

Terrorism and Economic Complexity: An Impact Evaluation

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at George Mason University

by

William Johnson
Bachelor of Arts
Iowa State University, 2011

Graduate Program Director: Agnieszka Paczynska
The School for Conflict Analysis and Resolution

Spring Semester 2016
George Mason University
Fairfax, VA



This work is licensed under a [creative commons attribution-noncommercial 3.0 unported license](https://creativecommons.org/licenses/by-nc/3.0/).

DEDICATION

This thesis is dedicated to all of the conflict analysis and resolution researchers and practitioners who are working tirelessly to transition conflict toward peace.

ACKNOWLEDGEMENTS

I would like to thank my professors and fellow students at The School for Conflict Analysis and Resolution for their guidance and support. In particular, Professor Agnieszka Paczynska, Professor Thomas Flores, and Professor Daniel Rothbart were instrumental in helping me achieve my academic goals.

TABLE OF CONTENTS

	Page
List of Figures	vi
List of Abbreviations	vii
Abstract	viii
1. Introduction	1
1.1 Research Methods and Limitations	4
1.2 Importance of Study	6
2. Theory and Concepts	9
2.1 Literature Review	9
2.2 Theoretical Framework A: Labor Market Depletion	18
2.3 Theoretical Framework B: Capital flight	19
3. Research Design	23
3.1 Ethics and Objectivity	23
3.2 Description of Economic Complexity Index Data	25
3.3 Description of Terrorism Data	30
3.4 Description of Variables.....	35
4. Results of Analyses	41
4.1 Model 1 Results.....	42
4.2 Model 2 Results.....	44
4.3 Model 3 Results.....	45
4.4 Model 4 Results.....	47
4.5 Discussion: Counterintuitive Results	48
5. Conclusion	52
References	54

LIST OF FIGURES

Figure	Page
Figure 1: ECI Values for 144 Countries	30
Figure 2: Countries Included in Study	35
Figure 3: GDP Per Capita (Not Adjusted)	38
Figure 4: GDP Per Capita (Natural Log Applied)	39
Figure 5: Results of Model 1	41
Figure 6: Results of Models 2,3,4.....	42
Figure 7: GDP per capita and ECI Scatter	50

LIST OF ABBREVIATIONS

Economic Complexity Index	ECI
Foreign Direct Investment	FDI
Gross Domestic Product	GDP
Global Terrorism Database	GTD
Multinational Corporation	MNC
Net Foreign Direct Investment.....	NFDI
Observatory of Economic Complexity	OEC
Organization for Economic Co-operation and Development	OECD
The National Consortium for the Study of Terrorism and Responses to Terrorism.....	START
United States Dollars	USD

ABSTRACT

TERRORISM AND ECONOMIC COMPLEXITY: AN IMPACT EVALUATION

William Johnson, M.S.

George Mason University, 2016

Thesis Director: Dr. Agnieszka Paczynska

This thesis describes the impact of terrorism on the economic complexity of countries. Terrorism wreaks havoc on multiple elements of economies. A discussion of relevant literature will lend itself to the logic behind two theoretical frameworks that are employed to help speculate why terrorism may cause changes to country-level economic complexity. The frameworks, which I developed, are referred to as the Labor Market Depletion Framework, and the Capital Flight Framework. Four statistical models were analyzed. First, a comparison of means test was conducted, which indicated no correlation between economic complexity of countries in which terrorism occurred compared to those in which it did not occur. Three other multiple regression models were analyzed, and incorporated different terrorism measures, and all controlled for gross domestic product (GDP) per capita and region. The terrorism measure for the second model was a binary measure of terrorism occurrence (yes or no), and showed counterintuitive results – that in countries where terrorism occurred, economic

complexity values were higher; the measure for the third model utilized the natural logarithm of a terrorism score (which includes number of people killed, wounded, and hostages) and excluded outliers, and indicated counterintuitive results by similarly showing that countries with more terrorism were associated with higher complexity levels; and the fourth model utilized the natural logarithm of a terrorism score (which includes number of people killed, wounded, and hostages) and included all available data, and indicated that countries with more terrorism showed lower levels of economic complexity, although the relationship is insignificant. The study concludes by discussing reasoning for the counterintuitive nature of some of the results.

1. INTRODUCTION

The following research study set out to discover if a relationship exists between terrorism and economic complexity at the country level. It was hypothesized that countries with higher rates of terrorism exhibit lower levels of economic complexity. As discussed by Robson (2011) one goal, as a researcher, is to use information uncovered from a study to suggest ways “in which desirable change might take place” (p. 7). It is important to better understand the relationship between terrorism and economic dynamics in order to gain insight into the complex systems that function around unstable environments. By measuring and analyzing the relationship between terrorism and economies, the need for types and intensity of interventions that seek to strengthen economies and reduce terrorism can be assessed. Effective interventions can lead to positive change, and can lay the foundation for increased stability - and ultimately peace. For the purpose of the study, terrorism was designated as the independent variable, and economic complexity as the dependent variable. Various measures of terrorism were utilized, and all of the data was taken from the Global Terrorism Database (GTD). Economic complexity was assessed using the Economic Complexity Index (ECI), which is a measure of the ease at which producers globally can produce it, and uses ubiquity and diversity of products as an indicator for the level of knowledge required to produce the products (Hausmann et. al., 2011). The ECI will be discussed in more depth later in this

study. Other variables, which include GDP per capita and region, were used as controls in the various models.

It was anticipated from the outset that terrorism has a negative impact on economic complexity. The logic behind this assertion is explained by 2 theoretical frameworks (as described in Chapter 2): the Labor Market Depletion Framework, and the Capital Flight Framework. However, upon testing various models of the impact of terrorism on economic complexity, counterintuitive results were found. In the first model analyzed, a difference of means test shows insignificant results for 2012 ECI values of countries where terrorism occurred and did not occur in 2011. The second model analyzed indicates that a relationship between terrorism in 2011 and the 2012 ECI value exists, which although statistically insignificant, is counterintuitive to the original theoretical frameworks – it shows that in countries where terrorism occurred, ECI values increased. The third model does not include outliers, and indicates counterintuitive results – for countries in which more terrorism occurred in 2011, economic complexity levels in 2012 were higher. Finally, the fourth model, which includes outliers, displays a coefficient for terrorism in 2011 that is negative – and aligned with the direction that is predicted by the theoretical frameworks – indicating that for increases in the terrorism score of countries, complexity values decrease, however, the relationship is insignificant.

Economic complexity is defined in this study as “how diversified and complex a country’s export basket is” (OEC, 2015). More specifically, complexity is a measure of the knowledge and “capabilities in a society that get translated into the products it makes” as well as its production diversity (the number and variety of different products it

produces) and the ubiquity of those products (how many other countries are able to produce them) (OEC, 2015). Adam Smith famously points out that division of labor is the secret of the wealth of nations (Hausmann et al., 2011, p. 15). Specialization in different areas of knowledge, strong communication and synergy between people and institutions with specialized knowledge, availability of resources and goods, knowledge and capacity of a workforce, and good infrastructure and government systems lay the foundation for countries to achieve complex economies. “Markets and organizations allow the knowledge that is held by few to reach many” and well-regulated, efficient markets are the bridge to higher levels of economic complexity (Hausmann et al., 2011, p. 15).

Although the index that will be used to gauge complexity only takes exports into consideration, it is indicative of the country’s overall economic health and it provides a snapshot of production capabilities. It is important to note that economic complexity may serve as an indicator for present economic growth, because complexity indicates that relationships and capacities are present which facilitate the production of goods and services efficiently. A challenge with using the ECI is that it only incorporates export data – however, the reason for still using this is because statistics on domestic production for internal consumption and internal trade statistics are incomprehensive for many countries. Export data sourced from individual countries can be validated by “mirror” data offered by trade partners, whereas internal production data cannot be validated as reliably. Export data, therefore, is used within the ECI because of the unreliability of domestic production statistics. Even though exports are not the perfect proxy for country economic health, they can still shine light on how country economies perform relative to

each other. My research deviates from the common understanding of various economic theories of conflict by analyzing the relationship of terrorism on economic complexity rather than conflict or terrorism on general economic growth or health. This is important to consider because I hypothesized that terrorism affects specific mechanisms within an economy that contribute to economic strength and complexity – foreign investment, and the labor market (which will be explored in more depth below). Although I was not able to confirm causality between the relationships, the results will still contribute to the body of knowledge concerned with understanding the relationship between terrorism and economies.

1.1 Research Methods and Limitations

Several statistical models were analyzed in order to attempt to understand the relationship between terrorism and economic complexity. In the models described in Chapter 4, countries with ranging scores of economic complexity in the year 2012 were studied. It was found that the year 2012 had the most data available for the highest number of countries. Terrorism incidents occurring in the previous year, 2011, were matched with year 2012 ECI values for the respective countries. The software programs Excel and STATA were used to clean and analyze the data variables, which were collected from the Observatory of Economic Complexity, The Global Terrorism Database, and The World Bank. Microsoft Excel was used to collect the data and to build a compendium, and STATA was used to render and analyze data from the various sources. Although it may seem intuitive that terrorism and economic health (or

complexity) exhibit a bidirectional relationship, I chose to focus on one direction of their interaction, terrorism's impact on economic complexity.

