NORTHERN ILLINOIS UNIVERSITY

The Elusive and Complex Parabolic Relationship between Terrorism and GDP per-capita

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By

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HONORS CAPSTONE ABSTRACT

The 21st century saw a dramatic focus on terrorism after the events of September 11, 2001. The search for an explanation for the causes of terrorism have led economists to turn to the role of GDP on terrorism. This research aims to search for a pattern in the relationship between GDP per-capita and acts of terrorism. Previous research has pointed towards both a positive and negative trend. The stark different findings in previous research attests to the various ways terrorism is measured and analyzed. Encapsulating the previous research, this research merges the two theories and aims to show there is an inverse parabolic curve between terrorism and GDP per-capita. At low-income levels, people feel a perceived need to lash out with violence towards symbolic political targets. At high-income levels, people have easier access to the tools required to organize acts of terrorism. Research into the causes of terrorism contributes to its elimination and should be used to prevent violence. Using three separate regressions with the data from the Global Terrorism Index, the World Bank, and the General Education Index for 49 countries. Each regression attempts to find a stronger relationship between GDP per-capita and the Global Terrorism Index. This research finds no significant relationship between terrorism and GDP per-capita. It does find a significant, negative relationship between the general education index and the global terrorism index.
The Elusive and Complex Parabolic Relationship between Terrorism and GDP per-capita

1. Introduction

“No day shall erase you from the memory of time.”

The quote above is found at the 9/11 memorial written by the classic poet Virgil. The memorial uses the quote in reference to the victims of the terrorist attacks on September 11, 2001. The United States began an extreme focus on terrorism early in the 21st century due to the attack on the World Trade Center on September 11, 2001.

The 21st century has experienced an unprecedented period of terrorism. Countless acts have permanently changed the way governments and law enforcement operate. It has led to religious intolerance, racial profiling, wars, and an ongoing media frenzy. News on groups like the IRA and ISIS have appeared to become a national past time. A more specific definition of terrorism is the violence against symbolic targets by an organized group in the minority to achieve a political goal (Federal Bureau of Investigation, 2022). This is the operational definition that will be used in this research. Terrorism is a real economic threat, even when the target is not inherently economic, like the World Trade Center. Acts of terror prevent business and international trade.

Fear from extremists can paralyze healthy markets. The number of terrorist activities have varied over time due to a variety of factors, including GDP per-capita. To properly understand the relationship between GDP per-capita and acts of terror, we need to redefine extremists as rational agents. Abu Bakr al Baghdadi, a man who led ISIS during the 2010s, had a PHD (Timeline: The Life and Death of Abu Bakr al Baghdadi, 2022). Nelson Mandela, before leading attacks against the South African government, owned a law firm (Biography of Nelson Mandela, 2022). Terrorism is prompted by the cultural and economic environment. My
hypothesis is as the GDP per-capita of a nation increases, the number of terrorist threats decrease until a point where the increase of GDP per-capita causes an increase in terrorism, holding all other factors constant.

2. Literature Review

Kis-Katos et al. (2010) published a discussion paper on the origin of terrorism. The paper recognizes the debate among the root causes of terrorism and whether there is a positive or negative relationship between GDP per-capita and terrorism. This research pulls data from the Global Terrorism Database (GTD) from 1970 to 2007; however, I use a terrorism index from 2011 to 2019. This research differentiated between international and domestic terrorism, while I will consider them one entity. Kis-Katos et al. (2010) conclude that as GDP per-capita increases, domestic and international terrorism increases. This is a result of the available tools to carry out a terrorist attacks, higher population, and large democracies that can control less (Kis-Katos et al., 2010). This research supports half of my hypothesis by supporting that as GDP per-capita increases, as the amount of terrorism increases.

