THE EFFECT OF COUNTRY-LEVEL INCOME ON DOMESTIC TERRORISM:
A WORLDWIDE ANALYSIS OF THE DIFFERENCE BETWEEN LONE-WOLF AND GROUP AFFILIATED
DOMESTIC TERRORISM

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By

Sonia M. Stottlemyre, B.A.

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Thesis Advisor: Thomas Wei, PhD.

ABSTRACT

Despite vast literature examining causes of terrorism, domestic terrorism has only recently begun to be studied as an entity unto itself. It has long been postulated that a country’s wealth influences its domestic terrorism rates but very little research has backed that claim. Preliminary data suggests that there may be important differences between what leads to domestic attacks conducted by terrorist organizations and attacks conducted by people acting alone. The current study hypothesizes that the relationship between a country’s wealth, as measured by GDP per capita, and its domestic terrorism rate may be different for lone-wolf terrorism than for group-affiliated terrorism. Results support this hypothesis but not in the expected way; per-capita GDP appears to have a non-linear relationship with lone-wolf terrorism and a linear relationship with group-affiliated terrorism. The data were highly sensitive to changes in model specification so caution must be taken when drawing conclusions based on these findings. Although these results are preliminary, they should encourage future researchers to examine the differences between lone-wolf and group-affiliated domestic terrorism to best understand and prevent both phenomena.
This thesis is dedicated to all of the wonderful people without whom this would not be possible.

To my wonderful husband Steve, thank you for always encouraging me to work hard and keep learning.

To Chris and Corey, thank you for the flexibility and understanding that allowed me to continue my education.

To Tom, thank you for your guidance and dedication.

Sonia M. Stottlemyre
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INTRODUCTION

The best way to fight terrorism is to understand what causes it so that it is possible to prevent it from happening. The September 11, 2001 (9/11) attacks on the United States heightened politicians’, policy makers’, and the general public’s interest in the causes of terrorism. Nearly 90 percent of the research on terrorism has been produced in the years since 9/11, much of it focusing on the economic correlates (Silke, 2008). Unlike possible causes of terrorism that are political and demographic in nature, the economic correlates of terrorism are not well understood, and research results have been mixed. Some studies have found a relationship between various measures of economic wellbeing, like GDP and unemployment, but most studies have found no such relationship (Campos & Gassebner, 2013; Krieger & Meierrieks, 2011; Tavares, 2004). Part of the reason for these discrepancies may be the tendency to focus on transnational terrorism and to not distinguish between types of terrorists, for example those who act alone versus those who act on behalf of an organization. Yet domestic terrorist incidents are far more common than transnational incidents (see figure 1). As early as 2003,

**Figure 1.** Worldwide terrorism totals by type 1970 – 2011.
domestic terrorist incidents outnumbered transnational incidents by more than 6:1 (Abadie, 2004). The current study aims to address these shortcomings in the literature by examining how domestic terrorism rates are related to countries’ income levels. This study will further extend current empirical efforts by distinguishing between attackers who act individually (“lone-wolf” or “loner” terrorists) and those who act on behalf of a terrorist organization (“group-affiliated” terrorists).

It has been postulated that domestic and transnational terrorists are motivated in different ways, with the former frequently leading to the latter (Abadie, 2004; Sandler, 2003). Several researchers have attempted to explain this phenomenon in terms of the opportunity cost of terrorism (Freytag, Kruger, Meierrieks & Schneider 2009; Krieger & Meierrieks, 2011). It is easier and cheaper for potential terrorists to conduct attacks within their own country, and this may segue into more complex and expensive transnational attacks. The differences between domestic and transnational terrorism, however, have just begun to be examined.

Lone-wolf domestic terrorism has been around since at least the nineteenth century but has only recently received much attention from empirical researchers (Novak, 1954; Spaaij, 2010). Recent studies examining the differences between lone-wolf and group-affiliated terrorists have discovered several differences between these groups. Using case studies, Spaaij (2010) concluded that loners’ motivations tend to be a combination of personal grievances and political/religious ideologies, whereas terrorist group members’ motives tend to be almost exclusively ideological. Lone-wolf terrorism is often considered more dangerous than attacks conducted by terrorist groups. Because loners do not need to interact with or receive funding from a group, it is very difficult to track their movements or even their existence. It is difficult
for law enforcement officials to detect when an individual becomes radicalized, whereas the ideology and general intent of terrorist groups is often widely publicized (Bakker & DeGraaf, 2010). For all these reasons, lone-wolf terrorists often do not end up under scrutiny from law enforcement officials until they have already conducted at least one attack, making prevention extremely difficult.

