Causal Relationship between Terrorism and Economic Indicators

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Abstract:

This study aims to understand the causal linkage between terrorism and various economic indicators such as Gross Domestic Product, Tourism, and Foreign Direct Investment by running a Granger Causality regression. The expected results will show that terrorism does indeed decrease or increase as a result of changes in these economic indicators. In order to test for Granger Causality a unit-root test will first be performed, followed by a co-integration test. The results show that each nation experiences a different causal relationship with each of these indicators. Inflation is the most significant causal indicators in terms of percentage of countries tested which have a significant causal relationship. The results of this study will be helpful in making advice for policy decisions. Ultimately, ensuring economic stability, especially in regards to inflation, is the biggest policy implication to be taken away from this study.

JEL Classification: C22, E24, E31, F21, F59, O47

Keywords: Granger Causality, Terrorism, Gross Domestic Product, Foreign Direct Investment, Inflation, Unemployment

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1.0 INTRODUCTION

This study examines the causal relationship between terrorism and various economic indicators such as Gross Domestic Product, Foreign Direct Investment, Inflation, and Unemployment. The goal is to understand these relationships in order to provide insightful policy implications. It is expected that each of these indicators will have a significant causal relationship with terrorism for at least some of the tested countries that are concerned with in this study. These countries include Pakistan, Israel, Saudi Arabia, France, Germany, Italy, Ireland, the United Kingdom, and Spain. It is expected that terrorism will decrease as GDP increases. It is expected that FDI will decrease as terrorism increases. Finally, it is expected that terrorism will increase as Inflation and Unemployment increases.

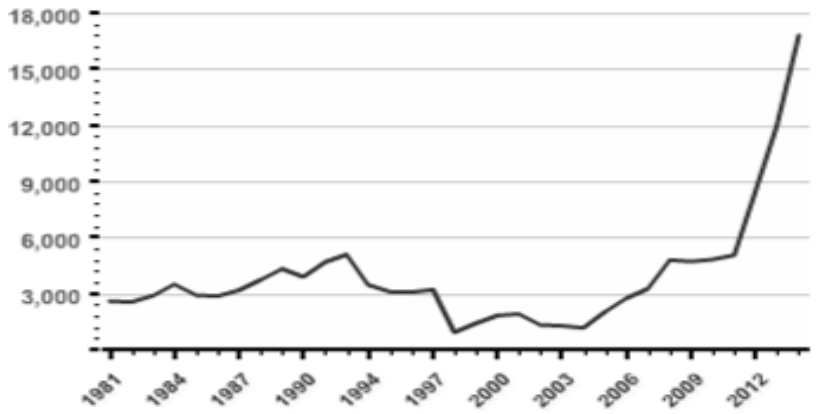
This topic is gaining increasing importance as a result of the dramatic rise in terrorist activity over the past several years which will be discussed in further detail. Acts of terrorism can be motivated by various different factors. Some of these factors include, but are not limited to political, nationalistic, religious, and economic factors. This study is particularly concerned with those economic motivating factors. A greater understanding of these motivating factors will help to implement policies that will combat terrorism.

This topic is also of growing importance in the political spectrum as a result of the current events occurring in Europe because of the wave of Syrian refugees. Everyone is closely watching political leaders all of the world, especially the US in regards to the upcoming election. Ultimately, the goal is to determine more efficient ways in combating both domestic and transnational terrorism.

2.0 TREND OF TERRORISM

Figure 1.1 demonstrates the trend of global terrorism during the time period that this study is concerned with (1981-2014). This graph shows the rise in global terror incidents over the past three and a half decades. This rise particularly spikes over the last several years, a trend which reinforces the importance of this topic and the need for discovering policy implications to reduce terrorism in developed and developing nations.

