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Does the Stock Market React to a Terrorist Attack? Evidence from 9/11 Attack Using Event Study

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Abstract: The global economy and financial markets around the world are said to be adversely affected by the terrorist attack of 11 September 2001. The present study empirically evaluates the impacts of terrorist attacks on the top 20 stock market indices of the world. The Event study approach is used to conclude that there is a significant impact of the terrorist attack on stock indices of the selected countries, as the following stock market indices showed an adverse abnormal return on the day of the event namely, New York Stock Exchange, NASDAQ, Shenzhen Stock Exchange, National Stock Exchange of India, Frankfurt Stock Exchange, Bombay Stock Exchange, Euronext Paris Exchange, Johannesburg stock exchange and Euronext Brussels. While the rest of the selected stock markets showed a positive abnormal return on the event date. In the following days of the event, the Stock exchange in China showed a negative abnormal CAR for 80 days, while stock exchanges in India showed a negative abnormal CAR in the 20 days following the event. Most of the stock exchanges were not much affected by the event, even if there was an effect it didn't last long, as the abnormal return was positive after a while.

Keywords: Terrorism, stock markets, 9/11 attacks and Event Study.

1. Introduction

The definition of terrorism has been interpreted differently by various social scientists. There are several meanings of terrorism, therefore it is a phrase that is open to interpretation. Some people may use the idea of terrorism as a justification for their holiness or as a means of retaliation against oppressors. Some people could view it as an unpardonable crime (Enders and Sandler, 2011). Terrorism, an age-old phenomenon that has afflicted humanity for generations, not only causes deaths and other physical harm but also has a greater psychological impact. Statistics on the number of people injured, killed, and property destroyed as a result of terrorist attacks and activities demonstrate that the psychological effects of terrorism are increasing daily. The primary the reasons for terrorism and terrorists are the same throughout the world: to cause damage, destroy nationwide

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assets and capital, disrupt service-based operations, and attract attention. Terrorist operations instill the nation with fear, panic, insecurity, and uncertainty (Keeney & Von Winterfeldt, 2010: Aslam & Kang, 2015). In addition, it influences the political, foreign, and economic conditions of a nation (Asongu, Uduji, & Okolo-Obasi, 2020; Atr, 2004).

In general, our study focus on the impact of terrorist attacks on the stock market. One of the most sensitive topics is terrorism factors to which a stock market is exposed, as it affects the investment sentiment of investors. A stock market is essential to the economic growth and development of a nation. It is a suitable instrument for mobilizing and allocating funds among competing purposes that are vital for the growth and productivity of a nation's economy. A progressive stock market reflects the health and vitality of the economy and serves as a barometer of a nation's economic growth (Dagar, 2014). The stock market is extremely susceptible to simultaneous events such as terrorist attacks, financial crises, and military coups. The country's credit policy, inflation, interest rates, stock market volume, political climate, investor herd behavior, risk aversion, internal development, financial situation, peace conditions, lending costs, and currency exchange rates are a few elements that affect stock market volatility. (Ghufran, Awan, Khakwani, & Qureshi, 2016; Wiloski, 2015). Due to the disclosure of fresh information within the country, the trading of equities on the stock market exhibits substantial price volatility (Wiloski, 2015).

The rest of the paper is organized as follows: Section II introduces the literature review; Section III presents the research methodology; Section IV provides results and discussion; and Section V presents the conclusion.

2. Literature review

This brief literature review will focus on a few important studies that utilize data from the United States and several other industrialized nations. One of the earlier studies on this topic found that the economic effects of terrorism are greater in economies with a more open structure than in those with a more closed structure (Hamilton and Hamilton, 1983). Some research investigates the effects of terrorist attacks on the tourism business using a vector autoregressive model (Enders and Sandler, 1991). They observed that despite the fact that the tourism industry may recover from terrorist attacks, significant lag effects persisted for extended periods of time. Others have studied the effects of terrorist strikes on numerous macroeconomic indicators (Drakos and Kutan, 2003; Larocque, Lincourt and Normandin, 2010). Many of the available studies on the effect of terrorism on financial market performance were undertaken just after the September 11 attacks in the United States. They have explored whether the amount of market risk as measured by betas has altered since the September 11th attacks (Choudhry, 2005). Few studies have examined the relationship between terrorism and stock market mood and concluded that market integration is one of the key drivers of the magnitude of terror incidents' effects on a nation's stock markets. (Nikkinen, Omran, Sahlstrom and Aijo, 2008; Nikkinen and Vahamaa, 2010). Based on data from six nations, a study suggests that