Defining Terrorism

Based on the most widely accepted definitions of terrorism, an act of terrorism must satisfy the following criteria: 1) be illegal, 2) use coercion or intimidation, 3) involve actual or threatened violence, and 4) be intended to influence government action (see, for example, 18 U.S.C. § 2331 and UNSCR 1556). Because this study uses the University of Maryland’s Global Terrorism Database (GTD), it will rely on the GTD’s definition of terrorism: “the threatened or actual use of illegal force and violence by a non-state actor to attain a political, economic, religious, or social goal through fear, coercion, or intimidation.” This definition satisfies the four criteria listed above and adds a fifth criterion that the perpetrator must be a non-state actor. Though potentially controversial, this distinction avoids the problem of conflating terrorism with acts of war.

It is important to note that terrorism is not defined by the act’s success or failure, nor is it defined by whether the act results in death or injury. For example, the fire started by the Earth Liberation Front at an Oregon lumber factory in 2001 resulted in no injuries but still met all of the above criteria for terrorism, and earned at least one participant a terrorism conviction (Grigoriadis, 2007).
There are several possible ways to define domestic and transnational terrorism. Most simply, the term domestic terrorism applies when the nationality of the perpetrator(s) and victim(s) is the same as the nation in which the incident took place. If this is not the case, the terrorist act is transnational. An attack is also transnational if one or more international borders are crossed during the course of the attack as may happen in cases of hijacking or kidnapping. Because these incidents involve more than one country by definition, it is important to clarify that transnational terrorism rates are measured as the number of transnational incidents that occur within a given country. In other words, a country’s transnational terrorism rate for a given year is the number of transnational terrorist incidents that occurred within that country’s borders during that year, not the number of transnational terrorist incidents that were perpetrated by its citizens.

Finally, lone-wolf or loner terrorism is a terrorist act conducted by a single individual who is not a member of, or acting on behalf of, a terrorist organization. A lone-wolf terrorist may be influenced by terrorist ideology but does not represent the organization. Essentially, if there is two-way communication between the individual and the group, in the form of training, resources, or tasking, the individual would be considered a group-affiliated terrorist. For example, the Tsarnaev brothers, who allegedly perpetrated the 2013 Boston Marathon bombings, learned to build bombs from al-Qaeda’s Inspire Magazine and were influenced by Islamic extremist ideology. However, they were self-radicalized and never communicated with al-Qaeda or any other terrorist group directly. They would, therefore, be considered lone-wolf terrorists, even though the two of them acted together. There is some possible ambiguity in this definition if, for example, a large group of people worked together to conduct an attack but were not supported by a terrorist organization. However, this is an unlikely occurrence since such a group would almost
certainly be considered a terrorist organization in its own right and be classified by the United States as such.

**Literature**

Limited research has been conducted on the causes of lone-wolf domestic terrorism and even less is available comparing it to group-affiliated domestic terrorism. Recent studies have acknowledged the preliminary nature of this work and tend to be largely descriptive (Moskalenko & McCauley, 2011; Pantucci, 2011). In contrast, much work has been done on transnational terrorism, and there is a growing body of research on domestic terrorism more generally. Therefore, this study relies largely on the broader literature to form an empirical basis for its hypotheses.

Research on the origins of terrorism has uncovered three categories of causes; political, demographic, and economic. Political and demographic variables are widely believed to play a key role in predicting terrorism worldwide (Abadie, 2004; Berkebile, 2012; Burgoon, 2006). Piazza (2006) found that the structure of party politics was the most significant predictor of transnational terrorism. More repressive countries (as measured by a combination of variables such as political rights and civil liberties) and countries with fewer political parties experienced less terrorism than freer countries with 2 or 3 political parties. Abadie (2004) found that the risk of terrorism was higher for countries with moderate levels of political freedom but lower for countries with high and low levels of political freedom and concluded that countries transitioning from authoritarian regimes to democracies tend to suffer temporary increases in terrorism due to the heightened levels of political upheaval. Relationships have also been found between terrorism and population, ethno-religious diversity, increased state repression, domestic political
instability, and even the amount of mountainous terrain in a country. (Campos & Gassebner 2013; Choi & Salehyan, 2013; Krieger & Meierrieks, 2011). Each of these factors is hypothesized to contribute to a potential terrorist’s capability or intent, either by providing the resources or environment conducive to conducting an attack or by creating motivation in the form of disgruntlement (see McCauley, Moskalenko, & Van Son, 2013 for a discussion of lone-wolf grievances).

The relationship between terrorism and economic factors like income and unemployment remains unclear. Until recently, most research showed no link between measures of a country’s economic state and its terrorism rates (Abadie, 2004; Piazza, 2006; Tavares, 2004). Abadie (2004) examined the relationship between income/income inequality (as measured by GDP per capita, the GINI index\(^a\), and the United Nations World Development Index\(^b\)) and terrorism risk and found no associations. However, Abadie grouped transnational and domestic terrorism together, preventing detection of potential differences between the groups.