Figure 1.1: Global Terror Incidents

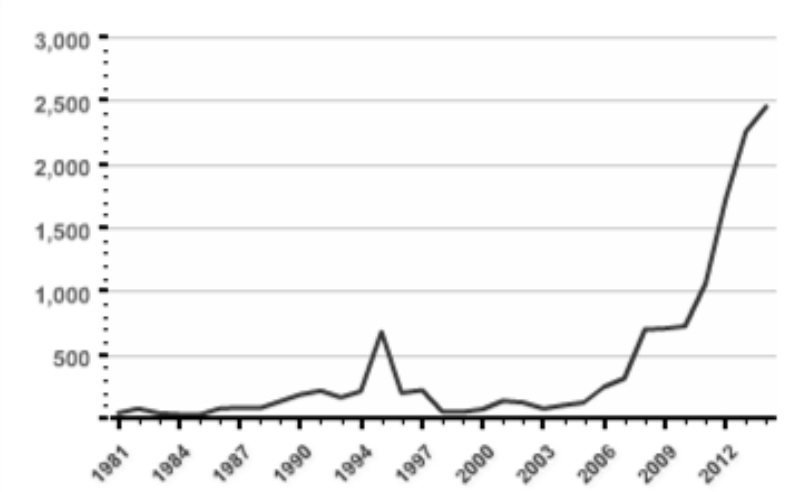


Source: Global Terrorism Database

Figure 1.2 demonstrates the current trend of terrorism in select Middle Eastern countries. This graph depicts the sum of all terror incidents in the three Middle Eastern countries selected for this study: Pakistan, Israel, and Saudi Arabia. The countries in this graph experience a similar spike in terrorism that is witnessed on a global scale. Therefore, it can be concluded that terror activities in the Middle East (specifically the three countries included) over the past several years have at least partially contributed to the recent global rise in terrorism.

Figure 1.3 demonstrates the current trend of terrosim in select European countries. This graph depicts the sum of all terror incidents in the six European countries selected for this study: France, Germany, Ireland, Italy, Spain, and the United Kingdom. This graph does not show the same rise in terrorism over the past several years, but rather a decline. Therefore, it can be concluded that these six European countries have not contributed significantly in this drastic rise in terror activities.

Figure 1.2: Middle Eastern Terror Incidents



Source: Global Terrorism Database

Figure 1.3: European Terror Incidents

Source: Global Terrorism Database

In addition to the general spike in terrorism, this topic has other important policy implications as a result of current events. The Syrian refugee crisis is a hotly debated topic in the political realm. Various foreign powers are in the process of debating foreign policy which could result in either closing borders entirely or opening them to these refugees. Some European countries have already loosened their borders to provide refuge. The current debate is whether or not these countries will feel the backlash of this policy decision in terms of a potential increase in terror activity. This study will determine relationships

between terror activity and various economic indicators which will perhaps provide insight into some of these policy decisions. Ultimately, the decision to house refugees will rely more heavily on the security threat of opening up borders, and not solely on the relationships discussed in this research. However, some insight will be applicable.

3.0 LITERATURE REVIEW

Meierrieks and Gries (2012) found that the causation between terrorism and growth is heterogeneous over time and space. They believe this causality can be explained by the changing geographical and ideological terrorism that was witnessed at the end of the Cold War era. Evidence of this was demonstrated through the decrease in terrorist activity in Latin American countries as they experienced economic growth. In African and Islamic countries, terrorism was found to drastically hinder growth in countries with high levels of political instability and low levels of political openness. Gries et al. (2009) found a strong causal linkage between economic performance and domestic terrorism. They examined several Western European nations and found that economic performance was important for some of the countries in determining terrorist violence and that all of the attacked economies were successful in overcoming the threat of terrorism. Piazza (2006) conducted a study which analyzes and evaluates the hypothesis that economic issues such as poverty, inequality, and poor development are the main causes of terrorism. This study actually concluded that no relationship was found between terrorism and economic development factors. However, he found a relationship between other variables including population, ethno-religious diversity, repression, and structure of party politics which was found to be the most significant.