terrorist attacks have a negative effect on stock market returns, with the impact being greater in rising economies (Arin, Ciferri, and Spagnolo, 2008). In contrast, research using Israeli data indicated that terror acts had no substantial impact on the stock market or foreign exchange market (Eldor and Melnick 2004). Certain developing nations, such as Iran and Pakistan, have established a correlation between terrorist acts and stock market performance (Nguyen and Enomoto, 2011). (Kollias, Papadamou, and Arvanitis, 2013). Several recent studies have examined the effect of terrorist attacks on stock returns. (Hobbs, Schaupp and Gingrich, 2016; El, 2019; Wang and Young, 2020). The findings indicate that although the effects of terrorist attacks on stock market returns are multidimensional, these effects are persistently more significant if the event is a large one. Existing research have also analyzed daily stock and bond returns from European countries to conclude that financial markets can be influenced by security shocks such as terrorist acts. However, compared to other countries, terrorist incidents occurred more frequently in the United States (Wang and Young, 2020). Their research indicates a considerable decline in investor risk preferences around the time of terrorist strikes. In addition, some recent studies suggested that terrorist attacks caused higher stock market volatility in European markets and discovered that the extent of stock market volatility is proportional to the intensity of the assault (Corbet, Gurdgiev and Meegan, 2018).

There is a wide literature available related to our study and the whole work is done in most effective and efficient manner, but there is always a limitation of the time period, availability of data, financial resources, and many more. So there is a gap between the existing literatures on which the present research is conducted. In this study, we focus on the top 20 stock market indices in the world on the basis of capitalization and how the 9/11 attacks affected these stock market indices. In general, our studies focus on the impact of terrorist attacks on the stock market. Hence based on the above, we assume the following hypothesis:

$H_{0\text{-}1}$: There is no significant impact of the terrorist attack on financial markets.

3. Methodology

The data considered in the study is about the stock market indices of selected countries which include the Top 20 stock market indices all over the world on the basis of market capitalization. The data regarding stock market indices have been collected from the stock exchange's official website yahoo finance and Wall Street Journal respectively. Further, the data regarding the terrorist attacks has been gathered from Global Terrorism Database (GTD).

Table 1: List of Sample Selected Stock Exchanges

Stock Exchange	Country	Representative Index	Market Capitalization
New York Stock Exchange	USA	The NYSE Composite Index	$26 trillion
NASDAQ Stock Exchange	USA	Nasdaq Composite and Nasdaq 100	$24.32 trillion
Shanghai Stock Exchange	China	SSE Composite Index	$7.96 trillion
Tokyo Stock Exchange	Japan	Nikkie 225	$6.48 trillion
Shenzhen Stock Exchange	China	SZSE Component index	$6.14 trillion
Hong Kong Stock Exchange	Hong Kong	Hang Seng Index	$5.50 trillion
National Stock Exchange of India	India	Nifty 50	$3.43 trillion
Frankfurt Stock Exchange	Germany	The DAX	$2.39 trillion
Bombay Stock Exchange	India	BSE Sensex	$2.22 trillion
Swiss Stock Exchange	Switzerland	Swiss Market Index	$2.19 trillion
South Korea Stock Exchange	South Korea	KOSPI Index	$2.12 trillion
Euronext Paris Exchange	France	The CAC 40 Index	$2.09 trillion
Taiwan Stock Exchange	Taiwan	The Taiwan Stock Exchange Capitalisation Weighted Stock Index	$1.94 trillion
Johannesburg Stock Exchange	South Africa	FTSE/JSE	$1.09 trillion
Brazil Stock Exchange	Brazil	Brazil Stock Exchange Index	889.93 billion
Madrid Stock Exchange	Spain	IBEX 35	$743.08 billion
Euronext Amsterdam Stock Exchange	Netherlands	AEX index AMX index AScX index	$728.49 billion
Singapore Exchange	Singapore	The Straits Times Index	$651.36 billion
Indonesia Stock Exchange	Indonesia	IDX Composite/ Jakarta Islamic Index	$565.22 billion
Euronext Brussels	Belgium	BEL 20	$414.56 billion

Source: Authors own compilation

3.1. Event Study Methodology

The study has utilized the Event Study Approach to analyze the data. The daily closing price was calculated using the formula:

$$Rct = 1n (Pct/Pct-1)$$

Where, Rct is the daily index return of the stock of the country c at the time t, Pct and Pct-1 are the price of the stock market index on a daily basis of the county c and t represents time and t-1 also represents time respectively.