Limitations of my research included the inability for it to provide a universal interpretation of the relationship between terrorism and economic complexity. Every country has a unique economic environment, and countries differ immensely with regard to their ability to deal with the effects of terrorism and other implications stemming from conflict. Because of this, this study does not provide individualized recommendations for country-level interventions; rather, it aimed to provide a framework for understanding the impact of terrorism on country-level economies. The study can serve as a starting point for further analysis of the unique dynamics of specific country systems.

Challenges exist any time large datasets are being manipulated. One main challenge that was anticipated to emerge is inadequate representation of a country's economic complexity due to the effect that an economy's size is likely to have on its complexity levels. Although the source of the complexity data, the Observatory of Economic Complexity (OEC), does not take the size of an economy into consideration, I argue that some of the highest ranked countries by economic complexity (Japan, Switzerland, Singapore) are geographically small and the size of their economies (by GNP, PPP dollars) is much smaller than countries with larger economies and geographical area. In addition, the Observatory of Economic Complexity OEC does not take into account service exports, which (although relatively insignificant for most countries) may slightly shift the ECI, if included. Although services were not included, export data is an adequate proxy for an analysis of economic performance between

countries. Another challenge that was presented, specifically within the data, is that data is not available for terrorism and economic complexity for all countries in the world for every year. Because of this, I selected years in which the most data are available, for the highest number of countries, for the most variables.

Within my analysis, I controlled for factors that may affect the relationship between terrorism and economic complexity. However, I will not be able to control for factors such as low levels of economic complexity resulting from, for example, societal norms in a specific region that normally preclude business activities that lead to economic complexity.

1.2 Importance of Study

This study attempted to answer the question: Does terrorism have a significant impact on economic complexity levels of national economies? It was expected that the research will shed light on the magnitude of the impact of terrorism on economic complexity, at the country level. Ideally, discoveries that emerged as a result of my research would contribute to the body of knowledge concerned with lessening the impact of terrorism on national economies and recommending interventions to increase resilience of economic systems under the threat or reality of terrorism. Less impact felt by terrorist activities may ultimately prevent destabilization and can strengthen economies over the long term, decrease perception of economic risk to investors, lead to improvement and maintenance of infrastructure systems needed for efficient production, and ultimately contribute to a more complex economy.

By analyzing the impact that terrorism has on economic complexity, it may be possible to recommend policy and measures that soften the impact of terrorism on specific components of economies. A complex economy is characterized by systems that allow for the production of a relatively diverse and technically advanced set of goods, relatively high societal knowledge applied in producing the goods because of their requirement for advanced technical and industrial knowledge, and a diverse portfolio of export trade partners. These characteristics are harmonious with conditions that allow people to generate sustainable and licit livelihoods.

The conventional understanding of the relationship between terrorism and the health of an economy holds that poor economic conditions such as higher supply of labor than demand (high unemployment) and lack of well-paying jobs may lead to the propensity for terrorism and conflict to occur (Mercy Corps, n.d.). This relationship may exist due to the temptation to joined armed groups for pay when no other options exist for members of the labor market. Other research demonstrates the devastating effects that conflict (and elements of conflict, such as terrorism) has on the health of an economy due to its devastation on infrastructure, the labor force, entrepreneurship, and general investment (USIP, 2009). A more comprehensive discussion on the relationship between terrorism, conflict, and economic health can be found in the next chapter. More research needs to be conducted to better understand the causal processes that may contribute to fluctuation of complexity levels. If, in further study, it is found that frequency and magnitude of terrorism is indeed correlated with economic complexity, interventions in

both the security and economic context can be better designed to increase stability of affected economies.

It is important to remember that terrorism impacts the private and public sectors differently. I intend for this research to inform transitions toward more effective operational practices by the public and private sectors in fragile markets. On the private sector side, ideally, this information could be used to create mechanisms and processes within trade networks that are more shock-resistant to terrorist attacks, which could mean the components of complex economies could maintain stasis during the presence of violence, and collectively maintain economic complexity (or at least not decline as quickly).

The public sector of countries, especially in more developed countries, is likely to implement a multifaceted approach to address the impact of terrorism. Developed countries are likely to draw in resources from the military, intelligence community, and diplomatic avenues in order to mitigate the cause and effect of terrorism. In less developed countries, terrorism is likely to be felt as a harder shock, and unfortunately, governments are less likely to be able to combine capabilities from multiple avenues to address and mitigate the effects of terrorism. However, by better understanding the relationship of terrorism and economies, interventions in both the public and private sector can be better calibrated and provision of information about the relationship can inform stakeholders working to stabilize and strengthen economies.

2. THEORY AND CONCEPTS

Existing literature on terrorism's impact on economies is explored in this section, as well as two theoretical frameworks that seek to explain how terrorism might affect economic complexity. Previous research has been heavily concerned on studying terrorism's impact on economic growth and foreign direct investment inflows. Research looking at terrorism's impact on economic complexity is virtually nonexistent. This is not likely due to the lack of validity or quality of economic complexity data; rather, it is likely due to the newness of economic complexity data and the slow uptake for conflict analysts and researchers to analyze it in conjunction with terrorism and conflict-related data. For this reason, much of the literature review focuses on terrorism's impact on indicators of economic performance in an economy (those other than economic complexity, such as economic growth) because that is the majority of the relevant research that is available at this time.

2.1 Literature Review

The quantitative nature of this analysis required a review of literature about the major independent variables, major dependent variables, and studies that related to the interaction of the independent and dependent variables. Several studies have been performed in order to analyze the relationship between economic health, terrorism, and conflicts. Some researchers believe that commodity-based (less-complex) economies lead to a greater propensity for violent conflict to occur; others believe that conflict occurs independently from the micro and macro-economic environment (as discussed below). It

is likely that both of these schools of thought are true, depending on the context. A large body of research exists that analyzes and seeks to better understand bidirectional causality between terrorism or conflict and economic growth of countries.

No literature was found that analyzes the effect of terrorism specifically on economic complexity. However, a large body of research exists that analyzes the relationship between terrorism and other economic indicators, such as economic growth. Economic growth is similar to economic complexity because in order to improve both indicators, they require a mix of inputs and a healthy economic environment that can catalyze growth, which results in better long-term prospects for country-level economies. However, it is important to study complexity because it indicates health of economic systems at a more granular level and shines a light on the diversity of country-level economies. Economic growth data can be misleading, for example, when growth is driven by export of a small number of commodities (petroleum, for example). Complexity allows the more granular connections within economic systems to surface, and “penalizes” (or adjusts) for countries with small export baskets – and hence less-complex economies. For this reason, literature on other factors such as economic growth was substituted for literature specifically pertaining to economic complexity. According to Meierrieks & Gries (2013) terrorism can impair economic health by destroying an “economy’s physical and capital stock [by causing] loss of life and property damage” (p. 92). They go on to argue that terrorism may hurt economic sectors in an economy due to its effect in decreasing national consumption, investments, government spending and savings, and causing withdrawal of capital and foreign financing (p. 92). In addition,

conflict (and components of it, such as terrorism) may be initiated because of “greed” and an opportunity to gain from the fighting is perceived. Meierrieks & Gries (2013) analyzed the bidirectional relationship between terrorism and economic growth data for 160 countries between 1970 and 2007, and among heterogeneous results, found that “economic growth exerts a causal effect on terrorism for the Cold War era but not vice versa” (p. 98). They conducted non-causality tests for the full dataset of 160 countries and found that in the post-Cold War era, terrorism affects economic growth, but not vice versa (Meierrieks & Gries, 2013) 12). Several additional causality tests were conducted. One test analyzed causality between terrorism and economic growth by grouping countries together by their level of political development (democracy or non-democracy) and economic development (income level of each country). They found that “non-democratic countries experience detrimental economic effects from terrorism, whereas democracies do not” and they hypothesize that non-democracies may be more affected by acts of terrorism because they are less able to withstand shocks to their national economy (Meierrieks & Gries, 2013, pp. 100-101). They attribute this to non-democratic economies’ typically more centralized nature, and their relatively less-effective utilization of institutions to provide social and financial support to vulnerable populations following economic destruction resulting from terrorism. They also tested the causal relationship between terrorism and economic growth by grouping countries together based on indicators for political stability (i.e. episodes of civil war, episodes of minor instability, and relative political instability). From this information, the link between terrorism and economic growth seems to matter depending on the existing political, economic, and

conflict environment of the countries in which the terrorism is perpetrated. This is intuitive because economic growth (and economic complexity) need open economic systems to facilitate the exchange of information and resources required to produce goods and services, and more closed or centralized economic systems are likely to be less conducive to those fundamental aspects. The limits of a relatively closed or centralized economic system exacerbate the impact of terrorism, because they are likely to be less able to withstand the shock of devastating financial damage within them.

One of the objectives of terrorist operations is to cause economic disruption to target countries through direct targeting of foreign investment interests, destruction of infrastructure causing loss of productivity - causing firms and governments to spend more resources to mitigate the spread of terrorism (Enders & Sandler, 1996). In addition to many other implications on social, political, ethnic, religious, and other systems within a targeted area, the ensuing economic disruption that can occur as the result of terrorism can deeply affect the ability for private firms to do business. Firms are likely to face additional costs when terrorism is a perceived risk due to increased security measures at their physical locations as well as added security for staff traveling overseas who may be targeted by terrorist attacks.

