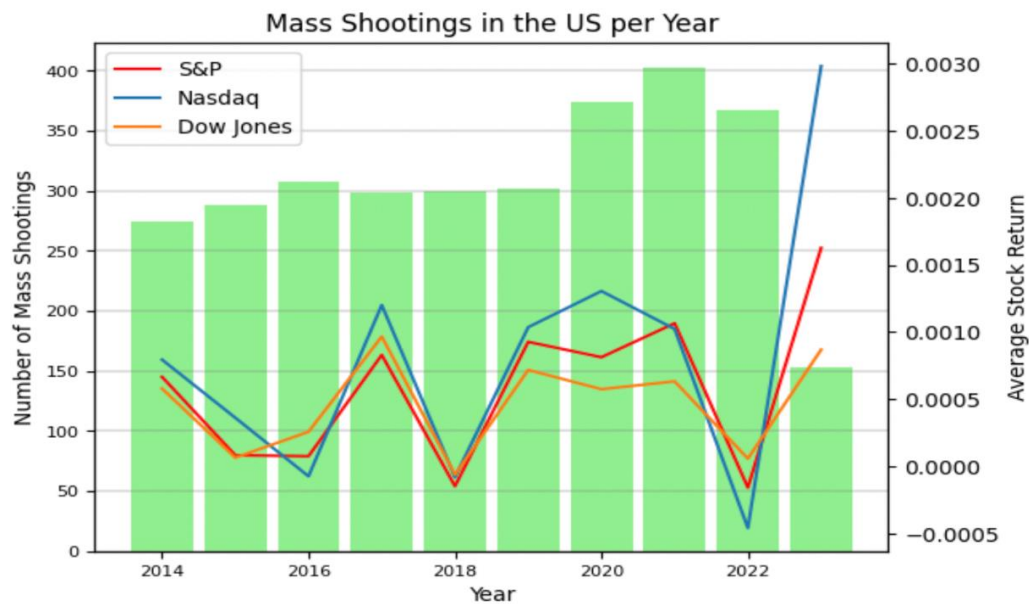
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Highlights

- Negative investor sentiment creeps into the market during incidence of mass shooting.

- There is a significant negative impact of mass shooting on the return of the US market, albeit more pronounced for Dow-Jones index.

- We show that an occurrence of mass shooting is correlated with the intensity of internet-related search about the event.

- Our results reveal that the abnormal returns of the market were adversely affected in the first few days but later showed signs of recovery.

- Lastly, the effect of mass shooting on the market varies with sector.