

# **Impact of Terrorism on International Stock Markets**

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*This article investigates the impact of terrorist attacks on global capital markets. We find economic consequences of terrorist attacks spillover through trading partners. When a bigger economy (measured by GDP) is targeted, the spillover is specifically prominent for economically smaller trading partners. Such partners see a -2.5% reduction in national stock indices. Odds for smaller trading partners experiencing a negative abnormal stock impact are over 5.7 times greater than other countries. An attacked country's bigger trading partners do not experience a decline in stock indices. Democratic countries are more vulnerable while country specific trade characteristics do not contribute to spillover.*

## **INTRODUCTION**

Terrorist attacks are geopolitical events that are believed to have an adverse effect on national and global economy. These attacks have direct and indirect financial consequences. The direct costs include human losses as well as financial losses associated with damage to property and infrastructure. Indirect losses could be significantly higher than direct losses, as terrorism could negatively affect consumer behavior and investor confidence, which could be manifest in the stock market and the economy (Karolyi 2006). Research has shown ill effects of terrorist attacks in the form of lower stock returns (Drakos, 2009; Chen and Siems, 2004), diminished economic growth (Abadie and Gardeazabal, 2003), and higher commodity prices (Giodolin and La Ferrara, 2010).

Globalization and open economies have resulted in markets that are interlinked by trade and financial channels. In the last few decades, there has been an increase in global trade (Arora and Vamvakidis, 2005). The growing economic integration between countries could make international markets influence each other's performance. Positive or negative news about a country's financial markets have the potential to affect the performance of financial markets across the world. This implies that in today's tightly interlinked capital markets, terrorist attacks may have financial implications beyond national boundaries. Negative financial consequences of terrorism may not be limited to the attacked country.

Research has identified various event types that impact financial markets across borders. Some of these events include financial crisis (e.g., Asian crisis of 1997) terrorist attacks (e.g., World Trade Center Attacks of 2001), currency devaluation (e.g., Mexican devaluation of 1994), and change in credit ratings (e.g., Euro countries in 2011). Although some studies have shown that economic effects of events such as terrorist attacks spillover in international markets, little is known about what makes countries vulnerable to spillover and through which mechanisms spillover occurs (Classens and Forbes, 2001). Some studies

point to financial links between countries as an important spillover transmission mechanism (Kaminsky and Reinhart, 2000).

We use national stock indices to assess the financial impact of terrorist attacks. A national stock index quantifies the performance of stock markets in a country. Stock market performance reflects investor's beliefs and views about "future cash flows and discount rates and the liquidity of financial markets provides an efficient conduit for these views to be quickly reflected in asset" (Karolyi and Martell, 2010). Broun and Derwall (2010) suggest that terrorist attacks produce mildly negative price effects, but they recover within a week. Therefore we focus on short term effects on stock indices. Specifically, we study one, six, and eleven days cumulative abnormal returns.

This paper contributes to the literature by developing a deeper understanding of economic spillover from terrorist attacks through trading partners in international stock markets. To the best of our knowledge this is the first paper that systematically studies and finds that terrorist attacks have negative financial impact across borders. We identify trading partners and economic size (as measured by GDP) as mechanism by which financial losses from terrorist attacks spillover to other countries. A trading partner on an average experiences a -1.90% drop in stock index after a terrorist attack. When a bigger economy is targeted, the spillover is specifically prominent for economically smaller trading partners. Such partners could see a -2.5% reduction in stock index following a terrorist attack. The odds for a smaller trading partner experiencing a negative abnormal stock index are also over 5.7 times greater than other countries. Trading partners bigger than the attacked country did not experience negative financial effects on national stock indices. Trade characteristics of a country as defined by Trade Dependence Index (TDI), Import Penetration Index (IPI), and Export Penetration Index (EPI) have no effect on spillover. We also reveal vulnerability of democratic countries as they experience more spillover of economic consequences of terrorist attacks at trading partners. Our results are not driven by any major terrorist attack. The statistical significance of the results remains unchanged even after removing 2001 World Trade Center attacks (henceforth 9/11) from our dataset.

There have been many studies relating terrorist attacks and financial markets, however, ours is unique in several aspects. First, most studies focus on a small set of hand-picked terrorist attacks and study their impact on financial markets. This is often motivated by the observation that stock markets have negative effect only from major terrorist attacks. We analyze 30 terrorist attacks worldwide on business targets that resulted in most human losses for the time period 1990-2010. Research has shown that business interests are a prime target of terrorist attacks (Stecke and Kumar, 2009). Despite focusing on major attacks, our approach avoids data bias that may be induced by hand-picking a dataset. Second, to understand the global financial consequences of terrorist attacks, we systematically study the impact of these attacks on stock market indices of 63 top countries (as measured by GDP). Our data is significantly richer than most other studies. Standard event study methodology and abnormal stock returns are used to identify the impact of a terrorist attack. A Logit regression model is then used to understand the spillover to other countries.

It is important to understand the international financial consequences of terrorist attacks. Such an understanding could help plan and device policies that could avoid or mitigate the effects of terrorist attacks. Specifically, our findings have implications for investors, business managers, and government policymakers. The identified spillover mechanism provides information for investors to make better portfolio decisions that incorporate the risk of terrorist attacks. Business managers could incorporate our findings in decisions such as outsourcing, demand forecasting, and terrorist risk insurance for plants and assets. Finally, government organizations could also benefit as the long term international trade policies should incorporate the impact of terrorist attacks. Various governments' global terrorism prevention efforts should be focused towards trading partners, thereby reducing the spillover of economic impact of terrorist attacks that happen in other countries.

The rest of the paper is organized as follows. In the next section, we present the relevant literature and identify our contributions to the current state of research. Then we develop our research hypothesis followed by a section to discuss the data and their sources. Our research methodology is then discussed. We present important findings and their implications and conclude the paper.