Leßmann (2013) uses cross country data to analyze the relationship between GDP per-capita and internal conflict, including terrorism. Leßmann concluded that inequalities between GDP-per capita can lead to an increase in internal conflict (2013). He suggests that decreasing this inequality would decrease regional conflicts (2013). There are two conclusions to the hypothesis of this research. The first is that there is a positive relationship between the economic inequality spread across a population and the level of terrorism. Assuming the GDP per-capita inequality decreases due to an increase in overall GDP, there would be a parabolic relationship between GDP and terrorism. In comparison, Leßmann’s conclusion aligns with my hypothesis, that there is a parabolic causal relationship between GDP and terrorism.
Mascarenhas and Sandler (2013) take a different approach and argue that terrorism will increase with GDP per-capita. This is due to the funding required for acts of terror. Developed nations have public and private groups who are willing to fund terrorist organizations, which is why terrorist groups can be found in wealthy countries like Ireland (2013). Larger and more organized terrorist groups require more funding. Poorer countries are found to have a high amount of terror due to outside funding. Mascarenhas and Sandler (2013) find that international remittances are a major source of this funding. It is shown that the higher remittances result in higher amounts of terrorism. Mascarenhas and Sandler (2013) conclude that increases in GDP per-capita increase both domestic and transnational terrorism. The most important finding in terms of my hypothesis is that the amount of terrorism will increase due to an increase in GDP per-capita.

In one study on the terrorism and the economy in Pakistan, Muhammad et al. (2012) concludes that there is a parabolic relationship between political strife and violence. The relationship between the power of the state and rebellion of citizens in the long run first increases with the amount of power and then decreases. Muhammad et al. (2012) states that the increase in GDP implies a more powerful government and therefore militants are more likely to use terrorism as opposed to warefare tactics. A more powerful government is more likely to win a war than to completely snuff out terrorist organizations. This is to say that there is a positive relationship between GDP and terrorism. People who are willing to commit acts of terror do so because it is more logical than organizing a formal war. Due to Pakistan’s growing GDP, the Pakistani government has the resources to win an internal war. In application to my own thesis, this is another piece of evidence that at a certain point, the amount of terrorism will increase with
GDP; however, my research utilizes GDP per-capita. According to this article, that point is the same point at which the opposing government has the ability to win a war.

Berrebi and Ostwald (2011) delve into several factors of terrorism. It was found that after a nation had experienced a natural disaster, nations with lower GDP per-capita would experience a higher level of terrorism (2011). Nations with larger GDP per-capita did not experience an increase in terrorism after a natural disaster. The article concludes “richer countries have more resources at their disposal to aid in the recovery process and to combat terrorism” (p. 398). My research will not consider natural disasters as a relevant variable. However, the application of this research supports that there is a negative relationship between terrorism and GDP per-capita. This research adds another dimension of complexity to the meaning of GDP. A nation with more wealth has the ability to provide for its citizens, thus relieving the perceived need to lash out violently in order to create political change.

South-eastern Turkey serves as a case study on the relationship between terrorism and GDP. Sezginb and Feriduna (2008) set out to show that improving GDP is a better anti-terrorist method than counter-military tactics. Turkey is notable for its terrorist activity, because active groups during the study were from multiple sides of economic and political spectrums. This is useful for comparing how different types of political motivations effect how they respond to improvements in the economy. Sezginb and Feriduna (2008) compares different components of GDP to the amount of terrorist attacks over time. They conclude that an improvement in GDP will decrease terrorist attacks. This study goes further than similar ones by showing that the development of the agriculture sector and government sector of GDP will do the most to prevent terrorist attacks. Overall, this study finds a negative causal effect between GDP and terrorism.
There are six journal articles referenced here. Each reflect the vast array of viewpoints of how terrorism will change based on the wealth of a nation. Two of the articles conclude that as GDP per-capita increases, the level of terrorism will decrease (Kis-Katos et al., 2010; Mascarenhas & Sandler, 2013). Another two articles agree that as the wealth of a nation increases, the amount of terrorism will decrease (Ostwald & Berrebi, 2011; Sezginb & Feriduna, 2008). The last two articles display a parabolic relationship between GDP and terrorism, again also disagreeing on the use of GDP and GDP per-capita (Leßmann, 2013; Muhammad et al., 2012). As my hypothesis supports a parabolic relationship, it is important to turn to sources that provide reasoning for both positive and negative causation for terrorism. Ultimately, they do not contradict each other; instead they compliment each other.