In the last few years a handful of studies have detected a relationship between poor socio-economic conditions and increased terrorism rates (see, for example, Freytag, Kruger, Meierrieks & Schneider, 2011). Enders & Hoover (2012) examined worldwide terrorism rates between 1970 and 2007 and found that the relationship between per-capita GDP and annual terrorism rates was non-linear and differed between domestic versus transnational terrorism. For domestic terrorism, as per-capita GDP increased from the lowest levels, terrorism remained relatively high and increased only slightly. Once per-capita GDP reached approximately $1000, domestic terrorism

\(^{a}\) The GINI index is a measure of income inequality widely used in development research.

\(^{b}\) The U.N. World Development Index uses levels of health, education, and income to measure economic wellbeing at the country level.
rates began to steadily decrease. For transnational terrorism, the relationship between per-capita GDP and annual terrorism rates took a bell-curve shape, where the peak of the curve was at approximately $2215 per capita GDP. Enders & Hoover speculate that this difference could arise at least partly from the fact that multiple countries’ economic situations are in play in transnational terrorism, potentially complicating this relationship.

Berkebile (2012) found a similar relationship between a country’s per-capita gross national income (GNI), and rates of domestic terrorism. This study found an inverse U-shaped relationship between per-capita GNI and domestic terrorism rates. The poorest and richest countries suffered comparably less terrorism than middle-income countries.

These studies contributed significantly to the literature on the economic correlates of terrorism but they were not without their drawbacks. Enders & Hoover only examined terrorist incidents in which at least one death occurred, assuming that incidents resulting in death would be more widely reported and thus more accurate. Because different types of terrorists tend to select different attack methods, this assumption likely created a selection bias. For example, in recent years religiously-motivated terrorists have begun to employ increasingly violent attack methods resulting in greater numbers of deaths (Gaibulloev, Sandler, & Santifort, 2012). Many domestic terrorist groups such as environmentalist organizations tend to opt for methods that minimize or eliminate casualties (Carson, LaFree & Dugan, 2012). By only examining incidents that resulted in death, Enders & Hoover may have biased their sample towards the religious extremist population relative to the environmental extremist population.

Enders & Hoover also did not account for the possibility that per-capita GDP may have a lagged relationship with terrorism: An increase in income may lead to a drop in terrorism but it
may take a year or more for the effect to permeate the economy. Both Enders & Hoover and Berkebile examined domestic terrorism as a single group, without considering possible differences between loners and terrorist groups. Because loners and group-affiliated terrorists may have somewhat different motivations and because motivation is such a large driver of terrorism, it logically follows that patterns of terrorist attacks may be different for lone wolves versus group-affiliated terrorists.

Finally, the designs of all these studies, including the current one, just look at associations. They do not allow researchers to draw causal conclusions about the relationship between wealth and terrorism at the country level. Unfortunately, the nature of the subject matter prevents the conduct of randomized controlled trials so researchers must settle for less causally conclusive models.

**Conceptual Model**

The current study tests the hypothesis that there is a non-linear relationship between a country’s wealth and its group-affiliated domestic terrorism rate but a linear relationship between wealth and lone-wolf domestic terrorism. I expect the relationship between wealth and group-affiliated domestic terrorism rates to be consistent with the findings of Enders & Hoover (2012) and Berkebile (2012). One explanation for this pattern is that people in the poorest countries do not have the material resources to commit terrorist acts because all of their resources go toward meeting their basic needs. Additionally, the government may have few resources to put toward counterterrorism efforts. This situation could cause terrorism to be relatively low in the poorest nations. As a country’s wealth increases and its people are able to meet their basic needs, they may have enough excess resources to invest in terrorist acts but not so much as to satisfy many
of their desires, giving some a motivation to turn to terrorism. At the same time, the government may have some resources to expend on counterterrorism measures, but not enough to make these measures robust, leaving the country somewhat vulnerable to attack. These circumstances could lead to an increase in domestic terrorism for middle-income countries. As countries approach the wealthiest end of the spectrum, governments have more resources to invest in counterterrorism efforts and citizens are getting their needs met, giving them less motivation to commit terrorism. We would then expect to see a decline in terrorism for the richest countries (see figure 2).

However, the pattern for lone-wolf domestic terrorism may be different. Currently, I am aware of no studies examining the relationship between a country’s wealth and its lone-wolf

**Figure 2.** Conceptual model of the hypothesized effect of wealth on group-affiliated domestic terrorism rates.

CT = counterterrorism
terrorism rate so predictions about this relationship rely largely on inferences from what is known about lone-wolf terrorists.