One study investigates whether or not and to what extent transnational terrorism affects US FDI. They found through a time-series analysis that the 9/11 attacks did not generally have a lasting effect on US FDI flows. Turkey was the only country which experienced a long lasting drop in US FDI. They also examined the effect that terrorist attacks against US interests had on the stock of US FDI. They found that these attacks had a significant, but small impact on these stocks. The largest declines were experienced by Greece and Turkey which were 5.7% and 6.5% of their average US FDI stocks respectively (Enders et al., 2006). Busse and Hefeker (2005) examined the relationship between

political risk and FDI inflows. Contrary to the results of the previous study mentioned, they found that some factors are highly significant determinants of FDI inflows. The variables include government stability, absence of internal conflict, absence of ethnic tensions, basic democratic rights, and the ensuring law and order.

Shahbaz (2013) examined the relationship between inflation, economic growth, and terrorism in Pakistan. The empirical results confirmed the co-integration between these variables. He found that an increase in inflation corresponds to an increase in terrorist activity. Using a Granger Causality approach, he discovered bidirectional causality between inflation and terrorism. He concludes with the policy implication of lowering and steadying inflation in order to reduce terror activity in Pakistan. In another study, Shahbaz and Shabbir (2011) examine the same hypothesis of whether or not inflation is the economic indicator responsible for the spike in terrorism in Pakistan. This study resulted in the same finding that inflation and terrorism are co-integrated and that inflation is responsible for Granger causing terrorism. They also discovered that economic growth is also a major contributor in determining terrorist activity.

4.0 DATA AND EMPIRICAL METHODOLOGY

4.1 Data

This study uses annual time series data from 1981 to 2014. Data was obtained from the World Bank's World Development Indicators (WDI). The data extrapolated includes Gross Domestic Product (GDP) at market prices at current US$ and net inflows of Foreign Direct Investment (FDI) at current US$ for the following nine countries: Israel, Pakistan, Saudi Arabia, France, Germany, Italy, Ireland, Spain, and the United Kingdom. Data was also taken for annual percent Inflation using consumer prices and total Unemployment as a percent of total labor force. Due to data availability restrictions, this data was only obtained for the four following countries: Israel, France, Italy, and Spain. In addition, Total Population was taken for all nine countries in order to calculate per capita GDP and per capita terror attacks.

Data was obtained from the Global Terrorism Database (GTD) for annual Total Terror Incidents for all nine countries. This is defined as all incidents, regardless of doubt. GTD does not have any data regarding information from the year 1993. Therefore, terror

attacks for 1993 for all countries was estimated by calculating the average between terror attacks occurring in 1992 and 1994.

4.2 Empirical Model

This study uses the same Granger Causality model followed by Meierrieks and Gries (2012) in order to test for unidirectional and/or bidirectional causality between terror attacks and GDP, FDI, Inflation and Unemployment. The time stationary bivariate model can be written as follows:

$$x_{it} = \sum_{l=1}^{p} \alpha^{(l)} x_{it-l} + \sum_{l=1}^{p} \beta_i^{(l)} y_{it-l} + \mu_i + u_{it} \qquad (1)$$

$$y_{it} = \sum_{l=1}^{p} \gamma^{(l)} x_{it-l} + \sum_{l=1}^{p} \delta^{(l)} y_{it-l} + \eta_i + v_{it} \qquad (2)$$

The variable x is the measure of terrorism for county i over t periods of time. This is measured by the number of terror incidents, regardless of doubt for every 100,000 inhabitants in that specific country. The variable y represents the indicator being tested for causality (GDP, FDI, Inflation, and Unemployment). GDP is measured as market prices at current US$. FDI is net inflows measured at current US$. Inflation is measured as a percent using the consumer price index. Unemployment is measured as total unemployment as a percent of the total labor force. The autogressive slope coefficients (α and δ) are identical for all cross-sections, but may very over different lags. The regression coefficients are constrained to be equal over different lags. The lag order of the model may run from $l = 1$ to p. This study works with lag lengths ranging from $p = 1$ to $p = 5$. The variables μ and η are the country-specific effects; the constant is always excluded. The variables u and v are the error terms.