## LITERATURE

Economic and human losses from terrorist attacks have attracted researchers to study the motives and impacts of terrorism. Events, such as 9/11, that caused large losses provided impetus for research in the area. Various disciplines including, economics, finance, public policy, psychology, and sociology have studied terrorist attacks with the aim to understand and prevent future occurrences and associated financial consequences.

A stream of research is focused on studying the impact of terrorist attacks on financial markets. This research primarily focuses on short term effects of terrorist attacks on stock markets because in the long term “financial markets are generally efficient in absorbing shocks stemming from terrorist attacks” (Johnston and Nedelescu, 2006). A significant research has been directed to events surrounding 9/11 and the US stock market, though few have broadened the scope to other events and markets (Karolyi, 2006).

Financial markets shift up or down according to investor’s perceptions about the future. Research has shown that terrorist attacks are perceived as a negative outlook and results in lower stock returns. For 14 *big* terrorist and military events (e.g., 9/11, Pearl Harbor attack, Iraq invasion of Kuwait, and Pan Am bombing) dating back to 1915, Chen and Siems (2004) conclude that terrorist attacks and military invasions negatively impact capital markets around the world. They found a varying degree of impact from these events. For example, Pearl Harbor attack had a -2.75% impact on the US stock index while for 9/11 the impact was -7.14%. Drakos (2009), Enders and Sandler (1996), and Pshisva and Suarez (2006), among others, similarly find large effects of terrorism on economic variables. Guidolin and La Ferrara (2010) study the effect of 112 internal conflicts (civil wars) and found that besides affecting national stock index, such events significantly increase the commodity prices.

Berrebi and Klor (2005) focused specifically on attacks on Israeli companies and find that the abnormal stock returns in the US stock market for companies cross-listed for trading in the US to be -0.77%. For companies in non-defense businesses the reactions were much higher at -4.58%, while defense related companies recorded a positive reaction of +3.89%. Karolyi and Martell (2010) found a negative stock price reaction of -0.83% around the day of a terrorist attack on businesses interests of publicly-traded companies. Following the 9/11 attacks, Cummins and Lewis (2003) and Doherty, Lamm-Tennant, and Starks (2003) found strong negative stock market reactions for property-casualty insurance companies.

Others have sought a more direct measure of the impact of terrorist attacks on financial markets. Using a case instance of Basque Country from Spain, Abadie and Gardeasabal (2003) estimate that a “one standard deviation increase in the intensity of terrorism produces a 5% fall in the net FDI position of the country.” They also report a 10% gap in per capita growth for the Basque Country as compared to a benchmark region.

Terrorist attacks have consequences across national borders. Significant terrorist attacks have been found to increase correlations across global financial markets (Hon, Strauss, and Yong, 2004). Contagion effect has regional and national dependence. For example, contagion between the US and European markets is stronger as compared to those from Asia or Latin America and the US markets (Hon, Strauss, and Yong, 2004). Despite consensus on contagion and spillover from terrorist attacks, little is known about the underlying reasons behind these effects.

Terrorism and economic development are interrelated. “Economic developments of a country and its top trading partners reduce the number of terrorist incidents inside the country. To the extent that trade and FDI promote economic development, they have an indirect negative effect on transnational terrorism” (Li and Schaub, 2004). A two-fold increase in the number of terrorist incidents could decrease bilateral trade between targeted economies by about 4 percent (Nitsch and Schumacher, 2004).

Nguyen and Enomoto (2009) study the effect of terrorism on national stock indices and volatility, but only for two countries, Pakistan and Iran. Chen and Siems (2004) study the impact of terrorist attacks on national stock indices from 30 countries. They, however, focus on only two attacks, 9/11 and the Iraq invasion of Kuwait. Moreover, their primary focus was to understand the resilience of international stock markets. Chesney, Reshetar, and Karaman (2011) focus on Swiss (SMI), US (S&P 500), and European

(MSCI Europe) stock indices. They concluded that the 77 terrorist attacks in their dataset had a significant negative impact on at least one of the three indices. Like some others, their results also indicate that terrorist attacks could have an impact on international markets. Arin, Ciferri, and Spagnolo (2008) show that for six different countries the stock markets show a negative return after the attacks. They also find that the magnitude of stock index decline is higher for emerging economies.

Our research is closely related to that in Chen and Siems (2004) and Chesney et al. (2011). These studies are, however, primarily focused on establishing a relationship between terrorist attacks and financial markets. We focus on the understanding of spillover of economic consequences from terrorist attacks in international markets. A richer terrorist attack and financial data increase the relevance of our results.

## **HYPOTHESES DEVELOPMENT**

Stock market performance reflects the expectations and outlook about the future returns. Good or bad news may influence these expectations. Good news could improve future outlook and have a positive impact on the stock market. Alternatively, a bad news could result in negative stock impact. Terrorist attacks are potentially bad news as they undermine investor confidence (Johnston and Nedelescu, 2006). They also lower consumption and investment activities, while risk aversion of investors and firms increase (Karolyi, 2006). Political instability caused by terrorist attacks has an effect on investment, savings, and economic growth (Alesina and Perotti, 1996). Factors such as investor confidence, investment activities, and consumption affect stock markets. Therefore, terrorist attacks may result in negative abnormal stock returns as investors could move to stable markets.

The financial impact of terrorist attacks are not constrained by national boundaries. Various studies have documented that countries other than the attacked country also experience decline in stock markets. Chen and Siems (2004) show that stock performance in 33 national capital markets registered a significant decline following the 9/11 attacks. Similarly, 17 capital markets registered negative abnormal returns following the Iraq invasion of Kuwait in 1990. Chesney et al. (2011) find that both Madrid and Russian bombing in 2004 had a negative effect on Swiss, European, and the US stock markets. Johnston and Nedelescu (2005) report that after 9/11 and the 2004 terrorist attack in Spain, investor confidence deteriorated beyond the nations attacked in both cases. They attribute this to contagion effect in international financial markets.