Despite the fact there is no distinctive structure for executing the "event study" approach, there are some precise frameworks that need to be followed for the execution of the analysis. This framework starts with specifying the date of the event. In the case of this study, the date we have considered is the date of the event which is the date on which the terrorist attack took place. Thereafter, the "period of estimation" and the "period of the event" is required to be determined for conducting the examination of the time series. Usually, the "period of estimation" and the "period of event" are not overlying. The "estimation period" as per MacKinlay is the period of time that is considered to compute the approximate return forecasted by the market surrounding the "date of the announcement" which is the event date. In this study we have employed 250 trading days preceding to the event date as our period estimated. To simplify the investigation time duration around the event, the "event period" is conventionally interpreted to be more wide-ranging than the certain interest period. This apprehends the probable implication of insider trade dealing prior to the event and also the events long lasting repercussions.

Provided the regrettable reality that terrorist attacks are unpredictable, we started our analysis on the impact of terrorist attacks on various selected stock markets from the date of the event that is the date of the attack, and use "event windows" in addition to concentrating on the event date. The event windows employed are (10) days preceding the event date, 5, 10, 20, 40 and 80 days succeeding the event date. We have considered different event windows to examine the impact of terrorist attacks on different dates and to also find out how soon the market accepted the news. It's likely that the preliminary concerns and ambiguity may continue keeping the market index low, while uncertainties are rapidly dispelled by the introduction of new information and leading the stock market to recuperate. The response to the proclamation a terrorist attack is calculated by forecasting a "normalized" return for the stock index throughout the "event window" and then reducing this return from the real return obtained on the day of the terrorist attack and days succeeding days of the terrorist attack.

Accordingly:

$$ARc,t = Rc,t - E(Rc,t)$$

ARc,t is referred to as the Abnormal Return or the Excess Return of the stock market index of the country 'c' at the time t, E(Rc,t) is referred to as the Expected Return of the stock market index of the country 'c' at time t.

The event day abnormal return can be used to gauge the rapid response of investors to the occurrence of the terrorist attack. The Cumulative return in the following days or weeks may furnish a more accurate picture of the market flexibility and capability to rebound from the terrorist attack. So, it would be captivating to test if CAR is equal to Zero in each of the event windows, once the abnormal