Testing for Granger Causality includes the following three steps. First, a unit-root test must be conducted to determine whether or not the data should be taken at level or at the first difference. This study used the Augmented Dickey Fuller (ADF) test. Second, the variables must be tested for co-integration to ensure they are correlated. If the variables are not cointegrated, the Granger Causality test cannot be completed. This study uses the Johansen System Cointegration Test. Finally, if the variables are cointegrated, they can be

tested for Granger Causality. At this point, a lag length is selected (which will vary for each individual country), and the variables will be tested for unidirectional and bidirectional causality. Based on previous studies, it is expected that a causal relationship between terrorism and GDP, FDI, Inflation, and Unemployment will exist for some, but perhaps not all of the tested countries as this relationship has been found to be heterogeneous over space and time.

5.0 EMPIRICAL RESULTS

The empirical results are presented in the following tables. Table 5.1 demonstrates the ADF, co-integration, and Granger Causality test results for the relationship between terror attacks and GDP. Table 5.2 demonstrates the results for FDI, Table 5.3 shows the results for Inflation, and Table 5.4 shows the results for Unemployment. For each of the four indicators tested, the data fell in the 1% significance range when taken at the first difference. Refer to Appendix A to see a sample regression for the relationship between terrorism and GDP in Pakistan.

Table 5.1 shows that only two countries (Germany and Ireland) have no co-integration between terror attacks and GDP. Of the seven countries that do have co-integration, Italy and the United Kingdom do not experience Granger Causality at a significant level. Pakistan, Israel, Saudi Arabia, France, and Spain each have a significant relationship between terror attacks and GDP. For Pakistan, France, and Spain, it is GDP that Granger causes terror attacks. For Israel and Saudi Arabia, it is terror attacks that Granger causes GDP. Pakistan, Israel, and France are calculated at a lag length of 2, while Israel and Saudi Arabia are calculated at lag length 5, and Spain at lag length 1. All of the countries that have a significant relationship, with the exception of Israel, are significant at the 5% level; Israel is significant at the 10% level.

Table 5.1: Empirical Results (GDP)

Country	ADF Statistic: first difference	Co-integration Test	Granger Causality F-Statistic	Lag
Pakistan	23.9063***	YES	GDP → TERROR 4.9689**	2
Israel	45.7481***	YES	TERROR → GDP 2.5367*	5
Saudi Arabia	65.0132***	YES	TERROR → GDP 2.9511**	5
France	31.1771***	YES	GDP → TERROR 3.6188**	2
Germany	36.3894***	NO		
Ireland	45.5583***	NO		
Italy	33.2704***	YES	NO CAUSALITY	
Spain	24.5787***	YES	GDP → TERROR 7.5515**	1
United Kingdom	29.2689***	YES	NO CAUSALITY	

Note: ***, **, and * denotes significance at the 1%, 5%, and 10% respectively.

Table 5.2 shows that Saudi Arabia is the only country with a significant causal relationship between terror attacks and FDI. For Israel, Italy, and Spain, the variables are co-integrated, but do not experience Granger Causality at a significant level. Terror attacks and FDI are not co-integrated for the remaining countries. In Saudi Arabia, it is terror attacks that Granger causes FDI, taken at lag length 5, and falling the 1% significance range.

Table 5.2: Empirical Results (FDI)

Country	ADF Statistic: first difference	Co-integration Test	Granger Causality F-Statistic	Lag
Pakistan	29.1249***	NO		
Israel	48.0282***	YES	NO CAUSALITY	
Saudi Arabia	51.7975***	YES	TERROR → FDI 6.0454***	5
France	36.1701***	NO		
Germany	54.2041***	NO		
Ireland	72.8762***	NO		
Italy	41.0946***	YES	NO CAUSALITY	
Spain	44.9766***	YES	NO CAUSALITY	
United Kingdom	50.1148***	NO		

Note: ***, **, and * denotes significance at the 1%, 5%, and 10% respectively.