Economic growth of trading partners is interrelated. Trade links cause the economic developments in a country influenced by developments in its trading partners. A trading partner's growth also positively influences a country's domestic growth (Arora and Vamvakidis, 2005). Economic growth of a country could lead to increased imports, which implies increased exports for its trading countries. Besides surplus, trading partners can also benefit from mutual "technology transfers and other efficiency gains associated with international trade" (Coe and Helpman, 1995). Stock market activities in major trading partners could forecast a country's subsequent stock returns. A country's stock market responds to significant news about its trading partners (Rizova, 2010). Contagion or spillover could spread in international markets through financial market linkages (Pritsker, 2001).

Summarizing our expectations, we hypothesize in H1 that spillover of financial consequences from terrorist attacks may take place between trading partners, while non-trading partners of an attacked country will not have a significant negative impact on stock market.

*H1: Trade interactions cause spillover of financial losses from terrorist attacks to international markets.*

*H1a: Trading partners of an attacked country experience a significant negative impact on national stock market index.*

*H1b: Non-trading partners of an attacked country do not experience a significant negative impact on national stock market index.*

Terrorist attacks of 9/11 had a profound and significant impact on stock markets all across the world (Hon et al., 2004). In contrast, Mumbai attacks of 2008 and Beslan massacre of 2004 in Russia had little financial consequences outside the country of attacks. An explanation for this difference is the severity and chosen financial target of the 9/11 attacks. Besides these reasons, some big economies, such as the US, provide engines for global growth. An event that causes negative abnormal returns in the US stock market will likely have other economies register a drop in their stock market outlook. This example indicates that attacks at bigger economies could spillover to smaller economies.

For most terrorist attacks, direct financial losses are minimal as compared to the financial strength of a country. Also, most terrorist attacks do not affect a country's financial fundamentals. Therefore, many terrorist attacks are unregistered by the stock markets. For bigger attacks, the size of GDP plays an important role in determining the ability of a country to withstand and absorb terrorist attacks (Sandler and Enders, 2008). This implies that countries, especially with big economies, should be resilient to terrorist attacks. Moreover, for terrorist attacks of similar magnitude and severity, a bigger economy should be more resilient than a smaller economy. Chen and Siems (2004) found that the US capital markets are more resilient to terrorist attacks as compared to other global capital markets.

Smaller economies are more vulnerable to economic consequences of terrorism. Big economies generally have capable monetary, fiscal, and other policies to recover from terrorist attacks (Sandler and Enders, 2008). In big economies, especially developed countries, terrorism may only cause a substitution of economic resources from sectors vulnerable to terrorism into relatively safer areas and thus does not affect the entire macro economy. No new resources may be needed to counter terrorism. In contrast, for smaller economies terrorism can impact GDP and curb the development. When a small economy is targeted, investors may be more inclined towards directing their funds to safer countries.

Smaller economies are also more vulnerable to spillover from attacks at bigger trading partners. Smaller economies could be more dependent on trading partners for demand for their products and services. A terrorist attack at the bigger economy may indicate a potential reduction in demand of such products and services. Consider two trading partners, *Big (B)* and *Small (S)*. *B* is a larger economy, in terms of GDP, as compared to *S*. An example of *B* could be the US, while *S* could be India. Also assume *T* to be the total trade (Import+Export) between *B* and *S*. Since the two countries are trading partners, investors in each country are interested and affected by economic developments in both countries. For *S* the mutual trade *T* may represent a significant portion of its total economic activities. For the bigger economy *B*, the mutual trade may have lesser significance. An attack at *B* may have implications for the trade between the two countries. This mutual trade is a significant part of *S*'s economy. Therefore, the economic effects of an attack at *B* may spillover to *S*. In contrast, an attack on *S* may have lesser possibility of spillover to *B* as the mutual trade has lesser significance for *B*. Also *B* being a bigger economy may be more resilient to terrorist attacks.

Therefore, in H2a we hypothesize that attacks at trading partners with bigger economies have stock market impact on trading partners with smaller economies. In H2b we hypothesize that attacks at smaller economies may not spillover to trading partners with bigger economies. Literature provides some support for our hypothesis. While studying the sovereign debt rating downgrades, Ferreira and Gama (2007) found that emerging markets experience a higher spillover when a developed economy experiences downgrades.

*H2: A trading partner's relative economic size affects the stock market impact from terrorist attacks.*

*H2a: A trading partner with a smaller economy than the attacked country experience negative impact on national stock market.*

*H2b: A trading partner with a bigger economy than the attacked country does not experience negative impact on national stock market.*

Hypotheses 1 and 2 propose trade channels as the mechanism through which financial consequence of terrorist attacks spillover to other countries. The premise is based on economic opportunities that trade

creates. A trading partner may provide market for domestic companies. The trade may also help increase domestic demand as the products and services could be imported. Therefore, countries may be economically vulnerable to events that take place at trading partners.

Countries are different. For some economies exports are higher than imports, for others imports are a significant part of the economic activities. Total trade alone may not capture the complex interactions between trading countries. Therefore we use three widely used trade indicators to classify countries based on the importance of import, export, and total trade for the economy. Specifically, we differentiate countries based on Trade Dependence Index (TDI), Import Penetration Index (IPI), and Export Propensity Index (EPI). These indicators are often used to understand a country's vulnerability to external shocks (Mikic and Gilbert, 2009).

TDI is also called as *openness* index and is one of the most widely used trade indexes. TDI is the ratio of total trade to the GDP of a country.

$$TDI_i = \frac{\sum_j E_{ij} + \sum_j I_{ji}}{GDP_i} \times 100$$

Where,  $i$  is the country for which we are calculating the TDI,  $j$  is the set of all countries that  $i$  trades with,  $E_{ij}$  is exports from country  $i$  to  $j$ ,  $I_{ji}$  is imports from country  $j$  to  $i$ , and  $GDP_i$  is the Gross Domestic Product of country  $i$ .