Four of the articles use GDP per-capita (Kis-Katos et al., 2010; Leßmann, 2013; Mascarenhas & Sandler, 2013; Ostwald & Berrebi, 2011), which is the overall GDP divided by the population of a nation. Muhammad et al. (2012) and Sezginb and Feriduna (2008) only use overall GDP. For the purposes of references, this difference is inconsequential. As GDP rises, GDP per-capita will also rise as long as the population stays consistent. My research applies GDP per-capita because it emphasizes the income inequality across nations. Using GDP per-capita also makes it easier to compare nations without population differences making the data more consistent. A nation may be comparatively wealthy, but its people are poor if the wealth is distributed among a billion citizens.

An important note to extract from these references include the wide disagreement in the trends of terrorism. Economic instability is a significant factor in increasing terrorism when GDP is low. Increasing GDP is especially effective as an anti-terrorist measure when citizens benefit from the wealth. When GDP is high, terrorists have more access to resources.
3. Theory

In the classical economic model, all people are assumed to be rational. Decisions are made by individuals with consideration given to the benefits and costs of an action. My hypothesis assumes that this classical assumption is correct and that all people, including those who commit acts of terrorism are rational agents. Most people would deem committing a violent act as an irrational, dangerous, and immoral choice. Rational people see violence as damaging to society and has more negative impacts than positive ones. My hypothesis is an exercise in understanding all sides of a situation. Merely the fact that so many organized acts of symbolic, political violence exist indicates that there is logic to these actions. It is believed to be a rational act based on situational context and not a random occurrence. It is instead, a rational response to a threat by a political or religious majority. The application of this assumption is not a defense or excuse for any act of violence and is not a reflection of my personal opinions.

The theory of bounded self-interest in behavioral economics assumes that people can make decisions that increase their country’s welfare as opposed to strictly serving an individual interest. Terrorists are engaging in political violence, in spite of the negative repercussions of their actions. The punishments of committing violence can range from charges of treason to capital punishment, including accidental and purposeful death. However, terrorists are engaging in bounded self-interest by undertaking what they perceive to be necessary for their group. For example, freeing their people from dictators, religious persecution, or political oppression. Although it is clearly not a personally beneficial decision, these acts of violence are rational for the greater good of a minority.

My thesis requires the understanding that people respond to GDP per-capita and that GDP per-capita affects lives. It is a measure of the quality of life and is an economic signal of
employment and growth. It is a number that can be analyzed distantly in the academic field, but its power comes from its impact on the quality of life. People with a lower GDP per-capita will experience lower wealth, while those with high GDP per-capita will have access to abundant resources. GDP per-capita is a tool that makes acts of terror easier. Wealthy nations give its citizens convenient access to stores, education, and communication devices which are all necessary to organize acts of violence. Poor nations are provided financial assistance from wealthy individuals, organizations, and even other governments in order to employ terrorism to fight political or religious oppression.

In terms of my hypothesis, this explains the parabolic relationship. Poor nations with political goals are funded by wealthy nations which is why there is theoretically more terrorism in poor nations, although there are few resources. Wealthy nations fundraise much more easily. Terrorism is therefore found at the extremes of rich and poor. Nations of the world polarized by conflict or with the means to broadcast those conflicts to millions. Countries in the middle of the spectrum are theorized to be much extreme with notably less violence. The Financial Action Task Force finds that terrorism not individually funded, requires a form of fundraising (FATF Report Ethnically and Racially Motivated Financing, 2021). Those sympathetic to a cause can donate their money and finance the expenses of a terrorist group. That is how small terrorist groups in impoverished nations acquire weapons and other resources. State sponsored terrorism takes place when a government funds violent groups with political goals that align with that government. Terrorist organizations in wealthy nations may also engage in fundraising; however, the need is less. It is easier for terrorists to acquire weapons in countries like the United States and Ireland.
4. Data