Table 5.3: Empirical Results (Inflation)

Country	ADF Statistic: first difference	Co-integration Test	Granger Causality F-Statistic	Lag
Israel	34.5494***	YES	TERROR → INFLATION 4.6359***	5
France	40.2233***	YES	INFLATION → TERROR 2.9517*	1
Italy	32.5910***	YES	TERROR → INFLATION 4.9058**	1
Spain	55.6439***	YES	INFLATION → TERROR 3.5850*	1

Note: ***, **, and * denotes significance at the 1%, 5%, and 10% respectively.

Table 5.3 demonstrates that each of the four countries (Israel, France, Italy, and Spain) tested for Granger Causality between terror attacks and Inflation do have a

significant causal relationship. Israel has the greatest significance level at 1%, while Italy is significant and 5%, and France and Spain are significant at 10%. For Israel, the Granger Causality regression is run at lag length 5 while the remaining countries are run at leg length 1. For Israel and Italy, it is terror attacks that Granger cause Inflation. For France and Spain, it is Inflation that Granger causes terror attacks.

Table 5.4 demonstrates that Italy is the only country with a significant causal relationship between terror attacks and Unemployment, and it is only significant at the 10% level taken at lag length 1. In France, it is Unemployment that Granger causes terror attacks. For Italy and Spain, the variables are co-integrated, but not significant when tested for Granger Causality. For Israel, terror attacks and Unemployment are not co-integrated at all.

Table 5.4: Empirical Results (Unemployment)

Country	**ADF Statistic: first difference**	**Co-integration Test**	**Granger Causality F-Statistic**	**Lag**
Israel	28.3456***	NO		
France	29.0173***	YES	UNEMPLOYMENT → TERROR 10.5332*	1
Italy	50.2695***	YES	NO CAUSALITY	
Spain	19.8336***	YES	NO CAUSALITY	

Note: ***, **, and * denotes significance at the 1%, 5%, and 10% respectively.

Ultimately, Inflation is the economic indicator with the greatest percentage of significant results as all countries tested have a significant Granger causal relationship between Inflation and terror attacks. It is also important to note that none of the results demonstrated bidirectional relationships. Rather all of the significant relationships were unidirectional.

5.0 CONCLUSION

This research study does have data limitations. Fist, as previously mention the GTD is missing data for the year 1993. This was adjusted for by averaging the terror attacks between the years 1992 and 1994 for each given country. This method was the best solution for accounting for the missing data, but does unfortunately misrepresent the data for that year. Also, this study was forced to omit countries of interest as a result of data limitations. Some of those countries includes Afghanistan, Iraq, and Iran for which the terrorism data was available, but the economic indicator data was not available through the World Bank's WDI. Finally, data limitations regarding Inflation weakens the results of this study. All four of the countries tested experience a significant relationship between terror attacks and Inflation. This study would have benefited from testing more countries for the relationship between those two indicators to see if that trend would have continued. Unfortunately, the data was not available for the five other countries this study was concerned with.

Ultimately, this study concludes with the same finding as the studies previously mentioned that terrorism and various economic indicators have a heterogeneous relationship over space and time. Basically, the relationship for each indicator varies according to each specific country. This conclusion is most accurately depicted by reviewing the empirical results of GDP. Refer to Table 1 to see that some countries have significant causal relationships between terrorism and GDP while other countries do not experience any co-integration between the variables. Even for indicators such as Inflation where every country experienced a significant causal relationship, the relationship does vary. For instance, refer to Table 3 to see that for Israel and Italy it is terror attacks that Granger causes Inflation while for France and Spain it is Inflation that granger causes terror attacks. Another major finding of this study is that these relationship vary even within regions. This study examined three Middle Eastern countries and six European countries expecting to discover similar causal relationships within those regions. However, that expected result was not the case. Refer to Table 1 to see that in Israel and Saudi Arabia it is terror attacks that Granger cause GDP while in Pakistan it is GDP that Granger causes terror attacks. This finding perhaps provides insights into the different motivating factors behind terrorism, demonstrating that these motives can vary even within specific regions. It's also important to consider why some of these countries have the individual results that