The literature indicates that smaller countries (in terms of economy) may feel the impact of terrorism more than larger countries. Economic growth of smaller countries is oftentimes dependent on foreign direct investment. Because smaller countries are more likely to depend on foreign direct investment, they are more likely to be affected by events that disrupt foreign direct investment (FDI) inflows, such as terrorism. FDI “is an

important source of savings” and “savings finance investment, which, in turn, is a primary determinant of growth” (Enders & Sandler, 1996, p. 332).

Research by Enders and Sandler (1996) goes on to show that terrorism has economic costs on FDI inflows of target countries due to its contribution in creating “an atmosphere of intimidation and heightened financial risks” (p. 311). The authors analyze whether terrorism has had a significant effect on net foreign direct investment (NFDI) of Spain and Greece, and go on to quantify the impact that terrorism has on the NFDI of these countries (based on terrorism incidents between 1968 and 1991). They chose to analyze smaller countries, because they hypothesize that larger countries have more padding to their development initiatives and are less reliant on foreign direct investment as a source and catalyst for development and growth. Their research shows that for Spain, one year of “terrorism reduced NFDI by 13.5% annually, while for Greece, an average years’ worth of terrorism limited NFDI by 11.9% annually” which translates to declines of \$488.9 million and \$383.5 million in NFDI, respectively (Enders & Sandler, 1996, p. 350).

According to research conducted by Blomberg, Hess, and Orphanides (2004) terrorism may have a negative effect on growth of countries, although the effect may be smaller than the effect of “external wars or internal conflict” (p. 1007). The authors go on to assert that terrorism is likely to redirect economic activity from investment spending to government spending. It follows, however, that terrorism’s effect on economic activity is short-lived and dissipates after approximately one year. This is due to terrorism’s relatively less significant effect on the economy compared to internal and external shock

factors to GDP, such as long-term conflict. Research shows that for Organization for Economic Co-operation and Development (OECD) member countries, terrorism incidents are more frequent than non-OECD countries, but the economic impact of terrorism on economic growth is smaller (Blomberg, Hess, & Orphanides, 2004, pp. 1007-1008).

According to Powers and Choi (2012) the nature and severity of terrorist attacks determines the level of negative economic impact that occurs as a result, but their research specifically focus on terrorism's impact on multinational corporations (MNC). They argue that terrorism, when targeted specifically toward MNCs or their interests, increases "their operating costs, their insurance rates, [and] their ability to attract and keep their workers and business managers" (Powers & Choi, 2012, p. 409). The authors assert that operating costs are affected due to terrorism's destruction of facilities and supply chains, as well as infrastructure. The damage to their production capabilities, coupled with fear that is generated in their employees and managers, causes a decrease in availability of qualified and talented workers and managers for employment at the organization. Terrorism that targets MNCs and their interests directly impacts investors because they lose confidence in organizations' ability to provide relatively high return on investment.

Keen (2000) argues that some groups may support rebellions or counterinsurgency campaigns in order to take advantage for their own purposes (p. 27); they may also "fight a war in order to exploit civilians" (p. 31). In his view, conflict may occur for reasons that have little to do with macro-level economic conditions, but for

much more personal reasoning pertaining to individual benefits. According to Keen (2000), conflict may have financial motivations, and some parties in conflict may prolong fighting if they are benefitting economically (pp. 26-27). Terrorist organizations, therefore, may be more inclined to continue attacking if they are gaining from the attacks in multiple ways, further deepening the impact to the structures that are conducive to economic growth and complexity. According to Collier (2006) several economic motivations exist for conflict, including feasibility for predation, especially in economies where revenue from export of primary commodities is high (pp. 4-5). He discusses how economic opportunity is one of many potential causes for conflict, and that “conflict is more likely in countries on economic decline” (Collier, 2006, p. 6). Terrorist organizations, operating under this logic, may be more inclined to attack if they see opportunity for gain.

According to Duffield (2000) globalization increases the ease at which parties at conflict use transborder trade connections to increase their propensity for sustainability and survival (p. 74). Duffield posits that linkages and relations required for parallel (illegal and unofficial) transborder trade of goods are “broadly replicated in contemporary war economies” (Duffield, 2000, p. 77). Profits derived from unofficial transborder trade, as perpetuated by some terrorist organizations, may disincentivize some groups from ceasefire, thus rendering their contribution to the licit (formal) economy less robust. This lack of contribution to the legitimate economy prevents healthy growth that is derived from collective contributions from society.

Not all of the relevant literature indicates that terrorism affects the economies of countries. Gries, Krieger, & Meierrieks (2011) set out to test if acts of terrorism result in diminished “allocation and accumulation of resources” due to terrorism’s effect of reducing people’s incentive to invest or save. The reduction of investment and savings, it follows, leads to poor economic growth. However, in line with the results of some of the statistical models in this study, when testing the effects of growth on terrorism and vice versa in seven Western-European countries, they find that terrorism almost never causally influences economic growth in the countries within their analysis (with the exception of Portugal); they hypothesize that the reason for this is because the countries in their model have robust economies that are able to withstand the impact of shocks caused by terrorism (Gries, Krieger, & Meierrieks, 2011). They find the reverse to be true, however – they find that the impact of economic performance (specifically growth) on the propensity for terrorism to occur is very strong, and hypothesize that terrorist’s perception of a country’s economic performance affects terrorists’ calculus in deciding where to attack. . They assert this because if “economic success allows for more economic participation and opportunities” the cost of violence caused by terrorism will be greater in the targeted area, because it is more likely that more people will be affected by the perpetration (Gries, Krieger, & Meierrieks, 2011, p. 502).

Other research suggests ways in which terrorism causes very specific microeconomic and macroeconomic effects to occur. According to Bird, Blomberg, & Hess (2008), some sectors, such as tourism and travel, will be more affected than others by acts of terrorism. This seems intuitive, because people are less likely to travel to a

country where terrorism is rampant or is increasing in severity. Financial markets are likely to be affected by terrorism for two main reasons. First, stock prices may drop because people will feel the need to have access to additional liquidity, which reduces macroeconomic prospects, and second, equity value will fall in sectors most impacted by terrorism (Bird, Blomberg, & Hess, 2008).

As asserted by Gaibulloev & Sandler (2009), terrorism can cause uncertainty in an economy because it deters foreign investment and pulls government expenditures away from public and private investments and toward security mechanisms aimed at mitigating the propensity for terrorism to occur. They also point out that terrorism raises the cost of doing business because employers have to raise wages to incentive workers who are deterred from working in a region due to risk, insurance premiums increase in riskier environments, and businesses have to spend more money on security expenditures. The research indicates that transnational terrorism in Asia has a short-term, “growth-retarding effect for developing countries in Asia” (Gaibulloev & Sandler, 2009, p. 379). Their research concurs with other literature positing that the impacts of terrorism on more-developed countries is less than on less-developed ones because they are better equipped to deal with the impacts of terrorism. This “softer” effect may be attributed to difficulty of reversing investment in already-capital intensive projects, which are commonly found in more advanced economies; it may also be the case that high income countries, when faced with the need to allocate public expenditures to mitigate the potential and effects of terrorism, feel less of a shock due to the proportion of government expenditures that are directed toward mitigation (Gaibulloev & Sandler, 2009). Wealthier

nations require a relatively smaller proportion of their national public expenditure to combat the flow of terrorism compared to countries with smaller economies.

According to a review of several studies on terrorism's impact on economies, Llussá and Tavares (2007) found that most large studies indicate that terrorism's effect on economic output is small, and much smaller than the impact of internal or external war on economies. It is important to note, however, that these studies are looking at national economies and aggregate output – so the effects of terrorism on “specific populations, regions, and sectors” may still be felt (Llussá & Tavares, 2007, p. 63)

2.2 Theoretical Framework A: Labor Market Depletion

The first theoretical framework, which is an original concept I developed, describes why terrorism may negatively affect economic complexity. It will be referred to as the “Labor Market Depletion” framework. Terrorism impacts both the supply and demand side of employment leading to weakened labor force and production capacity, which causes decreasing levels of economic complexity. On the supply side of labor markets (supply of labor), workers are likely to be less able to secure gainful employment due to challenges associated with a heightened security environment. It may be difficult for workers to travel around their city efficiently due to the existence of multiple checkpoints, or blanket restrictions on travel to and around certain areas. In addition to security apparatuses affecting the ability to travel, damage to infrastructure stemming from prior attacks may also cause lessened or fully diminished ability to travel to work, school, or other events. Skills training events, for example, may not be held or may be extremely limited due to terrorist threats on the institutions at which the trainings are

held. If the diminished ability to travel occurs for an extended period of time, it may have implications on the long term health of labor supply. In the long term, this can lead to a less skilled workforce and less opportunity to contribute technical knowledge to the production capabilities of a country. Additionally, terrorism groups may also recruit young people, who otherwise may be productive members of the labor force, with economic incentives (Mercy Corps, n.d.). The reduction of workers due to their uptake to terrorist organizations can deplete the collective skills and capabilities of labor markets.