TDI measures the openness and importance of international trade in a country's economy. A high TDI may also indicate the dependence of domestic economy on events happening at trading partners. Therefore, a high TDI may cause that terrorist attacks at trading partners spillover to domestic stock market. The hypothesis is presented in H3a. Our second index, IPI, measures the degree to which the domestic demand is satisfied by products and services that are imported from trading partners. A high IPI may imply dependence of a country on international imports. In contrast, a low IPI implies self-sufficiency in meeting the domestic demand. As with high TPI, high IPI may also indicate dependence of a country's domestic economy on trade and thus increased possibility of spillover from trading partners. The relevant hypothesis is H3b.

$$IPI_i = \frac{\sum_j I_{ij}}{GDP_i - \sum_j E_{ij} + \sum_j I_{ji}} \times 100$$

Our third index, EPI, measures the importance of exports for a country's economy. To sell their products, domestic producers of a country with high EPI, are reliant on markets in trading partner countries. It also shows the exposure of domestic economy to international events that take place in trading partner countries. High EPI also increases the vulnerability of domestic economy and stock market to international economic events. Hypothesis relating to EPI is H3c.

$$EPI_i = \frac{\sum_j E_{ij}}{GDP_i} \times 100$$

*H3: Trade indices determine the spillover of financial effects of terrorist attacks to trading partners.*

*H3a: A high Trade Dependence Index of a country increases the spillover of financial effects from terrorist attacks at trading partners.*

*H3b: A high Import Penetration Index of a country increases the spillover of financial effects from terrorist attacks at trading partners.*

*H3c: A high Export Propensity Index of a country increases the spillover of financial effects from terrorist attacks at trading partners.*

Trading countries may have different political systems. Research has shown an association between political system in a country and terrorism. Political openness created by democratic form of governments facilitates terrorism (Eugene, 2004). Sandler (1995) found that democracies appear to suffer more from terrorism related events. Karolyi and Martell (2010) analyzed the impact of terrorism on stock prices of individual companies that were targets of terrorist attacks. They found that firms domiciled in wealthier and democratic countries experienced a larger negative stock price reaction. In H4 we test for a relation between the form of government and the spillover from terrorist attacks at a trading partner country. Our expectation is that democratic countries may experience more spillover as compared to non-democratic countries.

*H4: Countries with democratic governments experience higher spillover of financial effects from terrorist attacks at trading partners.*

## **DATA**

The hypotheses we developed in the previous section relate terrorist attacks to the financial consequences for its trading partners. To increase the relevance and applicability of our results, we compile rich data from a variety of publically available sources.

The terrorist incidents data is collected from a Database of Worldwide Terrorism Incidents, maintained by Rand National Defense Research Institute. We focus on terrorist attacks between 1990-2010 that were targeted on business interests. The database provides an option for identifying such targets. We sorted the data for number of injuries and deaths. From the resulting data, countries that do not have functioning stock markets or stable governments (at the time of attack) were dropped. Some such countries include Iraq, Burma, Uganda, Sri Lanka, and Algeria. The resulting attacks are listed in Table 1. It is important to focus on business interests as terrorist attacks in past 20 years have been primarily targeted towards such interests (Stecke and Kumar, 2009). Many terrorist organizations choose the targets so as to hurt the “world by attacking economic nodes and avenues of commerce” (Nanto, 2004). We also focus on the attacks that caused most human losses (injuries+deaths) as financial markets are generally resilient to small terrorist attacks. Moreover, even if small attacks have an effect on financial markets, it would be difficult to identify the variability caused by the attacks as the financial markets have their own volatility. Past research has found that human capital losses are associated with larger negative stock price reactions when compared to attacks that cause physical losses (Karolyi, 2006).

To understand the global financial consequences of terrorist attacks we chose the top 70 countries based on GDP data from International Monetary Fund (IMF). From this list, we dropped countries that, at the time of attacks, did not have an operational stock market (Syria, Angola, Algeria, Libya, and Sudan), were politically unstable (Iraq), or do not have relevant data available (Taiwan). The remaining 63 countries were included in the analysis. As a proxy to financial impact of terrorist attacks we use broadest stock market indices available in each country’s stock market. These indices are comparable to the New York Stock Exchange (NYSE) composite index in the US. The daily stock index data was obtained from Bloomberg.

Our data also include information about a country’s trading partners. The US dollar value of exports and imports of goods for year 2010 by each country’s partners are collected from Directions of Trade Statistics database (DOT) of the IMF. Due to lack of information for Taiwan in the Directions of Trade Database, we exclude Taiwan from our trading partner sample. For each country in our sample, we rank its trading partners by US dollar value of exports and imports of goods for the year 2010. We limit trading partners to only major trading partners. The top 20 trading partners are identified and ranked. These 20

countries are considered *trading partners*; others are classified as *non-trading partners*. A country may have little trade with a trading partner ranked beyond 20, making it unlikely for the impact of terrorist attacks to spillover to such countries.

The trade data from DOT database and GDP from IMF are also used to calculate TDI, IPI, and EPI. The Democracy Index to test Hypothesis H4 is collected from the Economist Intelligence Unit, which ranks countries on a scale of zero to ten. Democratic countries get a higher score. For example, Norway scores a 9.80 while North Korea 1.08.