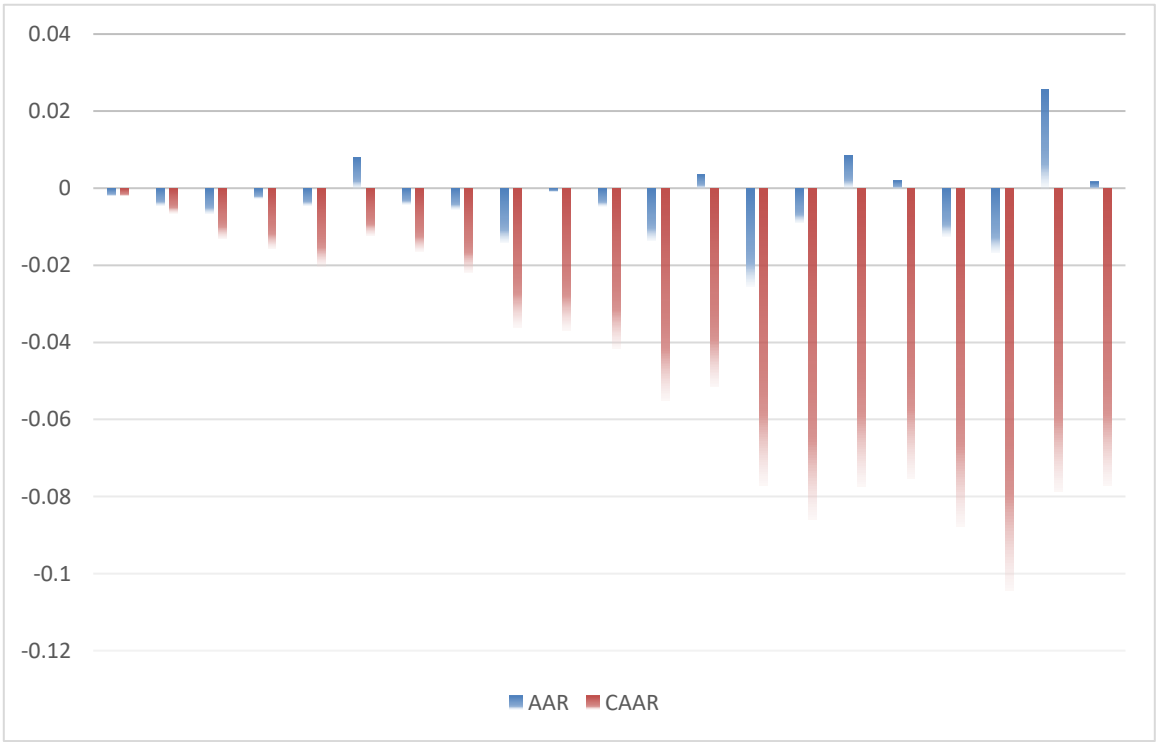
return time series is made. Thus, we find out whether the CAR is notably different from zero on event date and throughout the event windows.

4. Analysis and Discussion

At the outset, the descriptive statistics of the top 20 stock market in the world are presented in Table 2. For the Mean and Standard Deviation table we have taken the event window as 10 days prior to event and 10 days post-event. In case of the top 20 stock exchanges in the world on the basis of market capitalization, in the pre-event window Shanghai stock exchange, Shenzhen stock exchange, and Indonesia stock exchange showed a positive mean while the rest of the stock exchanges had a negative mean. At the same time in the case of the post-event window, every stock exchange showed a negative mean except New York Stock Exchange.

From the figure 1, we can see the Average Abnormal return and Cumulative Average Abnormal Return of the Top 20 stock indices in the world. In the chart, the event day is marked as 0 on the axis and the days preceding that are pre-event and the days succeeding are the post-event. The Cumulative Average Abnormal Return showed a negative return as a whole. While the Average Abnormal Return showed a negative return to a great extent but at the same time there were certain positive returns as well.

Figure 1: AAR and CAAR of selected Stock Markets



Source: Authors own compilation

Table 2: Descriptive Statistics of selected Stock Markets in the world

Stock Market	Pre-Event		Post-Event	
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**
New York Stock market	-0.0068	0.0088	0.0002	0.0196
NASDAQ Stock market	-0.0121	0.0133	-0.0061	0.0278
Shanghai Stock Exchange	0.0017	0.0160	-0.0038	0.0091
Tokyo Stock market	-0.0098	0.0191	-0.0069	0.0334
Shenzhen Stock market	0.0006	0.0182	-0.0079	0.0146
Hong Kong Stock market	-0.0079	0.0159	-0.0116	0.0373
National Stock market of India	-0.0037	0.0032	-0.0166	0.0312
Frankfurt Stock market	-0.0144	0.0182	-0.0057	0.0395
Bombay Stock market	-0.0041	0.0040	-0.0179	0.0328
Swiss Stock market	-0.0097	0.0128	-0.0031	0.0393
South Korea Stock market	-0.0048	0.0169	-0.0124	0.0470
Euronext Paris Exchange	-0.0111	0.0118	-0.0035	0.0320
Taiwan Stock market	-0.0021	0.0146	-0.0121	0.0158
Johannesburg Stock Exchange	-0.0054	0.0065	-0.0061	0.0324
Brazil Stock market	-0.0058	0.0095	-0.0078	0.0330
Madrid Stock Exchange	-0.0102	0.0160	-0.0042	0.0335
Euronext Amsterdam Stock market	-0.0114	0.0121	-0.0046	0.0400
Singapore Stock market	-0.0040	0.0099	-0.0175	0.0320
Indonesia Stock market	0.0006	0.0099	-0.0083	0.0207
Euronext Brussels	-0.0059	0.0096	-0.0042	0.0253