they do. For example, Saudi Arabia is the only country with a significant causal relationship between terror attacks and FDI out of the nine countries tested. This unique relationship should be examined. The co-integration and significant causal relationship between terror attacks and FDI in Saudi Arabia could perhaps be a result of Saudi Arabia's intense oil richness and high oil exports. A similar unique causal relationship is witnessed between terror attacks and Unemployment in France. France is the only country of the four tested that has a significant causal relationship for this indicator. This relationship can perhaps be explained by the severe unemployment problems in France. In France, it is Unemployment that Granger causes terror attacks which could be explained by potential revolts when unemployment spikes.

In conclusion, this study does result in valuable policy implications in combating terrorism. Countries and political leaders should focus on increasing political stability and especially economic stability. As the empirical results show, for many of these countries, there is at least one economic indicator that has a causal relationship with terrorism. Therefore, each of these countries would benefit and hopeful see a decline in terrorism with an increase in economic stability. Countries should specifically focus on stabilizing their inflation. However, the most important policy implication is for each country to understand their specific individual relationship between terrorism and various economic indicators. Understanding that specific relationship will allow policy makers to target their focus on the specific indicators that have the greatest causal relationship with terrorism in their country. Finally, and more generally, countries should focus on increasing the opportunity cost of terrorism. Ultimately, there are various motivations for terrorist activity, some of which are economic factors. Policy makers should focus on decreasing these motives and increasing other economic opportunities.

Appendix A: Sample Regression (Pakistan)

Null Hypothesis: Unit root (individual unit root process)
Series: PCGDP, PCTERROR
Date: 04/10/16 Time: 20:07
Sample: 1981 2014
Exogenous variables: Individual effects
Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0
Total (balanced) observations: 64
Cross-sections included: 2

Method	Statistic	Prob.**
ADF - Fisher Chi-square	23.9063	0.0001
ADF - Choi Z-stat	-3.92941	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Intermediate ADF test results D(UNTITLED)

Series	Prob.	Lag	Max Lag	Obs
D(PCGDP)	0.0087	0	7	32
D(PCTERROR)	0.0007	0	7	32

Date: 04/10/16 Time: 20:09
Sample: 1981 2014
Included observations: 32
Series: PCTERROR PCGDP
Lags interval: 1 to 1

Selected
(0.05 level*)
Number of

Cointegrating Relations by Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	1	1	0	0	0
Max-Eig	1	1	1	0	0

*Critical values based on MacKinnon-Haug-Michelis (1999)

Information Criteria by Rank and Model

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
	Log Likelihood by Rank (rows) and Model (columns)				
0	-192.9619	-192.9619	-190.0734	-190.0734	-184.9368
1	-185.2721	-183.8514	-182.8097	-182.5175	-179.8815
2	-184.9509	-182.6531	-182.6531	-179.5190	-179.5190
	Akaike Information Criteria by Rank (rows) and Model (columns)				
0	12.31012	12.31012	12.25459	12.25459	12.05855
1	12.07950	12.05321	12.05061	12.09484	11.99260*
2	12.30943	12.29082	12.29082	12.21994	12.21994
	Schwarz Criteria by Rank (rows) and Model (columns)				
0	12.49334	12.49334	12.52942	12.52942	12.42499*
1	12.44594	12.46545	12.50865	12.59869	12.54225
2	12.85908	12.93208	12.93208	12.95280	12.95280

Pairwise Granger Causality Tests
Date: 04/10/16 Time: 20:10
Sample: 1981 2014
Lags: 5

Null Hypothesis:	Obs	F-Statistic	Prob.
PCGDP does not Granger Cause PCTERROR	29	2.53371	0.0664
PCTERROR does not Granger Cause PCGDP		1.35007	0.2888

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