**TABLE 1**  
**TERRORIST ATTACKS ON BUSINESSES INTERESTS BETWEEN 1990-2010 WITH**  
**MAXIMUM INJURIES AND DEATHS**

Count	Date	Country	Count	Date	Country
1	February 26, 1993	United States	16	August 8, 2004	Pakistan
2	March 12, 1993	India	17	January 16, 2005	Thailand
3	December 15, 1998	Philippines	18	February 17, 2005	Thailand
4	May 18, 2001	Israel	19	October 29, 2005	India
5	June 1, 2001	Israel	20	December 8, 2005	Pakistan
6	August 9, 2001	Israel	21	September 16, 2006	Thailand
7	September 11, 2001	United States	22	February 18, 2007	Thailand
8	May 7, 2002	Israel	23	February 18, 2007	Thailand
9	September 28, 2002	Bangladesh	24	May 15, 2007	Pakistan
10	October 18, 2002	Philippines	25	July 19, 2007	Pakistan
11	December 7, 2002	Bangladesh	26	October 19, 2007	Philippines
12	March 5, 2003	Colombia	27	March 23, 2008	Pakistan
13	April 29, 2003	Israel	28	May 13, 2008	India
14	August 5, 2003	Indonesia	29	December 18, 2008	Philippines
15	May 22, 2004	Colombia	30	September 18, 2009	Pakistan

As compared to literature, our data is unique in many aspects. First, we do not hand-pick the attacks, but choose based on a criterion of target-type (business) and human losses. Since most small attacks do not have noticeable effect on financial market, extant research has resorted to hand-picking terrorist incidents (Karolyi, 2006). Other research uses single big events such as 9/11 to study the impact of terrorist attacks. This could potentially bias the results. The number of terrorist attacks we analyzed is larger than many others. Second, the number of countries included in our study is significantly larger than most other research studies. This broadens the scope of our research and results. Third, we use the trading partner data to understand the spillover of terrorist attacks to countries other than the attacked country. This is the first study that uses trade data to understand the effects of terrorist attacks.

## METHODOLOGY

The premise behind our methodology in the tradition of Fama et al. (1969) and others is that capital markets are efficient and will quickly incorporate the financial consequences of events such as terrorist attacks. A part of our analysis is built on event study methodology. We subsequently use Logit regression models.

## Event Study

Event studies have been constructively used in many research areas including economics, accounting, and finance. A stream of event study research investigates financial stock market response to new-value relevant information.

When new information is available, “investors immediately reassess individual firms and their ability to withstand potential economic, environmental, political, societal, and demographic changes resulting from the event” (Chen and Siems, 2004). Event studies rely on many investors assessing and processing all available information and taking actions so that the stock market reflects the true market value (Schwert, 1981). Depending on the perception of investors about the new information, the stock markets could register gains or losses. Terrorist events are potentially bad news for the future outlook of stock returns. Thus one could expect the stocks to show a decline after a terrorist attack.

We use country specific stock indices, which are expected to provide a means of assessing the capital market’s response to terrorist attacks. Using the mean adjusted returns approach described in Brown and Warner (1985), abnormal return on stock indices were calculated. In an event study, mean adjusted returns approach provides a method to capture the historical variability and the variability caused by the event under study. Stock markets are random while an event of significance could cause deviations in the returns. The deviations, if significant, imply that the event is of importance for the stock market.

According to mean adjusted returns approach, we calculate daily abnormal (excess) returns for event day and the following days as.

$$AR_t = R_t - \bar{R}$$

Where  $AR_t$  is the abnormal return at time  $t$ ,  $R_t$  is the actual observed return at time  $t$ , and  $\bar{R}$  is the mean-adjustment factor for daily return and is estimated over 20 days. The estimation window is (-30, -11).  $t=0$  is the event day.  $\bar{R}$  is computed as follows.

$$\bar{R} = \frac{1}{20} \sum_{t=-30}^{-11} R_t.$$

The cumulative abnormal returns are calculated as.

$$CAR_w = \sum_{t=0}^w AR_t.$$

Where  $w$  is the returns window. To capture the short term and medium term effects we consider three windows with  $w \in \{0, 5, 10\}$ , which corresponds to event-day, six days, and eleven days cumulative abnormal return. The methodology is similar to related research is Chen and Siems (2004) and Chesney et al. (2011). The event day may show the negative effects of terrorist attacks. Assessing the effect on longer windows of six and eleven days could suggest that the attack had a long lasting and significant effect on the stock markets. The statistical significance of these abnormal returns is tested using statistics described in Brown and Warner (1985). A statistically significant CAR may indicate that the terrorist attacks have an impact on the stock market while insignificance in CAR would imply terrorist attacks to be inconsequential for the stock markets.

## Logit Model

The second part of analyses uses logistic regression. To understand the factors that contribute to stock market impact from terrorist attacks, a dependent variable is constructed using the significance results from the event study. The dependent variable  $Impact_{ij}$  is 1 if a terrorist attack on country  $j$  results in a significant (at 5% or better) and negative impact on stock index of country  $i$ ; zero otherwise.  $Impact_{ij}$  is an indicator variable that represents the impact of terrorist attacks across countries. Following previous research on binary dependent variables (Stone and Rasp, 1991) we analyze the data with Logistic

regression. Specifically, to test the empirical expectations summarized in Hypotheses, we estimate using the following model.

$$Impact_{ij} = G(\text{Constant}, TP_{ij}, Size_{ij}, TDI_i, IPI_i, EPI_i, Demo_i),$$

Where  $G(\cdot)$  is the logistic cumulative function. Table 2 describes the notation and variables in the model.

**TABLE 2**  
**NOTATION AND VARIABLES**

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Indices:	
$i, j$	Indices representing a country
Dependent Variable:	
$Impact_{ij}$	Indicator variable that represents the impact of terrorist attacks across countries. $Impact_{ij}$ is 1 if a terrorist attack on country $j$ results in a significant (at 5% or better) and negative impact on stock index of country $i$ ; zero otherwise.
Independent Variables:	
$TP_{ij}$ :	Indicator variable that identifies trading partners. It takes a value of 1 if the attacked country $j$ is a trading partner for country $i$ ; zero otherwise.
$Size_{ij}$ :	Indicator variable that identifies the relative economic size of countries. It takes a value of 1 if country $i$ is economically smaller (as measured by nominal GDP) than the attacked country $j$ ; zero otherwise.
$TDI_i$ :	Trade Dependence Index for country $i$ .
$IPI_i$ :	Import Penetration Index for country $i$ .
$EPI_i$ :	Export Propensity Index for country $i$ .
$Demo_i$ :	Democracy index for country $i$ .