Source: Authors own compilation

As the table represents, the stock markets in the following top 20 stock market indices showed an adverse abnormal return on the day of the event namely, New York Stock Exchange, NASDAQ, Shenzhen Stock Exchange, National Stock Exchange of India, Frankfurt Stock Exchange, Bombay Stock Exchange, Euronext Paris Exchange, Johannesburg stock exchange and Euronext Brussels. While the rest of the selected stock markets showed a positive abnormal return on the event date. Further, it showed significance at 1% for New York Stock Exchange, Frankfurt stock exchange, Euronext Paris, and Euronext Brussels. While, NASDAQ, Tokyo Stock exchange, South Korea stock exchange, Madrid stock exchange, and Amsterdam stock exchange showed significance at 5%. In the following days of the event, the Stock exchange in China showed a negative abnormal CAR for 80 days while stock exchanges in India showed a negative abnormal CAR in the 20 days following the event. Most of the stock exchanges in the top 20 list were not much affected by the event, even if there

was an effect it didn't last long, as the abnormal return was positive after a while. Thus, CAR becomes statistically insignificant in the short span of time after the event. The significance at 1% was shown only for New York Stock Exchange, Hong Kong Stock Exchange, Frankfurt Stock Exchange, Euronext Paris, and Euronext Brussels on the event day. In short, in case of top 20 stock market indices in the world, the impact of the September 11 attack didn't last long and the abnormal return became positive again. In the selected countries, it was observed that in most cases the stock indices recovered quite rapidly, there were rarely cases where the negative cumulative abnormal return was more than 20 days.

Table 3: Abnormal Returns and Cumulative Abnormal Return of selected Stock Exchanges

Stock Exchange	**Event - Day AR**	**-10 Day CAR**	**5+ CAR**	**10+ CAR**	**20+ CAR**	**40+ CAR**	**80+ CAR**
New York Stock Exchange	-0.0455 (0.0000)***	-0.0038 (0.9136)	-0.0807 (0.0014)***	-0.0401 (0.2570)	-0.0012 (0.9707)	0.0181 (0.6085)	0.0610 (0.0852)*
NASDAQ Stock Exchange	-0.0656 (0.0348)**	0.0006 (0.9925)	-0.1008 (0.0543)**	-0.1012 (0.1714)	0.0608 (0.4105)	0.1924 (0.0096)***	0.3945 (0.0000)***
Shanghai Stock market	0.0030 (0.7591)	0.0089 (0.7913)	-0.0330 (0.1685)	-0.0357 (0.2928)	-0.0374 (0.2701)	-0.0644 (0.0580)**	-0.0617 (0.0694)*
Tokyo Stock market	0.0313 (0.0207)**	-0.0047 (0.9108)	0.0141 (0.6368)	0.0308 (0.4663)	0.0682 (0.1079)	0.0897 (0.0348)**	0.0348 (0.4112)
Shenzhen Stock market	-0.0043 (0.6784)	0.0115 (0.7424)	-0.0773 (0.0021)***	-0.0827 (0.0192)***	-0.0759 (0.0314)**	-0.0690 (0.0504)*	-0.0438 (0.2130)
Hong Kong Stock market	0.0337 (0.0081)***	0.0089 (0.8369)	-0.0241 (0.4304)	0.0029 (0.9463)	0.0997 (0.1036)	0.0372 (0.6666)	-0.0294 (0.8101)
National Stock market of India	-0.0095 (0.5563)	-0.0009 (0.9834)	-0.1302 (0.0000)***	-0.1689 (0.0002)***	-0.0698 (0.2686)	0.0105 (0.9062)	0.1531 (0.2251)
Frankfurt Stock market	-0.0606 (0.0000)***	-0.0157 (0.7041)	-0.0348 (0.2331)	-0.0464 (0.2613)	0.0385 (0.5093)	0.0486 (0.5556)	0.0396 (0.7344)
Bombay Stock market	-0.0102 (0.5452)	-0.0006 (0.9895)	-0.1262 (0.0001)***	-0.1808 (0.0001)***	-0.0658 (0.3110)	0.0135 (0.8827)	0.1681 (0.1961)
Swiss Stock market	0.0138 (0.1422)	-0.0129 (0.7112)	0.0219 (0.3731)	0.0244 (0.4844)	0.0678 (0.1695)	0.0973 (0.1631)	0.0819 (0.4060)
South Korea Stock market	0.0318 (0.0337)**	-0.0006 (0.9918)	0.0134 (0.7317)	0.0403 (0.4671)	-0.0052 (0.9473)	-0.0309 (0.7808)	0.0883 (0.5736)