On the demand side of labor markets (demand for labor), long-term effects of terrorism may significantly affect the production environment of a country, which could lead to a decrease in employment opportunities because of the strained business environment. A strained environment means less working capital and decreased ability to bring on new staff. When producers are dormant, they are less able to take advantage of the collective skills and abilities of the labor market in order to synergize processes, production, and initiatives that lead to increases in economic complexity. Business owners, when heavily impacted by terrorism, are likely to function enough to “get by” but not gain enough momentum to increase capacity, which can lead to higher complexity levels. This is exacerbated when the presence of terrorism is felt over the long term. Business owners are likely to be apprehensive about making new or renewed investment in that environment - especially bringing on new employees.

2.3 Theoretical Framework B: Capital flight

The second theoretical framework, which I developed based on a synthesis of the literature, describes why terrorism may negatively affect economic complexity. It will be

referred to as the “Capital Flight” framework. In high-risk areas, the risk of terrorism causes a general feeling of apprehensiveness. This apprehensiveness not only causes fear in people’s personal lives, it also causes collective fear in the business community. This fear may prevent collaboration and meetings that could bolster trade, as well as detract foreign and domestic investment. An economy that lacks the ability to bring people together in the same room, and attract investment, is at risk for dismantling the internal components that produce economic complexity. According to this framework, terrorism causes a reduction in foreign direct investment and reallocation of domestic investment funds. Additionally, terrorism is likely to create infrastructure and logistical challenges due to kinetic damage and a strengthened security apparatus. The damaged infrastructure prevents transport of goods and collaboration that is needed for productive output creation. The perceived level of risk for terrorist attacks differs depending on a variety of factors. The smallest economies with the most terrorism are likely to detract investors. In a relatively smaller, more-volatile community, investors are likely to grow apprehensive and reallocate investment funds toward other external less-risky markets. When volatility in the market is perceived, investors may pull out quickly. Investors are primarily concerned with return on investment, and the presence of terrorism is likely to dissuade investors from investing heavily in a market, especially if it is characterized by a capital-intensive production base. According to the framework, even if terrorism is not relatively high, risk-averse investors who have multiple options for investable markets may become wary of the country’s level of stability and can pull out their funding and reallocate to other markets, even if they feel a slight sense of insecurity. However, based on the results

of the analyses, it was found that this aforementioned hypothesis does not align with the framework.

It is important to note that terrorism can cause logistical challenges for producers synergizing or transporting goods due to a strengthened security apparatus or inability to navigate damaged roads, bridges, railroads, and other transportation mediums. Additionally, networking and communications infrastructure damage can also contribute to decreased ability to meet virtually, hold conferences or other events which may improve the business environment, or generally accomplish the necessary tasks needed to start or improve a business. Damage to both physical transportation and telecommunication infrastructure is hypothesized to negatively impact economic conditions of the countries in which the attacks occur and is likely to influence complexity levels. Reduced ability to communicate efficiently, and traverse economic markets can lead to decreased complexity because of less ability for business stakeholders to collaborate, as well as transport goods and services - which is needed to generate revenue (which is the foundation for increasing business capacity). In sum, it is likely that terrorism reduces the ability for producers to a) maintain a consistent supply of inputs or transport finished products to retailers due to logistical constraints caused by heightened security precautions or destruction of infrastructure, b) secure capital investments for production industries due to divestment caused by risk averse investors wary of instability, and c) collaborate and synergize with entrepreneurs and potential or existing trade partners due to fear of movement or inability to transverse the country due

to security apparatuses or damage to infrastructure caused by terrorist attacks. All of these decreased capacities tug at the factors that are needed to spur economic complexity.

3. RESEARCH DESIGN

The research described in this study builds on an existing body of knowledge concerned with discovering relationships between terrorist activity and its effect on surrounding community, regional, country, and international systems. The research was initiated by downloading data on the different variables (incidents of terrorism, ECI values, GDP per capita, and population statistics). Next, data was cleaned and rendered into a format that was usable and intuitive, and was then incorporated into the four statistical models, (as outlined in Chapter 1 and discussed in more depth below), to analyze relationships between variables. Because this study analyzes country systems and attempts to draw conclusions about multiple systems, a macro-level theoretical framework was used to inform the creation of the various models (Creswell, 2014, p.55). Based on the results of the various analyses, inductive reasoning could be used to more deeply analyze specific countries, in order to draw conclusions about the impact of terrorism on their economies. The study attempts to use statistical modeling in order to understand the relationship of terrorism to economies of countries worldwide. The research was intended to be explanatory in the sense that it attempts to explain if economic complexity is affected by acts of terrorism, and the results should be viewed through a pragmatic lens by policymakers and practitioners in order to be valuable.

3.1 Ethics and Objectivity

Information in this study, including the results of the analyses and content in the literature review, should not be taken as advisory information to third parties. For

example, if information is used by third-party investors when determining where to allocate investment funds, they could potentially choose to divest from economies with a high propensity for terrorism to occur. It is highly unlikely that the content of this study will be taken into consideration by interested third parties, however. Investors and business owners typically navigate their investments and operations, respectively, by utilizing a variety of information sources. This report simply summarizes existing literature on terrorism and economies, and does not recommend any information for investors or business owners to use in their decision-making process. Although the information contained within will address the potential for investors to pull away from a terrorism-affected economy, they are extremely likely to be already informed by other sources that help them decide whether or not to participate in investment activities in a specific market.

It is important to remind one's self to think of the issues being researched through the lens of the affected parties, perpetrators, or other members of the international community. It is easy to focus on the issues at hand as a member of a developed, relatively stable, and complex economy. However, in order to glean the most information from this report, it is important to consider the intent of terrorist organizations and whether or not they intend to alter economic systems - or if the alteration is purely an unintended consequence of actions motivated by other operational objectives. Due to the type of data being used, the quantitative analysis portion of my research will be unbiased because the data is not generated by interested, biased, or ill-intending sources. Although

it is fair to surmise that the quality of the data is not perfect, it is still a worthwhile analysis, because the data is sourced from industry-recognized institutions.

3.2 Description of Economic Complexity Index Data

The economic complexity index is based on the notion that complex outputs of an economic system require collective knowledge of the society in which they are produced to be shared amongst thought leaders and producers (OEC, n.d.). Products such as microchips require a multiplicity of inputs – different materials, different manufacturing capabilities, and highly specialized knowledge of people from multiple different disciplines in order to efficiently produce them. In contrast, economies that are largely composed of raw (unprocessed) agricultural product exports – such as barley, for example, do not require highly specialized knowledge, processing capabilities, knowledge sharing, or other significant inputs to produce it. However, in these same economies, if the products were part of a production-intensive economic system, complexity would be increased because capabilities would be needed to move the products from their raw state to a more “complex” good. Economic complexity is a measure of all of the export products within an economy, or its “export basket.” However, the availability of multiple different inputs, manufacturing capabilities, and knowledge is simply not enough to create a complex economy. The connections between these inputs and how efficiently information is transferred leads to more complex economies. For example, if thought leaders, business owners, and manufacturers are unable to efficiently exchange information and develop plans for production and sales of goods and services, complexity will not maintain or strengthen. Economic complexity is

“expressed in the composition of a country’s productive output and reflects the structures that emerge to hold and combine knowledge” (OEC, n.d.).

In theory, the number of countries that can produce a specific product tells us something about how difficult it is to create that product. The most complex products created worldwide require knowledge, diversity, and ubiquity. Knowledge in a society gets translated into the products it makes, diversity describes how many different products a country can produce, and ubiquity describes the number of countries able to produce specific products. The economic complexity index is a measure of the ease at which producers globally can produce it – in other words – is it common practice in that country, and additionally, how productive and competitive is the country in producing it (Hausmann et. al., 2011). Ubiquity, as defined by the number of other countries who have the specialized skills needed to produce something, and diversity of products, defined by the variety of the export basket, and knowledge are indicators for the level of knowledge required to produce the products (Hausmann et. al., 2011). It is important to note that diversity, as well as ubiquity, are “crude approximations of the variety of capabilities available in a country or required by a product” and hinge upon the availability of rare inputs (Hausmann et. al., 2011, p.20). Some countries may have diverse and ubiquitous products in their portfolio because they are rare but found in that country and few others, such as Uranium. However, in order to correct for the effect of scarce products showing a country has high complexity, the index takes into account the number of products that other countries with the same rare products are able to form, so to address this, “diversity

can therefore be used to correct the information carried by ubiquity, and ubiquity can be used to correct the information carried by diversity” (Hausmann et. al., 2011, p.20).

Economic complexity attempts to “measure the amount of productive knowledge that each country holds” (Hausmann et. al., 2011, p. 7). Societies accumulate productive knowledge, characterized by varying degrees of diversification and sophistication, as the result of several inputs - and the accumulation can cause living conditions to improve, development to quicken, and real economic growth to spur (Hausmann et. al., 2011). Complexity is determined largely by the collective knowledge within a society. Knowledge in society depends on the “diversity of knowledge across individuals and on their ability to combine this knowledge, and make use of it, through complex webs of interaction” (Hausmann et al., 2011, p. 15). Knowledge originates from education and skills training that can be attained either on the job or through more formal avenues, such as technical and vocational training programs.