Because loners must finance their own operations, the impact of changes in the wealth of their own country may be greater for these individuals than for terrorist groups because terrorist groups may receive financing from foreign countries. However, lone wolves are also more likely to use cheap, simple tactics like handguns, potentially offsetting much of the cost during times of economic hardship (Spaaij, 2010). Therefore, wealth is hypothesized to have small impacts on the capability of lone-wolf domestic terrorists.

Lone-wolf terrorists tend to have higher rates of mental illness than other terrorists, which may increase their likelihood to conduct terrorist acts for irrational reasons depending on the types of mental illnesses present in the population (Monahan, 1992; Schildkraut & Muschert, 2013; Spaaij, 2012). If this is the case, it could weaken the link between wealth and attack rates, which are based on assumptions of rational actors.

The result is that lone-wolf terrorism rates would be primarily determined by the counterterrorism capabilities of a country, which would increase as the country’s wealth increases. Thus, overall I predict that the relationship between lone-wolf terrorism and per-capita GDP is linear and that the rate of lone-wolf domestic terrorism will decline as per-capita GDP increases (see figure 3).
The current study relies on terrorism data from the Global Terrorism Database (GTD), a collection of information on every terrorist attack in the world since 1970 for which open-source information is available (over 104,000 terrorist incidents). The GTD contains a variety of descriptive variables, such as number of deaths, type of weapons used, location of the incident, and success of the attack. The National Consortium for the Study of Terrorism and Responses to Terrorism (START) based at the University of Maryland compiled the GTD and maintains the database. Data were collected in phases from publicly available sources, primarily media articles and electronic news archives. Other sources included existing datasets, books, journals, and legal documents. Pinkerton Global Intelligence Service (PGIS), a private security company, collected
data on attacks from 1970 to 1997. The Center for Terrorism and Intelligence Studies (CETIS) and START collaborated to gather data on attacks that occurred from January 1998 to March 2008. The Institute for the Study of Violent Groups (ISVG) collected data on attacks between April 2008 and October 2011, and START has collected all subsequent data. Although they did not collect the original data, START maintains the database and makes it publicly available “in an effort to increase understanding of terrorist violence so that it can be more readily studied and defeated.”

The GTD, while the most commonly used dataset in the terrorism literature, is not without its flaws. First, it is possible that the GTD is incomplete census of terrorist attacks. It is based strictly on open-source data, primarily media, which means it may be subject to a range of inaccuracies and reporting biases. Because it relies largely on media accounts, the details of individual incidents may suffer some degree of inaccuracy. There may be over-reporting or under-reporting of terrorist events depending on the country and the information source. For example, countries with more media and Internet restrictions, like China, may have under-reported incidents. News outlets that do not sufficiently check sources may over-report. However, a handful of studies indicate the GTD is at least as accurate as any other available dataset (LaFree, Dugan, Fogg, & Scott, 2006). The GTD seems to be the most widely used dataset in the terrorism literature so this limitation will not be unique to this study. Some researchers have tried to limit this potential bias by restricting their sample to only terrorist incidents that resulted in at least one death, assuming that these incidents would be more widely reported and, therefore, more accurate (Enders & Hoover, 2012). However, this selection process is likely to bias the sample in other ways. For example, religious extremists have tended to use
more lethal methods in recent years than other groups, which would cause this selection rule to over-weight incidents perpetrated by religious extremists (Gaibulloev, Sandler, & Santifort, 2012; Sandler, 2003).

Another issue with the GTD is that the data from 1993 was lost. Some of the data has been re-created but the sample for that year is still abnormally small and unlikely to be accurate. This small anomaly is unlikely to make much difference in a sample this size, but I conduct my analyses both with and without the 1993 data to assess the sensitivity of my results.

A third data issue is one that has not been addressed in the previous literature. The advent and subsequent widespread use of the Internet beginning in the late 1990s and early 2000s may have allowed incidents to be reported that otherwise would not have been documented by the GTD researchers. In remote areas that reporters cannot easily access physically, the Internet provides a means of getting that information out to the public. This could cause increased reporting in more recent years of the sample. This difference will become obvious if worldwide domestic terrorism rates increase significantly starting in the early 1990s when the Internet began to become widely available.

Data on GDP per capita, inflation, population density, unemployment, male youth unemployment, and military spending comes from the World Bank. However, reliable data on these variables was only available beginning in 1980 so the current study is limited to the years since then. Data on democracy and autocracy comes from the Polity IV Project, a dataset containing political regime characteristics and transitions from 1800 to 2012. Most countries had at least some missing data for each variable. I used linear interpolation to fill in missing data for GDP per capita and the control variables for years for which there was data before and after. No
missing data was extrapolated, because such data were often missing because a particular country came into or out of existence during the timeframe studied. No missing data was interpolated for any of the terrorism measures. Because most World Bank data were missing for years prior to 1980, I will only look at attacks that occurred between 1980 and 2011. The final sample consisted of 827 observations from 87 countries (see figure 4).