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In the model,  $TP$  and  $Size$  are indicator variables while trade statistics  $TDI$ ,  $IPI$ , and  $EPI$  are continuous variables. Finally  $Demo$  represents a country's democracy index on a scale of 1-10. To examine the hypothesis, we analyze multiple logistic models using a selection of variables presented in Table 2. Various interactions between dependent variables are also studied. All models are examined for event day, six days, and eleven days cumulative returns.

## ANALYSIS AND IMPLICATIONS OF RESULTS

Past research has shown that many terrorist attacks have a significant impact on stock markets. Terrorist attacks are global phenomenon with its reach across borders. Many terrorist organizations have international presence. They also have capability to strike in many countries. Countries react to attacks even if they are targeted at a foreign soil. The Homeland Security Advisory System in the US was elevated to Orange after the London attacks of 2005. Also with open economies and increasing world trade, it is critical to understand the financial consequences of terrorist attacks across borders.

### Results

To understand the effects of terrorist attacks on trading partner's stock market indices, we identify top 20 trading partners (by sum of export and import) for each country. Note that some countries may not have all 20 of its top trading partners in the list of 63 countries that we have included in our analysis. Thus in our analysis each country has a set of maximum 20 trading partners. The top 20 countries are considered *trading partners*; others are classified as *non-trading partners*.

Table 3A present results for event study to assess the impact of terrorist attacks on trading partners. The results show that when a country's trading partner is attacked, the stock index on an average declines by -0.18% on the day of the attack. The six and eleven days cumulative percentage declines are -1.1% and -1.9%, respectively. The impacts on event day returns are significant at 5% while the six and eleven days CARs are significant at 1%. The results show that economies involved in bilateral trade are susceptible to attacks that happen in other parts of the world.

To contrast the results of impact on trading partners, we also test for the impact on non-trading partners. Table 3B shows that, for a country, there is no significant impact on domestic stock index when a non-trading partner experiences an attack. The CARs are not significant for event day and eleven days. They are significant at 10% for six days. A t-test for difference in means for the impact on trading and non-trading partners show a significance in differences at 5% for event day returns and at 1% for both six and eleven days CARs. T-tests are not shown for brevity. Our results indicates that countries are susceptible to attacks targeted at trading partners, but not from attacks at non-trading partner countries. The negative effects of terrorist attacks on trading partners are also statistically higher than non-trading papers. The results support hypothesis H1, including the sub hypothesis H1a and H1b.

We now focus on the effect of trading partner's economic size as measured by its GDP. Table 4A reveals that a country experiences a significant negative impact on its stock market index when an economically larger trading partner is targeted by terrorists. The results show a percentage dip in CAR for event, six, and eleven days. All these are significant at 1%. A trading partner smaller than an attacked country could experience a stock decline of over -2.5% in 11-days following an attack. In contrast, Table 4B shows the results of stock impact on a bigger economy when a smaller trading partner is attacked. The CARs are not significant for six and eleven days. Event day returns are significant, but the mean is positive. This indicates that the spillover of economic losses from terrorist attacks occur in only one direction, i.e., from an attacked larger economy to smaller economy and not in other direction. Also a t-test for the difference in means of the impact from a larger and smaller trading partner is significant at 1% for all three periods. T-tests are not shown for brevity. The results indicate that smaller economies are statistically more susceptible to spillover from terrorist attacks at economically bigger trading partners. The results support Hypotheses H2a and H2b.

**TABLE 3**  
**EVENT STUDY RESULTS FOR STOCK INDEX IMPACT ON TRADING AND NON-TRADING PARTNERS**

<b>A: STOCK INDEX IMPACT ON TRADING PARTNERS</b>				
Trading Partners	N	Mean	t-value	Pr >  t
Event-day AR	461	-0.185	-2.12	0.03
6-day CAR	461	-1.105	-4.73	<.00
11-day CAR	461	-1.901	-5.73	<.00
<b>B: STOCK INDEX IMPACT ON NON-TRADING PARTNERS</b>				
Non-Trading Partners	N	Mean	t-value	Pr >  t
Event-day AR	1412	-0.025	-0.58	0.56
6-day CAR	1412	-0.205	-1.85	0.07
11-day CAR	1412	-0.212	-1.16	0.24

Table 3 reports the results of event study for the impact of terrorist attacks on trading and non-trading partners of an attacked country. We define the attack day as event day. If the terrorist attack happened on a day when the stock markets were closed, the event day is the next available business day following the attack.

**TABLE 4**  
**STOCK INDEX IMPACT ON TRADING PARTNERS THAT ARE SMALLER AND BIGGER THAN THE ATTACKED COUNTRY**

**A: STOCK IMPACT ON COUNTRIES SMALLER THAN THE ATTACKED COUNTRY**

Smaller Trading Partners	N	Mean	t-value	Pr >  t
Event-day AR	327	-0.362	-3.25	0.00
6-day CAR	327	-1.494	-5.01	<.00
11-day CAR	327	-2.538	-6.28	<.00

**B: STOCK IMPACT ON COUNTRIES BIGGER THAN THE ATTACKED COUNTRY**

Bigger Trading Partners	N	Mean	t-value	Pr >  t
Event-day AR	134	0.247	2.04	0.04
6-day CAR	134	-0.156	-0.48	0.63
11-day CAR	134	-0.347	-0.63	0.53

Table 4 reports the results of event study for the impact of terrorist attacks on trading partners that are economically smaller and bigger than attacked country. Economic size is measured by GDP. We define the attack day as event day. If the terrorist attack happened on a day when the stock markets were closed, the event day is the next available business day following the attack.

To test the robustness of results from the event study we run a set of logit regression models. Our first model is Model 1:  $Impact_{ij} = G(Constant, TP_{ij})$ . The output is presented in Table 5. The table corroborates the findings from the event study. The coefficients for *TP* are positive and significant at 1% for event day, six days, and eleven days CARs. The logit model also provides odds ratios, which could help understand the results. Interpreting the odds ratio for six days CARs tells us that the possibility of spillover from an attack at a trading partner is over 2.6 times more likely than a non-trading partner.