The paradigm shift in production toward more highly advanced products and services, (which is especially noteworthy in more developed countries), inherently prevents most individual members of the labor force from becoming an expert in all areas. An individual may spend her life studying organic chemistry, for example, and may be an expert in that area, but would not have the capacity or time in life to become as much of an expert on 2, 3, or even 4 other areas of study. In more economically complex economies, humans are likely to rely more heavily on the specialized skills and knowledge of others and collective knowledge of people in organizations and institutions for their lives to function. This logic can even be applied to relatively simple economies.

Take, for example, a city that is characterized by a weak economy and demonstrates a heavy reliance on imports and low productivity in most sectors. In this city, one would most likely find vendors specializing in selling one type of good or service. Of course outliers may exist, and some vendors may sell multiple types of products or have multiple income streams in their employment portfolio, but it is unlikely that they are experts in all sectors of the economic system of the city in which they live.

The difference between less advanced or weaker economies and more advanced ones is the amount of collective knowledge that is generated and how effectively producers of goods and services implement this knowledge in their production capabilities. In a weaker economic system, such as the one described above, it is apparent that specialization is not the only ingredient required to move toward a stronger economy. Specialization is not synonymous with complexity. Specialization, combined with the development of synergies between producers, can lead to improvements in efficiency and will set a weaker economy on a path toward complexity.

Economic complexity shines light on “the multiplicity of useful knowledge embedded” within the economy and is “is expressed in the composition of a country’s productive output and reflects the structures that emerge to hold and combine knowledge” (Hausmann et al., 2011, p. 18). These “structures” refer to businesses and organizations that produce goods or services. Institutions must be strong and able to work freely with other institutions to collaborate in order to generate synergetic connections that can lead to higher levels of economic complexity. Although it is not the only indicator for economic performance of countries, economic complexity is important

because it “helps explain differences in the level of income of countries, and more important, because it predicts future economic growth,” and countries who are able to achieve relatively high ECI levels tend to realize benefits in comparison to countries with lower levels of complexity (Hausmann et al., 2011, p. 29).

The economic complexity index ranks how diversified, ubiquitous, and complex a country’s export basket is. Diversity is measured by how many different type of products it produces, ubiquity is determined by how many other countries produce the goods within the export basket, and complexity combines the former and latter with the collective knowledge and capabilities required in an economy to produce the goods; for example, the world’s most complex goods are machinery and chemicals, while the least complex goods are agricultural products and raw materials (OEC, 2015).

A more complex good, in theory, requires more inputs and trade relationships in order to produce it. When a country produces complex goods, such as those requiring advanced technical knowledge to manufacture, composed of multiple inputs, requiring advanced machinery, and not commonly produced worldwide, it may be more economically developed or may be expected to experience fast economic growth in the near future based on the performance of all countries producing similar goods (OEC, 2015). The graph below shows the frequency distribution of ECI values for the 144 countries analyzed in this study. The average ECI value in 2012 is [.0000000389]. The standard deviation of ECI in 2012 (of countries for which there is data) is [.9965]. The first grouping below, ECI values between [.2.99, 2] includes South Sudan, while the next grouping between [-1.99, 1] includes Democratic Republic of the Congo. Afghanistan

can be found in the [-.99, 0] grouping, and Argentina is slightly over the average in the [.01, 1] category. Higher-complexity thresholds include Israel which can be found in the [1.01, 2] grouping, and Japan can be found in the [2.01, 3] grouping.

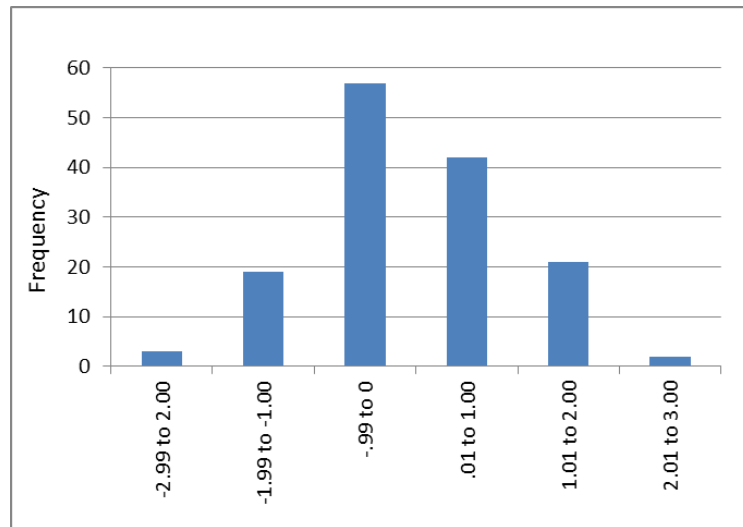


Figure 1: ECI Values for 144 Countries

3.3 Description of Terrorism Data

The primary independent variable in the models discussed below is terrorism, measured in a variety of ways. There are literally thousands of definitions of terrorism – but for the sake of this study, the primary measure of terrorism is composed of a calculation that tallies, in a given year, the number of people killed, wounded, or taken hostage in terrorist attacks, and subtracts the number of perpetrators from that value (because a suicide bomber, for example, is “captured” in the data as a death). An overview of the data contained in the different measures will be discussed first, and the specific measures respective to the different models will be subsequently discussed in

more depth. Data for various measures of terrorism was sourced from the Global Terrorism Database (GTD, n.d.b). The database is “an open-source database including information on terrorist events around the world from 1970 through 2014” and is currently the “most comprehensive unclassified data base on terrorist events in the world” (GTD, n.d.a). The GTD is made available and supported by The National Consortium for the Study of Terrorism and Responses to Terrorism (START), a Department of Homeland Security Center of Excellence that is located at the University of Maryland (START, n.d.). According to their website, they receive funding from a variety of federal agencies, other universities, and private foundations. The GTD collects statistics on terrorism from “a variety of open media sources” that are deemed credible by the GTD team (GTD, n.d.a). These sources include “electronic news archives, existing data sets, secondary source materials such as books and journals, and legal documents” (GTD, n.d.c).

The GTD codebook, on behalf of START, generally defines terrorism as “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” (START, 2015a, p. 8). More specifically, according to the codebook, in order to include an incident in the database, three attributes of an incident must be fulfilled: first, intentionality must be associated with the act of terrorism and the perpetrator or group carrying out the incident must consciously calculate their action and potential outcome of their action; second, violence or the threat of violence must be present, including violence against human beings or physical objects; and third, the incident must be planned and

executed by sub-national actors, which does not include state-sponsored terrorism (START, 2015a, p. 8). Additionally, in order for the GTD to include an incident, two of the three following criteria must also be met: (a) “the act must be aimed at attaining a political, economic, religious, or social goal” and with regard to economic goals, profit as a motive does not satisfy the definition of terrorism, rather the pursuit of profit must be conducted in an effort to secure larger systemic economic change; (b) evidence must exist that indicates the perpetrators intended to “coerce, intimidate, or convey some other message to a larger audience ... than the immediate victims,” irrespective of this realization by all members involved in the perpetration of the attack (as long as the individuals spearheading the attack acted with the intention to coerce, sway public opinion, or intimidate, the criteria is met); and (c) “the action must be outside the context of legitimate warfare activities” and falls outside parameters as outlined by international humanitarian law, particularly with regard to deliberately attacking civilians and non-combatants (START, 2015a, pp. 8-9). For the purpose of this study, as listed in the GTD codebook, an “incident of terrorism” is defined as an event during which one or more of the following activities occur and it is deemed that the perpetration of the incident satisfies the criterion above for what is constituted as terrorism (START, 2015a, pp. 21-23):

Assassination: The objective of this activity is to “kill one or more specific, prominent individuals.” This is typified by an attack on a specific person or individuals identifying with a targeted group.

Hijacking: The objective of a hijacking is to “take control of a vehicle such as an aircraft, boat, bus, [or other vehicle]. The difference between hijacking and hostage taking is the target – regardless of whether or not people are on board the vehicle, the fact it is a vehicle and not a person classifies it as a hijacking. Additionally, gaining ransom payment should not be the main objective of the hijacking.

Kidnapping: Classified as an act whose objective is “to take control of hostages for the purpose of achieving a political objective through concessions or through disruption of normal operations.” The difference between kidnapping and barricade incidents is in the movement of hostages – in a kidnapping incident, hostages are held in an alternative and typically clandestine location.

Barricade incident: This incident is characterized by intention of satisfying the objective of taking “control of hostages for the purpose of achieving a political objective through concessions or through disruption of normal operations.”

Bombing/explosion: Characterized by an event “where the primary effects are caused by an energetically unstable material undergoing rapid decomposition” and this does not include nuclear explosives. If the attack includes the use of explosives, such as grenades, accompanied by firearms, the attack is classified as armed assault.

Unknown: The attack type cannot be determined, but based on the source of information, it is apparent that damage was caused to physical objects or structures or harm to human beings occurred. For example, if a news source states there was an attack on a checkpoint by a group designated as terrorist, but does not report on the type of weapon used in the incident, it would be designated as unknown.

Armed assault: The objective in an armed assault is to “cause physical harm or death directly to human beings by use of a firearm, incendiary, or sharp instrument.” This can also include attacks involving the use of grenades, projectiles, or other devices that can be thrown which can cause an explosion.