Figure 4. Map of all 87 countries in the final sample

**EMPIRICAL STRATEGY**

The following are the primary regression equations this study used to test the hypothesis that wealth, as measured by GDP per capita, has a non-linear relationship with group-affiliated domestic terrorism but a linear relationship with lone-wolf domestic terrorism:

\[
\text{Number of group-affiliated domestic terrorism incidents}_{ct} = \beta_0 + \beta_1 \text{GDP per capita}_{c(t-1)} + \beta_2 \text{GDP per capita squared}_{c(t-1)} + \beta_3 \text{inflation}_{c(t-1)} + \beta_4 \text{population density}_{c(t-1)} + \beta_5 \text{unemployment}_{c(t-1)} + \beta_6 \text{male youth unemployment}_{c(t-1)} + \beta_7 \text{polity}_{c(t-1)} + \beta_8 \text{GDP growth}_{c(t-1)} + \text{error}
\]
Number of lone-wolf domestic terrorism incidents$_{ct} = \beta_0 + \beta_1 \text{GDP per capita}_{c(t-1)} + \beta_2 \text{inflation}_{c(t-1)} + \beta_3 \text{population density}_{ct} + \beta_4 \text{unemployment}_{ct} + \beta_5 \text{male youth unemployment}_{ct} + \beta_6 \text{polity}_{ct} + \beta_7 \text{GDP growth}_{c(t-1)} + \text{error}

GDP per capita is measured in thousands of constant 2005 U.S. dollars and is adjusted for purchasing power parity. Inflation is measured as a percentage rate of change per calendar year. Polity is a measure of how democratic or autocratic a particular country’s government is, with -10 being highly autocratic and +10 being highly democratic. Polity values were assigned by, and data were gathered from, the Polity IV project. Economic growth is measured as the percentage of total GDP growth per calendar year in constant 2005 U.S. dollars, adjusted for purchasing power parity. Each regression above was run as a negative binomial regression with country fixed effects, then with year fixed effects. To ease interpretation of the estimated coefficients, the negative binomial regression results are presented as incidence rate ratios (IRR). In this case, it is the ratio of the incidence of domestic terrorism at the value of GDP per capita + $1,000 (since GDP is being measure in thousands of dollars) to the incidence of domestic terrorism at the value of GDP per capita. This means that, if the IRR is less than 1, the incidence of domestic terrorism decreases in proportion to the IRR as GDP per capita increases by 1 unit. If the IRR is greater than 1, the incidence of domestic terrorism increases as GDP per capita increases. To test the sensitivity of the model, I also ran each regression as an ordinary least squares (OLS) regression with alternating country and year fixed effects. To test my hypothesis about the differing linearity of each model, I ran each regression both with and without the squared term and compared the explanatory power of the results.
This study controls for variables previously associated with changes in the level of domestic and transnational terrorism that could also be related to GDP per capita. These variables can be grouped into economic, political, and demographic factors (see Krieger & Meierrieks, 2011 for a detailed discussion of this grouping scheme). Unemployment, inflation, and economic growth are all economic factors likely correlated with domestic terrorism (Blomberg & Hess, 2006; Freytag, Kruger, Meierrieks, & Schneider, 2011). Government type (democracy versus autocracy versus anocracy) is related to terrorism, with democracies and autocracies suffering higher rates of terrorism than anocracies (Berkebile, 2012). Regime stability, regardless of type, is also negatively correlated with terrorism (Campos & Gassebner, 2013). Demographic factors related to terrorism are ethnic and religious diversity, population, population density, and mountainous terrain (Abadie, 2004). Terrain should be accounted for through the use of country fixed effects so it is not included as a separate control.

Reliable data on ethnic and religious diversity was unavailable. However, this variable is likely to remain somewhat consistent over time within countries so should be somewhat accounted for with the use of country fixed effects. Of course, this is an imperfect assumption and may bias the data if there is significant variation in ethnic and religious diversity within individual countries over time. Higher levels of ethnic and religious diversity are associated with higher levels of terrorism and several studies have found a negative relationship between ethnic/religious diversity and various measures of economic development, including GDP (Lipset, 1959; Montalvos & Reynal-Querol, 2005). Fortunately, this means that, if there is too much variation in ethnic and religious diversity for year fixed effects to be an effective control,
excluding these variables will bias the model downward and any significance detected will be weaker than is actually the case.