The Institute for Economics & Peace published the Global Terrorism Index (GTI) score which measures “incidents, fatalities, injuries and property damage” caused by terrorism per-country (Overall Terrorism Index Score, 2021) The GTI is a score given to a country every year that represents the severity of terrorism within those borders. The score is between 0 and 10, the higher the score, the larger the impact of terrorism. Vision of Humanity, the website presenting the Institute for Economics & Peace’s data, contains the GTI for 163 countries between 2011 and 2021.

The Global Terrorism Index is the dependent variable in this research. I randomly selected 49 countries from the list of GTI scores using a random generator on Excel. Using random countries limited any selection bias. The consequence of random selection is that the countries selected are not equally distributed across continents or national income. The GTI has the most restrictive list of countries. Forty-nine were selected as a manageable sample size but it was too large for an Excel regression. I categorized the 49 countries into six continental regions. Of the 435 observations, there were 108 observations in Africa, 13 in South America, 36 in Asia, 55 in North America, 107 in the Middle East, and 116 in Europe. Given the large population size, I do not expect a population bias. I found the GDP per-capita, education index, and GTI score for each of the countries over the period of 2011 to 2019. I used these nine years because data is available for all the needed variables. I controlled for time by creating a time trend variable for each of the nine years.

The World Bank collects data on countries for the purposes of advancing development. My data includes the GDP per-capita the selected countries from the World Bank with all currencies
converted into US dollars. I will use the countries and years from the World Bank consistent with what the GTI data is limited to.

The data representing the average level of education is the general education index (EI). This data comes from the UNESCO Institute for Statistics. The education index finds an “average of mean years of schooling (of adults) and expected years of schooling (of children)” as an index (Education Index, 2020). The index is calculated as a decimal, the closer the score is to 1, the more educated the population is.

To clean the data, I removed country and year pairs that lacked GDP data, which decreased the sample size from 441 to 435 observations. Table 1 contains the variables, the variable definitions, the mean, standard deviation, minimum and maximum for each of the variables.

5. Empirical Model

The model used to analyze the data is as follows.

\[ \text{GTI} = \beta_0 + \beta_1 \text{GDP} + \beta_2 \text{GDP}^2 + \beta_3 \text{EI} + \beta_4 \text{NA} + \beta_5 \text{AS} + \beta_6 \text{EU} + \beta_7 \text{AF} + \beta_8 \text{ME} + \beta_9 \text{Year} + \text{Error} \]

The dependent variable is the amount of terrorism as measured by the GTI index. The variables my regression include, GDP per-capita, GDP per-capita squared, the general educational index, dummy variables representing the geographical regions, and the years. GDP per-capita squared included because my hypothesis is testing for a quadratic relationship.

To estimate a quadratic relationship between GDP and GTI while holding other factors constant, I performed a multivariable regression using Excel. The coefficient estimate of GDP is expected to have to be negative, so that as GDP per-capita increases, GTI will decrease. The coefficient estimate of GDP\(^2\) is also expected to be positive. Other things equal, as GDP increases, the positive effect overshadows GDP\(^2\), which creates the parabolic relationship between GDP and GTI.
6. Results

The results of the regression are located in Table #2. The corresponding illustration of GDP\(^2\) and GTI for this regression is shown in Graph #1. The hypothesis of this research states that GDP per-capita has a parabolic relationship with GTI. The result of the regression shows that \(\beta_1\) and \(\beta_2\) are equivalent to 0. The p-value of this coefficient is .36, implying this coefficient is statistically insignificant with a significance level of .05. The results of this regression illustrate there is no relationship between GDP per-capita and GTI.