Unarmed assault: An unarmed assault occurs when “means other than explosive, firearm, incendiary, or sharp instrument” are used to cause harm or kill human beings. Unarmed assaults may include attacks involving the use of chemical or biological weapons such as mustard gas, as well as radiological weapons.

Facility/Infrastructure attack: This attack is described as an act whose primary objective is to cause damage to a non-human target, such as a building. Attacks can include arson and sabotage of critical infrastructure. Although people may get hurt or die as a result of the attack, it is classified as a facility or infrastructure attack when it is clear that the intent was to damage said installations and not to specifically harm human beings.

Two Global Terrorism Database electronic datasets were downloaded, cleaned, and considered for utilization in the regression models. Data covering terrorism events occurring between January 1, 1992 and December 31, 2010 was downloaded initially from the website; data covering terrorism incidents between January 1, 2011 and December 31, 2014 was then downloaded and combined with the first data file in an Excel-based data compendium (START, 2014). Although data contained in each respective file pertained to a different set of years, the variables contained in the files that were utilized in this study were the same.

3.4 Description of Variables

The following variables were utilized in the study. Specific descriptions of the measures and how they were applied uniquely to each model in the study will be discussed in the next section. The countries analyzed in this study are listed below.

Afghanistan	Egypt	Lebanon	Saudi Arabia
Albania	El Salvador	Liberia	Senegal
Algeria	Eritrea	Lithuania	Serbia
Angola	Estonia	Macedonia	Sierra Leone
Argentina	Ethiopia	Madagascar	Singapore
Armenia	Finland	Malawi	Slovakia
Australia	France	Malaysia	Slovenia
Austria	Gabon	Mali	South Africa
Azerbaijan	Gambia	Mauritania	South Korea
Bahrain	Georgia	Mauritius	South Sudan
Bangladesh	Germany	Mexico	Spain
Belarus	Ghana	Moldova	Sri Lanka
Benin	Greece	Mongolia	Sudan
Bolivia	Guatemala	Morocco	Sweden
Bosnia and Herzegovina	Guinea	Mozambique	Switzerland
Brazil	Guinea-Bissau	Nepal	Tajikistan
Bulgaria	Haiti	Netherlands	Tanzania
Burkina Faso	Honduras	New Zealand	Thailand
Burundi	Hong Kong	Nicaragua	Timor-Leste
Cambodia	Hungary	Niger	Togo
Cameroon	India	Nigeria	Trinidad and Tobago
Canada	Indonesia	Norway	Tunisia
Central African Republic	Iran	Oman	Turkey
Chad	Iraq	Pakistan	Turkmenistan
Chile	Ireland	Panama	Uganda
China	Israel	Papua New Guinea	Ukraine
Colombia	Italy	Paraguay	United Arab Emirates
Costa Rica	Jamaica	Peru	United Kingdom
Cote d'Ivoire	Japan	Philippines	United States
Croatia	Jordan	Poland	Uruguay
Cyprus	Kazakhstan	Portugal	Uzbekistan
Czech Republic	Kenya	Qatar	Venezuela
Dem. Rep. of the Congo	Kuwait	Republic of the Congo	Vietnam
Denmark	Kyrgyzstan	Romania	Yemen
Dominican Republic	Laos	Russia	Zambia
Ecuador	Latvia	Rwanda	Zimbabwe

Figure 2: Countries Included in Study

Economic complexity: The ECI was used as a measure of economic complexity of country-level economic systems. As described above, it is a measure of the knowledge in a society that gets translated into the products it makes, diversity of the products that are produced, and ubiquity of those products. The ECI was attained from the OEC.

Incidence of terrorism: The measure of terrorism incidents takes into account all events listed in a given year for a given country, as found in the GTD. Incidents include all nine of the event typologies listed above. Unlike the terrorism score, as discussed below, incidence of terrorism does not take into account the number of individuals affected by each incident, rather, it is a dichotomous variable, i.e. terrorism did or did not occur. A value of 1 (one) is assigned if between zero and infinity incidents occurred. If a terrorist event caused 100 fatalities, for example, the event still receives a score of 1 (one); similarly, if an act of terrorism causes no fatalities, it would also receive a score of 1 (one).

Terrorism score: The terrorism score is a proprietary score that is generated with GTD data, and is calculated by adding the number of deaths that were caused by terrorism in a given year for each country, minus perpetrator (terrorist) deaths; plus number of people injured in a given year for each country, minus number of perpetrators (terrorists) injured; plus the number of hostages that were taken by terrorists in a given year for each country. The terrorism score shows how many individual people were affected by terrorism. It does not take into account the number of incidents that occurred, rather it adds up the number of people that were affected by terrorism. The score is not driven by the number of incidents. For example, If a country in a given year experienced

12 acts of terrorism, but no one was hurt, killed, or taken hostage, and no terrorists were hurt or injured, the country would receive a score of 0 (zero) for that year. According to the GTD codebook, number of deaths includes confirmed fatalities resulting from an incident, including perpetrators, and if multiple sources report different figures for casualties, the value attained from the most recent trustworthy source is recorded (START, 2015a, p.46). Because perpetrators are included in the figure, they are subtracted off of the value to give an estimate of non-terrorist deaths. Total number injured is composed of “non-fatal injuries to both perpetrators and victims” (START, 2015a, p.47). Similar to the fatality measure, the number of perpetrator injuries is subtracted from this value, in order to reflect only the number of non-terrorists who were injured. The number of hostages and kidnapping victims also includes “the number of crew members and passengers aboard [a] vehicle at the time of the incident” (START, 2015a, p. 49). The GTD codebook specifies that for sources that report number of hostages vaguely, such as by stating “at least 10 hostages were taken” for example, the lowest value of the estimate is used. Similar to the other measures, if multiple sources report different values for number of hostages taken, the most recent report is used unless there is reason to question the validity of the source.

Natural Logarithm of GDP per capita: The natural logarithm of gross domestic product (GDP) per capita (constant 2005 US\$), for each country in a given year, is used as a control variable in the study in order to account for the impact that a country’s GDP has on its economic complexity. Before applying the natural logarithm to GDP per capita, the graph below shows its skew.

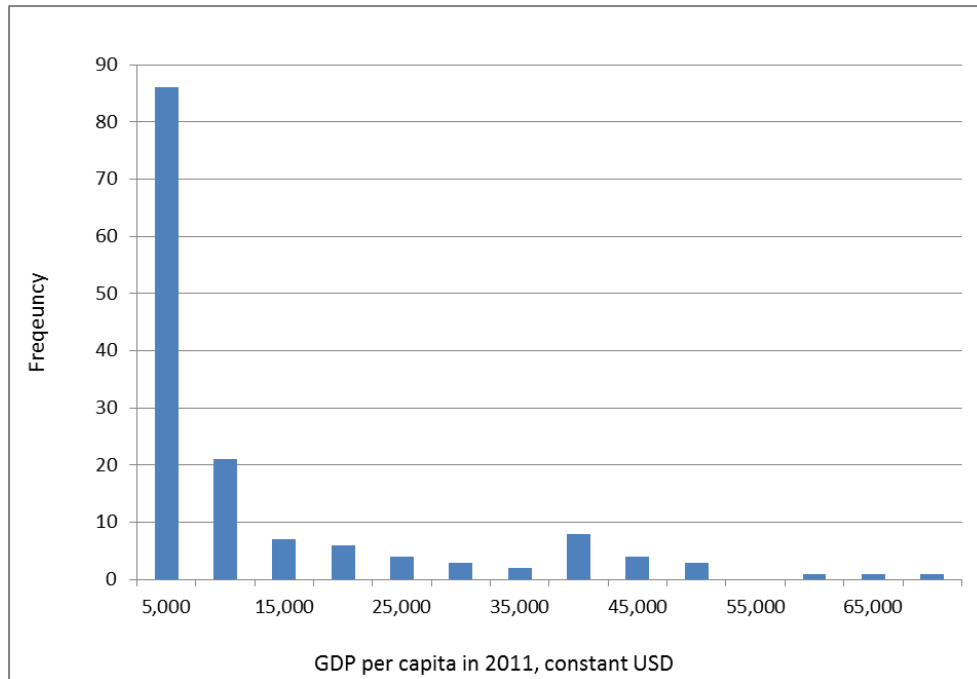


Figure 3: GDP Per Capita (Not Adjusted)

There is an extreme skew of GDP per capita toward the highest values, rendering GDP per capita across countries unevenly distributed. The natural logarithm is applied to GDP per capita in order to alter the scale and make the values across countries more normally distributed. The graph below shows the distribution of GDP per capita after applying the natural logarithm.