Since in the event study models we experience interaction between *Size* and *TP* variables, we specifically devise a logit model to test this interaction. Table 6 presents the results using Model 2:  $Impact_{ij} = G(Constant, TP_{ij}, Size_{ij}, TP_{ij} * Size_{ij})$ , which incorporates an interaction term between trading partner and size. The results in Table 6 indicate that the interaction term describes the dependent variable significantly. We lose the significance of *TP* as an explanatory variable for all three time periods studied. *Size* alone is also not significant for event day, while it is significant at 5% and 1% for six and eleven days, respectively. In contrast, the interaction between *Size* and *TP* is significant at 1% for both event and six days CAR. The results are important because they indicate that the spillover of financial implications of terrorist attacks happen for trading partners that are economically smaller than the attacked country. Using the odds ratio we could conclude that for a country it is over 5.7 times more likely to have a spillover from an attacked trading partner that is economically bigger than countries that are not trading partners or are economically smaller. The results show that we have support for hypotheses H1 and H2, however, a confluence of variables from the two hypotheses collectively help explain the spillover of terrorist attacks.

We also hypothesized trade characteristics of trading partner countries as a contributing factor for spillover. To test the expectations about trade characteristics following logit model was analyzed Model 3:  $Impact_{ij} = G(Constant, TDI_i, IPI_i, EPI_i, Demo_i)$ . Since we have found that spillover of economic consequences occur through trading partners, the impact of trade characteristics are tested only for trading partners. Therefore the data for Model 3 analysis include only those countries that trade with the attacked country. Table 7 report the logistic Model 3 results. The coefficients and significance does not support

any part of Hypotheses 3. This shows that the trade characteristics are not a contributing factor in determining the spillover of terrorist attacks' financial consequences to trading partners.

Research has shown that democratic countries are more prone to terrorist attacks. Logit Model 3 also tests for the impact of democracy on the spillover. In Table 7 the results for independent variable  $Demo_i$  indicate that democratic countries face a higher probability of spillover from trading partners. The coefficients are positive and significant at 1% for event day and six days CARs. Therefore, one could conclude that higher is the democracy index, higher is the possibility of spillover. We do not see significance for eleven day CARs, which could indicate that the spillover effect is dissipating by this duration. For intellectual curiosity we also tested for interactions of size with trade characteristics and democracy index. The results, however, show no significant interactions between these variables.

### **Discussion and Implications**

Research has shown that terrorism cause losses for the targeted country. These losses could be human as well as economic. Some of the economic consequences include destroying infrastructure, diverting FDI, redirecting public investment funds to security, and limiting trade (Sandler and Enders, 2008). The effects of terrorist attacks are not only limited to the attacked country, but could spillover to other countries as well.

Economic vulnerability to terrorism could originate from attacks at trading partners. Our results support hypothesis 1, which shows that the economic effects of terrorist attacks spillover through trading partners. A country with trading partners that are susceptible to terrorist attacks could also face consequences. For a country, the possibility of spillover from an attack at a trading partner is significantly higher than a spillover from an attack at a non-trading partner.

**TABLE 5**  
**LOGIT MODEL RESULTS FOR TRADING PARTNER AND SIZE AS INDEPENDENT VARIABLES**

LOGIT MODEL 1:  $Impact_{i,j} = G(Constant, TP_{i,j})$

Parameter	Event-day AR			6-day CAR			11-day CAR		
	Estimate	Pr > ChiSq	Odds ratio	Estimate	Pr > ChiSq	Odds ratio	Estimate	Pr > ChiSq	Odds ratio
Intercept	-3.11	<.00	0.04	-2.69	<.00	0.07	-2.27	<.00	0.10
TP	0.79	0.00	2.20	0.98	<.00	2.66	0.91	<.00	2.48

Table 5 reports results for impact on a trading partner of an attacked country using a logit model. The dependent variable is an indicator variable that takes a value of 1 if the trading partner experiences a negative significant (at 5% or better) impact on national stock index. See Table 2 for notation and definition of terms.

**TABLE 6**  
**LOGIT MODEL RESULTS FOR INTERACTION BETWEEN TRADING PARTNER AND SIZE AS INDEPENDENT VARIABLE**

LOGIT MODEL 2:  $Impact_{i,j} = G(Constant, TP_{i,j}, Size_{i,j}, TP_{i,j} * Size_{i,j})$

Parameter	Event-day AR			6-day CAR			11-day CAR		
	Estimate	Pr > ChiSq	Odds ratio	Estimate	Pr > ChiSq	Odds ratio	Estimate	Pr > ChiSq	Odds ratio
Intercept	-3.11	<.00	0.04	-2.88	<.00	0.05	-2.49	<.00	0.08
TP	-0.66	0.27	0.51	-0.36	0.44	0.69	0.26	0.41	1.29
Size	0.00	0.99	1.00	0.47	<.03	1.61	0.57	0.00	1.76
TP*Size	1.74	0.00	5.72	1.37	0.01	3.96	0.55	0.13	1.73

Table 6 reports results for impact on a trading partner of an attacked country using a logit model. The dependent variable is an indicator variable that takes a value of 1 if the trading partner experiences a negative significant (at 5% or better) impact on national stock index. See Table 2 for notation and definition of terms.