The education index showed that for every 1 point the general level of education increases, GTI decreases by 7.55 points. This is statically significant and telling. Graph #2 shows a cluster of nations on the x-axis with GTI score of 0 and education scores of .5 and higher. Generally, nations with higher education are shown to have smaller terrorism indexes.

Regional level data showed a negative, statically insignificant relationship to GTI. This was true of all regions aside from the Middle East. The coefficient of these dummy variables are the difference in the mean GTI data for the respective countries and their respective counter countries. North America and Africa have similar coefficients of -4.3. The Middle East has 106 country and year pairs in the data. The wide variety of nations and their varying cultural attitudes towards terrorism likely lead to a span of data too broad for the regression to apply a significant coefficient. The difference between the regional level data is not varied enough to make any general statements about what region is safest or least likely to experience acts of terrorism. That statement would require significantly more data and research.

The coefficient of the year variable states that every year after 2011, the GTI score increases by .07; however, this is found to be insignificant. The low coefficient and the high p-value implies that between 2011 and 2019 the terrorism index was not significantly higher in any
particular year. Any change in the GTI score is more likely to be explained by another factor than year.

The R-squared value is .29 and the adjusted R-squared value is .28. Using the adjusted R-squared data, 28% of the variance in the data can be explain by the variables in the regression. The F-statistic is 20.07. There are 435 observations.

To find a pattern in the coefficients in the model, the regression was repeated with only two variables, GDP and GDP². In doing this, I am looking for changes in the coefficient estimates. The regression with exclusively GDP and GDP² is found in Table #3. The coefficient estimates for both variables are nearly 0. The p-values for both variables are greater than .05. Therefore, the relationship is insignificant. The visual of Graph #3 is exciting from a data perspective. The trend line has a clear parabolic curve, keeping in mind it is not significant. Unfortunately the data does not follow the trend line.

I repeated the regression for a third time. This regression used GDP², GDP, and the general education index. Table #4 has the regression results for this experiment. The GDP coefficient estimate is significant with a significance value of .05. The coefficient of GDP is small, but the parabolic relationship shown in Graph #4 is significant. This curve illustrates an inverse parabola rather than my predicted parabola so that terrorism increases with relatively low GDP and decreases with relatively high GDP. Based on these results, I can confidently reject my hypothesis. Education has a strong, significant relationship with GTI, similar to the original regression.

7. Conclusions

I hypothesized that as the GDP per-capita of a nation increases, the number of terrorist threats decrease until a point where the increase of GDP per-capita causes an increase in
terrorism, holding all other factors constant. This hypothesis was constructed from established theories that the relationship is positive and other theories that state the relationship was negative. Bringing them together theorizes a parabolic relationship. The sociological theories behind the causes of terrorism are endless; however, from an economic perspective, GDP per-capita has been concluded in previous research to have a causal effect on terrorism. However, the results of the regression performed indicate that there is no causal relationship between GDP per-capita and terrorism.

Upon completion of an additional regressions in which only GDP², GDP, and the education index are included, the coefficient estimates are statically significant but do not support my hypothesis. With the limited number of variables in my regression, these estimates are not reliable. The relationship is elusive and complex and requires further research.

The hypothesis was written with the intent on finding a raw number of terrorist attacks that occurred within a nation. This data exists within the Global Terrorism Database; however, after several attempts, I found I was unable to download this data. Using the Global Terrorism Index changes the data from a raw number to a heavily weighted average. From a macro perspective, the more terrorism present in a nation will raise the GTI so it can still be used to test my hypothesis. It may be that if I had access to the Global Terrorism Database, the results of the regression would show a more parabolic relationship between GDP and terrorism.

My chosen method of regression was Excel. Due to the limits of Excel’s capabilities I had to limit my data to 49 countries. Using all 163 countries available from the Global Terrorism Index would have been difficult to manage and would have exceeded the limits of Excel’s regression tools. If I had been able to use 163 counties over the 9 years, I would have 1,467 data points, a much larger sample size. In addition to limiting the data points, I was not able to run
every nation in the regression; it would have resulted in 48 dummy variables. By using regional dummy variables, the regression was less accurate and did not support my hypothesis.