The dependent variables are the number of group-affiliated or lone-wolf domestic terrorist incidents per country-year as taken from the GTD. For the model in which group-affiliated domestic terrorism is the dependent variable, I expect the coefficient on GDP per capita squared to be less than 1. Because the coefficients are in incidence rate ratios, a coefficient less than 1 is the equivalent of a negative coefficient in standard OLS models. I expect the coefficient on GDP per capita to be greater than 1. This would mean that the best-fit curve would increase at a decreasing rate to the apex of the curve, at which point it would begin to decrease at an increasing rate, creating Berkebile’s (2012) inverse-U shape. For the model in which lone-wolf domestic terrorism is the dependent variable, I expect the coefficient on GDP per capita squared to be statistically insignificant and the coefficient on GDP per capita to be statistically significant and less than 1, indicating a downward sloping linear relationship (see figure 5).

**Figure 5.** Conceptual depiction of the predicted differences between lone-wolf and group-affiliated models.

<table>
<thead>
<tr>
<th>Group-affiliated Domestic Terrorism</th>
<th>Lone Wolf Domestic Terrorism</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP per capita</td>
<td>GDP per capita</td>
</tr>
</tbody>
</table>

**Analysis and Results**

Basic comparisons of worldwide annual lone-wolf and group-affiliated domestic terrorist attack rates revealed two different patterns. Mean worldwide lone-wolf attack rates were
consistently low (near zero) until the early 2000s, when rates suddenly began to increase (see figure 6).

There is no clear reason for this sudden increase in worldwide lone-wolf terrorist attack rates but it is possible that this increase is related to a worldwide increase in Internet availability around this time. Greater access to the Internet may give lone-wolf terrorists additional tools to conduct attacks on their own, such as access to information about bomb making. Increased Internet availability may also have led to an increase in reporting of terrorist attacks. Internet access may provide a means to make these attacks known to the public where no such mechanism existed previously. This would also help explain the uptick in group-affiliated attacks that does not appear to mirror changes in per-capita GDP. Group-affiliated attack rates were very
low in the early 1970s, rose steadily until the late 1980s, fell steadily until the early 2000s, and then rose again quickly for the next 10 years, somewhat mirroring the peaks and troughs in the mean worldwide GDP per-capita, which declines between 1980 and the early 1990s, then rises again throughout the early 2000s (see figures 7 and 8).

**Figure 7.** Unweighted mean annual worldwide group-affiliated domestic terrorism rates plus one standard deviation.

**Figure 8.** Unweighted mean annual worldwide GDP per capita, adjusted for purchasing power parity.
A negative binomial regression was chosen as the primary method of analysis because the data are non-negative count data. Some variables were lagged by one year to account for the possibility that variables such as inflation would have a delayed effect on terrorism rates. I used country and year fixed-effects models to control for unobserved variables that are consistent either across countries or over time. As a sensitivity check and for ease of interpretation, I also ran these models using OLS. The results are presented in tables 1 and 2.

**Table 1.** Negative binomial and OLS coefficients (standard errors) for lone-wolf regression models.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Negative Binomial</th>
<th>OLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>lagged GDP per capita (thousands)</td>
<td>1.323** (.131)</td>
<td>.468* (.210)</td>
</tr>
<tr>
<td></td>
<td>1.049 (.039)</td>
<td>.025 (.045)</td>
</tr>
<tr>
<td></td>
<td>.897*** (.025)</td>
<td>-.116** (.043)</td>
</tr>
<tr>
<td></td>
<td>.992 (.008)</td>
<td>-.016 (.014)</td>
</tr>
<tr>
<td>lagged GDP (in thousands) squared</td>
<td>.995* (.002)</td>
<td>-.008* (.004)</td>
</tr>
<tr>
<td></td>
<td>--- (.0007)</td>
<td>--- (.001)</td>
</tr>
<tr>
<td>lagged inflation (annual % change)</td>
<td>1.0004** (.0002)</td>
<td>.0002* (.0001)</td>
</tr>
<tr>
<td></td>
<td>1.0004 (.0002)</td>
<td>.0001 (.0001)</td>
</tr>
<tr>
<td></td>
<td>1.0001 (.0001)</td>
<td>.00002 (.00001)</td>
</tr>
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<td></td>
<td>1.0001 (.0001)</td>
<td>.00004 (.0001)</td>
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<td>population density</td>
<td>1.009** (.004)</td>
<td>.015 (.008)</td>
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<tr>
<td></td>
<td>1.012 (.003)</td>
<td>.018* (.0004)</td>
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<td>.999 (.0005)</td>
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<td>unemployment (percent)</td>
<td>1.058 (.083)</td>
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<td></td>
<td>1.024 (.977)</td>
<td>-.066 (.047)</td>
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<td></td>
<td>1.005 (.034)</td>
<td>-.007 (.026)</td>
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<td></td>
<td>1.017 (.034)</td>
<td>-.001 (.026)</td>
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<tr>
<td>male youth unemployment (percent)</td>
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<td>.934*** (.019)</td>
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<td>lagged GDP growth (in percent)</td>
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<tr>
<td>polity2 (-10 to +10)</td>
<td>1.021 (.034)</td>
<td>-.020 (.057)</td>
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<td>827</td>
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^676 is the number of observations that contained data for each variable in the dataset, after linear interpolation was conducted.