**TABLE 7**  
**LOGIT MODEL RESULTS USING TRADE STATISTICS AND DEMOCRACY INDEX AS INDEPENDENT VARIABLE**

LOGIT MODEL 3:  $Impact_{i,j} = G(\text{Constant}, TDI_i, IPI_i, EPI_i, Demo_i)$

Parameter	Event-day AR			6-day CAR			11-day CAR		
	Estimate	Pr > ChiSq	Odds ratio	Estimate	Pr > ChiSq	Odds ratio	Estimate	Pr > ChiSq	Odds ratio
Intercept	-4.10	<.00	0.01	-3.06	<0.00	0.04	-1.82	<0.00	0.16
<i>TDI</i>	0.03	0.39	1.02	-0.00	0.55	0.99	-0.01	0.49	0.99
<i>IPI</i>	-0.06	0.20	0.93	-0.01	0.48	1.01	0.01	0.48	1.01
<i>EPI</i>	0.00	0.83	1.00	0.00	0.76	1.00	0.00	0.80	1.00
<i>Demo</i>	0.28	0.00	1.32	0.18	0.01	1.20	0.08	0.18	1.08

Table 7 reports results for impact on a trading partner of an attacked country using a logit model. The dependent variable is an indicator variable that takes a value of 1 if the trading partner experiences a negative significant (at 5% or better) impact on national stock index. See Table 2 for notation and definition of terms.

Countries could financially benefit from reduction in terrorism. Increase in terrorism in a country has a significant negative effect on GDP (Eckstein and Tsiddon, 2004). It could also lead to lower per capita income. Abadie and Gardeazabal's (2003) analysis of terrorism in the Spanish Basque country region shows that terrorism reduced the region's per capita GDP by 10 percent. They also show the difference between expected and actual per capita GDP increase with spikes in terrorist activities. Therefore, it is worthwhile for countries to direct efforts and resources towards preventing and reducing terrorist attacks within a country. These efforts may have limited results, however, if the efforts are focused only on countering domestic incidents of terrorism. Lack of planning by trading partners could hurt a country. Counterterrorism efforts should be mutual and be devised so as to prevent attacks at other countries too. Many trading partners regularly discuss terrorism prevention and control initiatives at trade summits. Our results provide strong support for such practices. Trading partner countries should collectively contribute towards countering terrorism.

Terrorist attacks spillover from bigger to smaller trading economies. Smaller economies are also vulnerable because of the size of their GDP. Smaller economies are dependent on trading partners for demand for their products and services. A terrorist attack at the bigger economy may indicate a potential reduction in demand of such products and services. The trade between the bigger and smaller country could also be a significant portion of the small country's GDP. Therefore smaller economies are more vulnerable to attacks at bigger trading partners.

These results indicate that despite the limitation of resources, smaller economies have more to gain from investing and cooperating in terrorism prevention efforts, especially when the attacks are directed towards larger economies that are trading partners. The smaller countries, who may lack financial resources, could contribute to counterterrorism efforts by providing logistical and information support to bigger economies that may have more political and financial power in controlling terrorism.

Trade statistics TDI, IPI, and EPI are leading indicators of economic growth. These indices measure the importance of international trade in a country's economy. They are also a measure of the openness of an economy. A high trade statistic values indicate vulnerability of a country's economy to external shocks. Despite theoretical correlation between trade statistics and vulnerability, we did not find their association with spillover of economic terrorist attacks through trading channels. The results seem to indicate that trading structure of a country does not cause spillover.

The results reveal an interesting insight. The values of trade statistics signify the importance of international trade relative to the economy of a country. They do not directly relate to the importance of trade relationship between two countries. As shown by hypothesis 1, a country with extensive trade (in comparison to its GDP) with an attacked country will likely experience spillover of terrorist attack. High values of trade statistics do indicate involvement of a country in extensive trade, but not specifically with the attacked country. This could be a contributing factor for lack of support for hypothesis 3. Countries with high dependence on trade should hedge themselves against spillover of economic effects of terrorist attacks if a significant portion of their trade is with countries that are prone to terrorist attacks.

Democracy helps in creating prosperity. Democratic countries also tend to trade more (Decker and Lim, 2009). Despite these advantages, terrorist attacks may imply drawbacks of democracy. Democratic countries help harbor terrorism. They are also prone to international terrorism. We find that democratic countries also experience spillover of terrorist attacks from trading partners. The political structure has implications when terrorist attacks happen elsewhere. Countries with democratic governments should device policies that reflect their vulnerability of terrorist attacks.

## CONCLUSIONS

A significant amount of research has been devoted to terrorism and its economic consequences. Terrorist attacks have caused economic losses across countries. To date, however, little is known about the interactions between trade and terrorism. This article studies trade between countries as a channel through which financial consequences of terrorism could spread to other countries. Using stock market indices from 63 top (in terms of GDP) countries, we show that the stock index of a country could

experience a significant negative impact when a trading partner is attacked by terrorists. Terrorist attacks at non-trading partners do not impact national stock indices.

We find that bigger economies are more resilient to the spillover of terrorist attacks targeted at an economically smaller trading partner. Terrorist attacks propagate from a bigger trading partner to a smaller trading partner; but not in the other direction. Country specific trade statistics do not affect spillover. Specifically, TDI, IPI, and EPI do not contribute to spillover. Democratic countries experience a higher spillover when a trading partner experiences terrorist attacks.

Our findings caution that failure to counter terrorism will produce costs for all economies. The financial consequences are not limited to attacked countries. Trade provides opportunities for growth, but could also lead to spillover of terrorist attacks from trading partners. Smaller economies are more susceptible to terrorist attacks at trading partners. Therefore smaller economies have at least as much to gain from countering terrorism as bigger and more developed economies.

Our results have implications for investors, corporations, and government policymakers. Investors may benefit from our research as it provides an understanding of how terrorist attacks propagate through the trading partners. The study could provide guidance in choosing safer markets to invest. In today's open marketplace many corporations have global operations. These corporations could limit their risk exposure by choosing locations for production or markets that offer relatively safer alternatives. Also investors with stakes in these corporations may be able to better assess the risk in investing. Government policymakers make decisions about long term trading partners and investment in counterterrorism initiatives. Our study indicates that these efforts should be primarily directed towards trading partners. The findings could also help countries and organizations in devising longer-term regulatory, trade, monetary and fiscal policies.

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