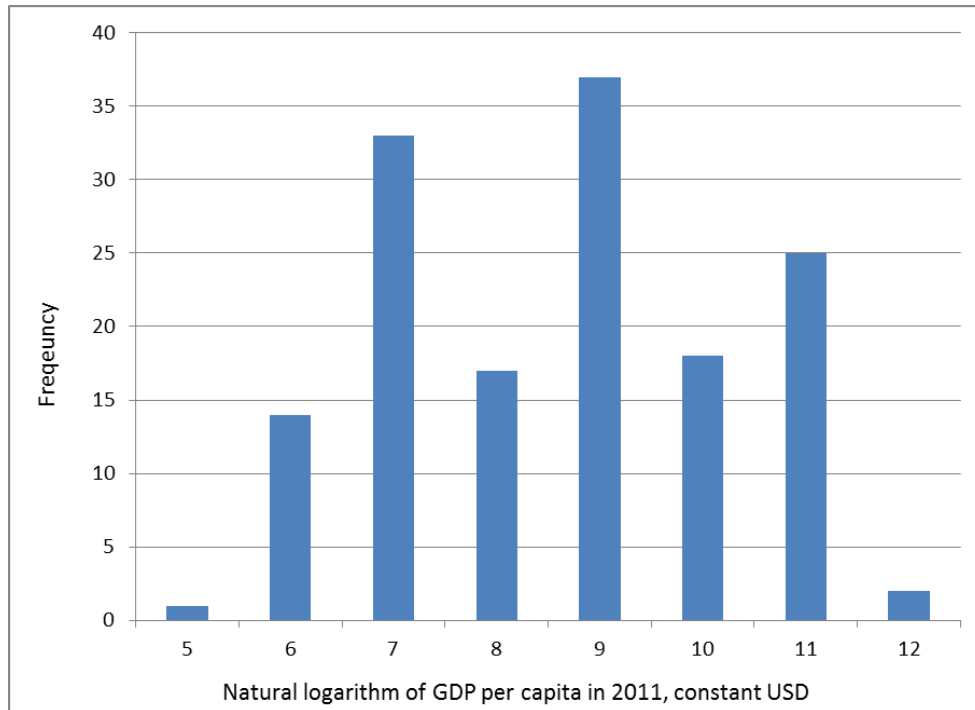


Figure 4: GDP Per Capita (Natural Log Applied)

GDP per capita values were downloaded from the World Bank and are measured in constant United States dollars (USD). GDP per capita is defined as “gross domestic product divided by midyear population [and is] the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products...without making deductions for depreciation of fabricated assets” (World Bank, n.d.a).

Regional “dummy” variables: Categorical variables, or “dummy” variables, are applied to the models in order to show the impact of terrorism (controlling for GDP per capita) on economic complexity in different regions. Cross-regional comparison allows insight to be gleaned into the effect of terrorism on economic complexity in different

regional-level economic systems. The regional variables include Africa, Asia, Australasia, Caribbean, Europe, Middle East, North America, and South America.

4. RESULTS OF ANALYSES

This chapter provides a detailed description of the results of the statistical models. Although the results were, for the most part, counterintuitive, they still provide valuable insight into the relationship between terrorism and economic complexity.

Group	Mean	Std. Err.	95% Conf. Interval
Terr. not present	-.12	.12	[-.35, .11]
Terr. present	.13	.12	[-.10, .37]
Difference	-.25	.17	[-.58, .08]

Figure 5: Results of Model 1

Variable	Models 2,3,4		
	(2) Binary occurrence of Terr.	(3) Terr. score, no outliers	(4) Terr. score, with outliers
Terrorism measure	.13 [.12]	.05 [.04]	-.01 [.03]
Controls			
GDP per capita	.11 [.04]*	.11 [.04]*	.11 [.04]*
Is Africa?	-1.59 [.16]*	-1.64 [.16]*	-1.58 [.17]*
Is Asia?	-.73 [.19]*	-.79 [.19]*	-.71 [.19]*
Is AustralAsia?	-1.56 [.37]*	-1.62 [.35]*	-1.64 [.36]*
Is Caribbean?	-1.19 [.37]*	-1.25 [.35]*	-1.27 [.36]*
Is MidEast	-1.24 [.22]*	-1.03 [.23]*	-1.19 [.23]*
Is N. America?	-.47 [.26]	-.50 [.25]*	-.50 [.26]
Is S. America?	-.98 [.25]*	-1.00 [.24]*	-.98 [.25]*

Notes: Standard errors in brackets. *Significant at 5%.

Figure 6: Results of Models 2,3,4

4.1 Model 1 Results

Model 1 compares ECI scores for countries in 2012 based on if any incident of terrorism occurred in the previous year. An incident of terrorism is defined as any terrorism-related event occurring - regardless of if any death, wounding, kidnapping, or physical property destruction that occurred as a result of the incident. For example, an unsuccessful bombing is counted as an incident if the attempting perpetrators were identified as being part of a terrorist organization. Data for 144 countries was analyzed,

and the one year lag time provides ample time for fluctuations to complexity levels to occur as a result of the previous years' activities within the country.

Model 1 is an independent group comparison of means test that compares ECI values for countries in which terrorism did not occur in 2011, and those in which it did occur. 76 observations were included in the sample group of countries where terrorism did not occur, and 68 observations were included in the sample group for countries where it did occur. The mean of the economic complexity index in countries where terrorism did not occur is ($M = -.12$) while the mean for countries where it did occur in 2012 is ($M = .13$). The two sample groups have relatively equal levels of variance. For countries in which terrorism did not occur, the standard deviation was slightly higher at ($SD = 1.02$), and for those in which it did occur, the standard deviation was lower, but not by much, at ($SD = .96$). Because the standard deviations are close, a two-sample t-test with equal variances model was utilized.

The difference in means between countries where terrorism occurred ("yes") and those where it did not occur ("no") is $[-.25]$. The sample group of countries where terrorism did not occur in 2011 shows a 95% confidence interval of $[-.35, .11]$. The sample group of countries where terrorism occurred shows a confidence interval of $[-.1, .37]$. The two sample groups demonstrate a confidence interval difference of $[-.58, .08]$. The confidence interval based on the difference of the 2 sample groups shows that there is not a significant difference in economic complexity levels between countries where terrorism occurred and those where it did not occur. There was not a significant effect for

the occurrence of terrorism, $t(142) = [-1.52]$; the pre-specified alpha value is $[\.05]$, and the p-value is much greater than the pre-specified alpha value at $[\.13]$.

4.2 Model 2 Results

Model 2 is a regression model that predicts ECI in 2012 as the result of terrorism occurring or not occurring in 2011, the previous year, and is controlled for with the natural logarithm of GDP per capita in 2011 and regional “dummy” variables. 141 countries were used in Model 2. Similar to Model 1, terrorism counts as occurring if any incident occurred, regardless of the outcome. Unsuccessful attempts at attacks, kinetic or otherwise, are counted as an incident if the attempting perpetrators are found to be associated with terrorism initiatives.

In Model 2, the R-squared value indicates that approximately 52% of the variance in economic complexity values is explained by presence of terrorism, GDP per capita, and region. It is important to note the direction of the terrorism coefficient. The results are counterintuitive to the predicted test of the hypothesis, showing that countries that experienced terrorism are associated with higher levels of economic complexity. The results of this model show that the effects of terrorism, controlling for GDP per capita and regions, is insignificant. For countries in which terrorism occurs, compared to those in which it does not occur, in 2012, the economic complexity index value increases by $[\.13]$, controlling for the natural logarithm of GDP per capita and region. Controlling for the effects of terrorism’s occurrence and region, for a 10% increase in natural logarithm of GDP per capita, the difference in the expected mean ECI of countries in the model will be equal to $[\.1096791*\log(1.1)]$, or $[0.0045]$.

Controlling for occurrence of terrorism and natural logarithm for GDP per capita, using Europe as the comparison region, it was found that countries in Africa have economic complexity values on average [1.6] lower than European countries, while Asian countries exhibit economic complexity values on average [.73] lower than European countries. Countries in “AustralAsia” have economic complexity values on average [1.56] lower than European countries, countries in the Middle East have economic complexity values on average [1.24] lower than European countries, and countries in South America have economic complexity values on average [.98] lower than European countries.

Terrorism’s occurrence (“ONEORZERO2011”), holding all other variables constant, is not statistically significant because its p-value is [.27]. Additionally, all other variables, except for the North American country control, show a statistically significant change to economic complexity, holding all other variables constant. The model also demonstrates that African countries overall have less complex economies than all other regions, and “AustralAsian” countries are also relatively less economically complex than other regions.

4.3 Model 3 Results

Model 3 is a regression model that predicts complexity levels in 2012 for 133 countries as the result of the natural logarithm of each country’s respective terrorism score for 2011, the previous year, and is controlled for by the natural logarithm of GDP per capita in 2011 and regional “dummy” variables. The model does not included countries in which the natural logarithm of the terrorism score is greater than or equal to

[6]. In Model 3, the R-squared value indicates that approximately 54% of the variance in economic complexity values is explained by the terrorism measure, GDP per capita, and region. Again, it is important to note the direction of the terrorism coefficient. The results of this model show that the effects of terrorism, controlling for GDP per capita and regions, is insignificant. For countries in the model, for a one-unit increase in the terrorism measure, in 2012 the economic complexity index value increases by [.05], controlling for the natural logarithm of GDP per capita and region. Controlling for the effects of the terrorism measure and region, a one-unit increase in the natural logarithm of GDP per capita causes an increase of [.11] to economic complexity. Controlling for the terrorism measure and natural logarithm for GDP per capita, using Europe as the comparison region, countries in Africa have economic complexity values on average [1.64] lower than European countries, while countries in Asia have economic complexity values on average [.79] lower than European countries. Countries in “AustralAsia” have economic complexity values on average [1.62] lower than European countries, countries in Middle East have economic complexity values on average [1.03] lower than European countries, and countries in South America have economic complexity values on average [1] lower than European countries.