Terrorism is a broad term that is defined slightly differently by different sources. This made comparing previous literature on the subject difficult. The causes of terrorism are also difficult to measure. GDP per-capita and education has the luxury of a numerical count kept by governments and research organizations. However, factors such as religious conflict, varying cultural acceptance of terrorism and suicide bombing, and state sponsored terrorism is not counted, nor publicized. Even if this regression had shown a perfect causal relationship between terrorism and GDP, there would be a very large error term due to the nature of violence.

The strength in this data is that it takes an approach that is not present in the previous literature. Of the six journal articles referenced in this research, only two use the term “parabolic.” Leßmann (2013) theorizes a parabolic relationship between GDP per-capita and “internal conflict.” Muhammad et al. (2012) uses GDP to test the relationship between violence and political strife. It is extremely difficult to find previous economic research with a hypothesis of a parabolic relationship similar to this paper. Unfortunately because this paper cannot conclude any relationship between GDP per-capita and terrorism, it does not support any of the other referenced literature that found significant relationships. My regression seems to be at odds with all other research referenced.

I believe that the reason trends in terrorism should be studied is to support its absolute elimination. Findings from research such as this would be most beneficial changing government policy on how to fight, prevent, or even predict acts of terror. Given the statistical insignificance of this data, no policy should be changed based on these findings. If this data was significant, no relationship would be found between GDP per-capita; therefore, efforts to end terrorism would
be better placed outside of economic measures. For example, the education index has a negative correlation with GTI. Efforts to prevent terrorism should be focused on increasing education. There is hope of seeing the complete prevention of political violence if research continues to study political aggressors as rational, organized groups.

The quote that begins this research used in Virgil’s “The Aeneid” is a solemn verse for those lost during the tragic acts of September 11, 2001. In celebration of the continued research into the prevention of terrorism, this research will end with another quote from “The Aeneid.” “Let me carry this hope I place in you with me, I will meet all dangers more boldly” (Virgil, 16-20/2002)
References

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n=435 observations
Table 2: Regression Results with all Parameters

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<th>Standard Error</th>
<th>P-Value</th>
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R-Squared: 0.298289772
Adjusted- R: 0.283430026
F-Stat: 20.07367901457
Significance F: 0.0306520198604767
*Denotes significant at .05
Observations: 435

Table 3: Regression Results with only GDP and GDP^2

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<th>Coefficient</th>
<th>Standard Error</th>
<th>P-Value</th>
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<td>GDP^2</td>
<td>-0.000000000028</td>
<td>3.13495E-10</td>
<td>0.364011708</td>
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R-Squared: 0.016005058
Adjusted- R: 0.011449526
F-Stat: 3.513323398
Significance F: 0.03065202
*Denotes significant at .05
Observations: 435
Table 4: Regression Results only GDP, GDP\(^2\), and EI

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<thead>
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<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>7.09148E-05</td>
<td>2.66652E-05</td>
<td>0.00811834*</td>
</tr>
<tr>
<td>GDP(^2)</td>
<td>-7.2154E-10</td>
<td>3.3631E-10</td>
<td>0.032473974</td>
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<tr>
<td>EI</td>
<td>-7.369311907</td>
<td>1.172974702</td>
<td>8.15246E-10*</td>
</tr>
</tbody>
</table>

R-Squared: 0.098558792
Adjusted R: 0.092284259
F-Stat: 15.70774996
Significance F: 1.03441E-09

*Denotes significant at .05
Observations: 435

Graph 1: Relationship between GDP\(^2\) and GTI Score from 2011-2019 in 49 Countries
Graph 2: Relationship between EI and GTI score from 2011-2019 in 49 Countries

Graph 3: Regression #2 Relationship between GDP and GTI from 2011-2019 in 49 Countries
Graph 4: Regression #3 Relationship between GDP and GTI from 2011-2019 in 49 Countries