^^Negative binomial regression results are reported as incidence rate ratios.

*p ≤ .05   **p ≤ .01   ***p ≤ .001
These results indicate that there is a non-linear relationship between lone-wolf domestic terrorism and per-capita GDP but a linear downward-sloping relationship between group-affiliated domestic terrorism and per-capita GDP. The key coefficient of interest is the quadratic term; GDP per capita squared. This term indicates whether the relationship between domestic terrorism and GDP per capita exists, whether that relationship fits a curve, and the basic shape of the curve. Coefficients on the quadratic term for the lone-wolf regressions were statistically significant, but not for the group-affiliated regressions.

Lone-Wolf Domestic Terrorism and Per-Capita GDP

Results show that the relationship between lone-wolf domestic terrorism and GDP per capita is complex and non-linear. The coefficient of .995 on lagged GDP squared in the lone-wolf domestic terrorism model with country fixed effects indicates that, holding constant all of

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<thead>
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<th>Table 2. Negative binomial and OLS coefficients (standard errors) for group-affiliated regression models.</th>
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<td><strong>Negative Binomial</strong></td>
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<td>lagged GDP per capita (thousands)</td>
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^676 is the number of observations that contained data for each variable in the dataset, after linear interpolation was conducted.

^Negative binomial regression results are reported as incidence rate ratios.

*p ≤ .05 **p ≤ .01 ***p ≤ .001
the variables in the model and accounting for country-level fixed effects, the relationship between lone-wolf domestic terrorism and GDP per capita can be described as an downward sloping curve. As per-capita GDP increases, rates of lone-wolf domestic terrorism increase. When the squared term was taken out of the regression, the linear per-capita GDP coefficient lost its significance, indicating that the relationship between lone-wolf domestic terrorism and per-capita GDP fits a curved model but not a linear model. This is contrary to my predicted results but is informative nonetheless. However, when the negative binomial regression was run with year fixed effects instead of country fixed effects, the predicted relationship changed. The statistically significant coefficient of 1.003 on the quadratic term indicates an upward sloping curve where lone-wolf domestic terrorism rates start high, then taper off quickly.

To test the sensitivity of the model, ordinary least squared (OLS) versions of each regression were run. The direction of the coefficients in these regressions was consistent with those of the negative binomial regressions, but the magnitude decreased and the coefficients lost their statistical significance. The fact that the negative binomial regression specification yielded statistically significant results while the OLS specification did not indicates that the relationship is highly sensitive to model specification.

To make sense of the apparently contradictory results when using country versus year fixed effects, I used the coefficients from the OLS models to get an idea of where the curve was within the dataset, how steep it was, and where it changed direction (see figure 9). It is important to note that these numbers are very rough approximations since we cannot plot the results of the negative binomial regressions. These graphs show that much of the parabola is outside observable data. Number of terrorist attacks cannot be negative, nor can GDP per capita so the
only relevant data is that in quadrant 1. Looking at just this data, it appears as though rates of lone-wolf domestic terrorism increase as per-capita GDP increases, holding country level characteristic constant but rates of lone-wolf domestic terrorism decrease as per-capita GDP increases, holding year constant.

**Figure 9.** Rough graphical depictions of relationship between domestic terrorism and per-capita GDP as predicted by OLS models with country or year fixed effects.

There is no clear explanation for this difference. It is possible that the relationship between GDP per capita and lone-wolf terrorism is simply very tenuous and does not hold up when tested against different model specifications. Looking at figure 9, there is very little variation in terrorism rates over time. It would not take much change in the data for this relationship to be statistically altered. But it is also possible that the relationship is actually different within a particular country over time versus worldwide at a given point in time.
**Group-Affiliated Domestic Terrorism and Per-Capita GDP**

Regression results showed a different relationship between group-affiliated domestic terrorism and GDP per capita than between lone-wolf domestic terrorism and GDP per capita. The coefficient on the GDP per capita term was statistically significant in all but one variation of the model. The model that included the quadratic term and country fixed effects produced statistically insignificant results for the GDP per capita coefficient. This suggests that, contrary to my predictions, the relationship between group-affiliated domestic terrorism and GDP per capita is linear. In the linear models, the incidence rate ratios were less than 1, indicating that rates of group-affiliated domestic terrorism decrease as GDP per capita increases. However, this also suggests that this relationship is sensitive to changes in model specification.