Euronext Paris Stock market	-0.0497 (0.0000)***	-0.0158 (0.6918)	-0.0281 (0.3179)	-0.0126 (0.7520)	0.0327 (0.5617)	0.0619 (0.4368)	-0.0050 (0.9648)
Taiwan Stock market	0.0123 (0.4909)	0.0001 (0.9979)	0.0331 (0.3905)	0.0028 (0.9593)	0.0390 (0.6125)	0.0443 (0.6844)	0.2265 (0.1423)
Johannesburg Stock market	-0.0216 (0.0561)*	-0.0023 (0.9491)	-0.0943 (0.0003)***	-0.0800 (0.0289)**	-0.0037 (0.9433)	0.0046 (0.9498)	0.2090 (0.0434)**
Brazil Stock market	0.0247 (0.1334)	0.0037 (0.9382)	0.0182 (0.5938)	0.0157 (0.7454)	-0.0089 (0.8962)	0.0124 (0.8980)	0.0018 (0.9897)
Madrid Stock market	0.0269 (0.0367)**	-0.0142 (0.7406)	0.0337 (0.2680)	0.0621 (0.1490)	0.0721 (0.2362)	0.1253 (0.1456)	-0.0700 (0.5651)
Euronext Amsterdam Stock market	0.0216 (0.0190)**	-0.0137 (0.7057)	0.0361 (0.1609)	0.0390 (0.2840)	0.0864 (0.0938)*	0.1033 (0.1564)	0.0662 (0.5198)
Singapore Stock market	0.0133 (0.2952)	0.0129 (0.7380)	-0.1285 (0.0000)***	-0.1466 (0.0002)***	-0.0557 (0.3085)	-0.0660 (0.3932)	0.2468 (0.0246)**
Indonesia Stock market	0.0085 (0.5037)	-0.0007 (0.9862)	-0.0569 (0.0393)**	-0.0639 (0.1007)	-0.1709 (0.0021)***	-0.1701 (0.0294)**	0.1542 (0.1614)
Euronext Brussels	-0.0465 (0.0000)***	0.0000 (0.9995)	-0.0659 (0.0038)***	-0.0656 (0.0406)**	0.0056 (0.9007)	-0.0112 (0.8612)	-0.0171 (0.8494)

Source: Authors own compilation

5. Conclusion

This study has utilized the "event study" methodology to concentrate on the association between a terrorist attack and stock market performance of the selected countries. Especially, we have considered Top 20 Stock exchanges in the world on the basis of market capitalization for our study. We have studied the relationship between the stock market indices of the specified countries and the 9/11 terrorist attack on the World Trade Centre and the Pentagon in US. The policymakers or the governments are also affected by a terrorist attack. The working of the nation is affected by a terrorist attack, it causes instability in the nation and leads to economic and social negative impacts. The attack can distort the smooth functioning of the government and create a deficit in the economy or lead to chaos. Thus, if the government takes the necessary steps in the appropriate time, then they can easily recover and start functioning normally. Overall, we can conclude that there is a significant impact of the terrorist attack on the stock market indices of the countries selected. The impact of the terrorist attack is majorly witnessed in the local market than in the global market, as it's the country that has

been under the attack is the one to face negative economic, financial, and social crises. At the same time, we can also say that the stock market indices recover quickly, as in the case of the 9/11 attack the stock market was closed only for four trading days and started functioning normally by 17th November 2001. Further, it can also be seen that the investors digest the news of terrorist attack better compared to the earlier days. The study is focused only on selected stock market indices of the countries. The scope of the study is limited to only a few selected stock exchanges. We have only used event study methodology to do the analysis and no other method has been considered for doing the study. Various other methods can be used to do the study. The study can be done by using various other methods like Regression, Correlation, etc.

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