To further examine the sensitivity of the negative binomial regression models, OLS versions of each group-affiliated domestic terrorism regression were run. These results were highly consistent with the negative binomial regression results. This could mean that the relationship between group-affiliated domestic terrorism and per-capita GDP is more robust to model specification changes than the relationship between lone-wolf domestic terrorism and per-capita GDP. This may also be partly due to the difference in sample characteristics between the groups. There was far more variation in rates of group-affiliated domestic terrorism than in rates of lone-wolf domestic terrorism. This built-in heterogeneity means that the relationship will hold up statistically to this kind of change.

**DISCUSSION**

These results support the hypothesis that the relationship between domestic terrorism and wealth is different depending on whether the perpetrator acts alone or on behalf of a group, but
not in the expected way. I predicted that the relationship between group-affiliated domestic terrorism and per-capita GDP would be non-linear as was found in Berkebile (2012) and Enders & Hoover (2012) and that the relationship between lone-wolf terrorism and per-capita GDP would be linear and downward sloping. My results indicate that the opposite may be the case. Lone-wolf domestic terrorism appears to have a non-linear relationship with per-capita GDP, while group-affiliated domestic terrorism appears to have a linear one.

This study adds to the limited body of research showing a relationship between domestic terrorism and a country’s wealth. It extends that research by examining lone-wolf and group-affiliated domestic terrorism separately. Results showed that the relationship between domestic terrorism and per-capita GDP was different depending on whether the domestic terrorism was perpetrated by organizations or by individuals acting alone. This could explain why so many studies did not find a statistically significant relationship between domestic terrorism and various country-level measures of wealth. Controlling for country versus year fixed effects changed the relationship between lone-wolf domestic terrorism and GDP per capita, indicating a relationship that is highly complex and highly depended on one or more variables accounted for in one of those models.

Although this study adds to the limited body of research examining the differences between various kinds of domestic terrorism, it has several limitations and the results should be interpreted with caution. First, there appears to be a non-linear relationship between per-capita GDP and lone-wolf domestic terrorism but the nature and strength of this relationship is still largely a mystery. The data were highly sensitive to model specification changes so limited stock ought to be placed in the statistical significance that was detected. A significant number of
observations were lost due to missing data, particularly missing World Bank data. Future research should leverage other sources of economic and demographic data to fill some of these gaps.

Second, it is possible, and perhaps likely, that there is a bidirectional relationship between terrorism and wealth; a smaller GDP per capita may cause disgruntlement and, therefore increase terrorism rates. Likewise, increased terrorism rates may have a negative impact on a country’s economy, causing GDP per capita to decrease. This is partly addressed by lagging GDP per capita. Even if increased terrorism caused per-capita GDP to decrease, it should not do so for the year before the terrorism rates increased. Without the ability to conduct true experiments, it is extremely difficult to completely mitigate this problem.

Third, the unit of analysis is aggregated to the country-year level, which means conclusions cannot be drawn from these results about the behavior of individual terrorists. The country’s wealth, not the individual’s, is being measured. To best determine the motivations of terrorism, researchers should look at the motivations of individual terrorists. In the case of this particular hypothesis, it would be ideal to explore economic correlates to terrorism at the individual level. That data by-and-large does not exist so studies like this one may be the closest researchers can get for the foreseeable future. Despite this, researchers should still be able to gain valuable insights about the relationship between domestic terrorism and GDP at the country-level and how this relationship may differ between lone actors and group-affiliated terrorists.

Fourth, there is always a chance of omitted variable bias. It is possible that there are other variables correlated with both domestic terrorism and per-capita GDP that are not accounted for in this study. I included as controls any variables correlated with domestic terrorism in the
literature to try to overcome this problem. Inclusion of country and year fixed effects also help to reduce the chances of omitting important variables that may influence the relationship between domestic terrorism and GDP per capita.

The final limitation is in the inability to infer causation from this study. Again, due to the study design, which is limited by the nature of the problem, any relationships detected are merely associations and do not necessarily indicate that changes in per-capita GDP cause changes in domestic terrorism.

The biggest contribution this study makes to the broader literature is that it indicates that GDP per capita has a different relationship with lone-wolf domestic terrorism than with group-affiliated domestic terrorism. Hopefully, this will get other researchers thinking about other ways in which these groups may differ. Until now, most research has not made this distinction and it could very well be an important one for understanding the causes of terrorism and coming up with better solutions to prevent it. The threat of lone-wolf domestic terrorism is a poorly understood phenomenon that is just beginning to be investigated. This study adds to the sparse literature on the economic causes of lone-wolf domestic terrorism, the sum of which may ultimately help policymakers and law enforcement officials direct resources more efficiently.
REFERENCES