The terrorism measure, holding all other variables constant, is not statistically significant because its p-value is [.181]. However, all other controls - natural logarithm of GDP per capita, and regional controls, show statistically significant changes to economic complexity holding all other variables constant. The model also demonstrates that

African and “AustralAsian” countries overall have less complex economies than all other regions.

4.4 Model 4 Results

Model 4 is a regression model that predicts complexity levels in 2012 for 141 countries as the result of the natural logarithm of each country’s respective terrorism score for 2011, the previous year, and is controlled for by the natural logarithm of GDP per capita in 2011 and regional “dummy” variables. The model demonstrates that a one unit increase in the terrorism measure causes a decline in complexity, or a decline of [.01]. The model includes all countries for which there are data, including outliers. It is evident that when outliers are excluded, as shown in Model 3, the results are counterintuitive to the theoretical framework as outlines in this study. In Model 4, which is inclusive of all countries for which there are data, the direction of the coefficient aligns with the theoretical framework by showing that an incline in the terrorism score causes a decrease in complexity. The presence of outliers can be attributed to the difference in the coefficient values and directions for Models 3 and 4.

In Model 4, the R-squared value indicates that approximately 52% of the variance in economic complexity values is explained by the terrorism score, GDP per capita, and region. The results of this model show that the effects of terrorism, controlling for GDP per capita and regions, is insignificant. For countries in the model, for a one-unit increase in the terrorism score, in 2012 the economic complexity index value decreases by [.01], controlling for the natural logarithm of GDP per capita and region. Controlling for the effects of the terrorism score and region, a one-unit increase in the natural logarithm of

GDP per capita causes an increase of [.11] to economic complexity. Controlling for the terrorism score and natural logarithm for GDP per capita, using Europe as the comparison region, countries in Africa have economic complexity values on average [1.58] lower than European countries, while Asian countries have economic complexity values on average [.71] lower than European countries. Countries in “AustralAsia” have economic complexity values on average [1.64] lower than European countries. Countries in South America have economic complexity values on average [.98] lower than European countries. The terrorism score, holding all other variables constant, is not statistically significant because its p-value is [.611]. All other variables, except for the North American country control, show a statistically significant change to economic complexity, holding all other variables constant.

4.5 Discussion: Counterintuitive Results

As shown in Model 1, the difference in means for 2012 ECI values in countries where terrorism occurred, and those in which it did not, in 2011, is insignificant. Additionally, Model 2 indicates a relationship between terrorism in 2011 and the 2012 ECI value exists, which although statistically insignificant, is counterintuitive to the original theoretical frameworks – it shows that in countries where terrorism occurred, ECI values increase. In Model 3, when outliers are removed, the results are counterintuitive, showing that for increases in the terrorism measure, complexity increases. Model 4 displays a coefficient for terrorism in 2011 that is negative – and aligned with the direction that is predicted by the theoretical frameworks – indicating that for increases in the terrorism score of countries, complexity values decrease, however,

the relationship is insignificant. It can be concluded that outliers must be accounted for, because of the relatively large weight in the models.

It may be the case that low levels of the effectiveness of rule of law, measured by public perception of government authority, may be responsible for both high terrorism rates and low economic complexity. Poor governance and weak rule of law can lead to conditions where it is easier for terrorist attacks to occur because forces are not effective in curbing the flow of weapons or explosives, or have weak intelligence capabilities, rendering them unable to stop terrorist organizations from operating. Similarly, poor governance and weak rule of law can also lead to low economic complexity by disincentivizing existing or potential producers to expand operations or start up, respectively, because producers may recognize their inability to run a successful business if corruption is rampant and barriers to entry are too great compared to their potential return on investment.

It is also important to explore reasoning as to why some countries have very high GDP per capita, but very low ECI scores. For example, in the figure below, it is apparent that many countries have low ECI but high GDP per capita. By understanding the context of individual economies, insights can be gleaned into the effect of terrorism on those specific economies.

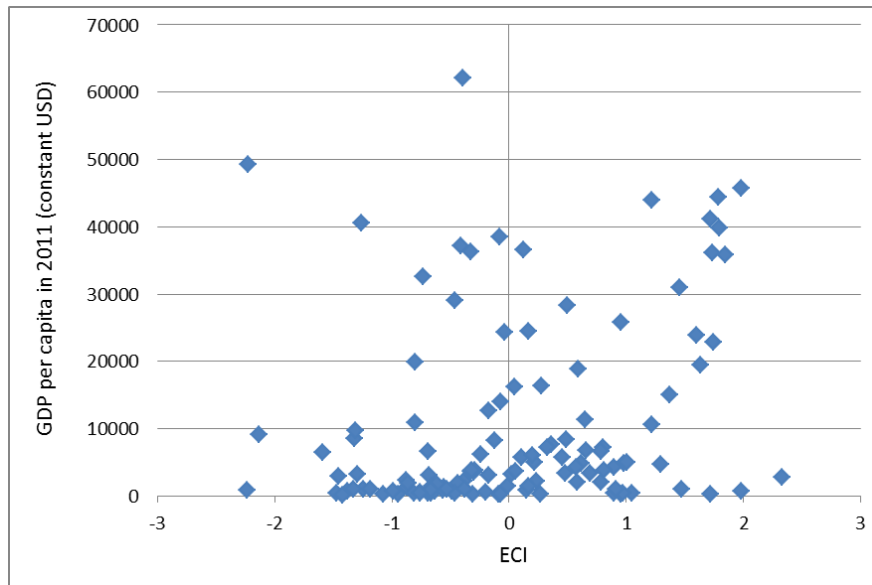


Figure 7: GDP per capita and ECI Scatter

There may be several reasons related to data quality that may explain why the results of the analyses are counterintuitive. By using data that is not completely reflective of terrorism events and economic complexity, and lacks data points for several countries, the results might not reflect reality. First, the data for economic complexity lacks or is nonexistent for multiple countries. Second, the ECI is based on trend data, meaning that it is based on the relative performance of one country compared to many. The components of the index value are not based purely on information derived from an individual country system. Third, the ECI is based on export values, which inherently neglects many aspects of the internal production environment of countries. Fourth, regarding quality of terrorism data, many news sources are likely to report on events differently, and relatively “closed” countries (in terms of ability for media to disseminate information) are likely to prevent information about specific events from reaching the mainstream media,

which is where the START team finds data for the database. Fifth, by only taking into account national-level data on the terrorism and ECI measures, trends and effect of terrorism at subnational levels is masked. For example, in the case of Nigeria, it is likely that terrorism has a large impact on the economy, but when using agglomerated data about terrorism and ECI for all of Nigeria, including stable regions, the statistical effects are diluted.

5. CONCLUSION

In conclusion, in the first model, a difference of means test produced insignificant results for 2012 ECI values of countries where terrorism occurred and did not occur in 2011. Additionally, the second model analyzed indicates that a relationship between terrorism in 2011 and the 2012 ECI value exists, which although statistically insignificant, is counterintuitive to the original theoretical frameworks – it shows that in countries where terrorism occurred, ECI values increased. The third model shows that when outliers are removed, increases in terrorism are associated with increased complexity levels. Finally, the fourth model analyzed displays a coefficient for terrorism in 2011 that is negative – and aligned with the direction that is predicted by the theoretical frameworks – indicating that for increases in the terrorism score of countries, complexity values decrease. Although some of the results are counterintuitive, the study itself provides a “jumping-off” point for further research. It would be beneficial for researchers to continue to analyze the relationship of terrorism on economic complexity by performing individual country analyses or case studies. The statistical modeling likely masks some of the interesting effects that terrorism has on some countries.

Regardless of the results of the analyses discussed in this study, it is still important for researchers and practitioners alike to attempt to better understand the effect that terrorism, and conflict more broadly, have on economic systems. Research should consider subnational data in order to better understand dynamics within smaller economic

systems, rather than countries as a whole. In doing so, interventions aimed at mitigating the effects of terrorism can be made more efficient and effective across the board.

REFERENCES

- Arestis, P., & Sawyer, M. C. (2010). *21st Century Keynesian Economics*. Houndsmills, Basingstoke, Hampshire: Palgrave Macmillan.
- Bird, G., Blomberg, S. B., & Hess, G. D. (2008). International Terrorism: Causes, Consequences and Cures. *World Economy*, 31(2), 255-274. Retrieved from <http://web.a.ebscohost.com.mutex.gmu.edu/ehost/pdfviewer/pdfviewer?sid=37291925-9074-40c4-ad17-e456666243be%40sessionmgr4005&vid=1&hid=4212>
- Blomberg, S. B., Hess, G. D., & Orphanides, A. (2004). The macroeconomic consequences of terrorism. *Journal of Monetary Economics*, 51, 1007–1032. Retrieved from <http://www.sciencedirect.com.mutex.gmu.edu/science/article/pii/S0304393204000509>
- Collier, P. (2006). Economic causes of civil conflict and their implications for policy (working paper). Oxford: Oxford University.
- Creswell, J. (2014). *Research design: Qualitative, quantitative, and mixed method approaches*. Thousand Oaks: SAGE Publications, Inc.
- Duffield, M. (2000). Globalization, transborder trade, and war economics. In M. Berdal & D. Malone (Eds.), *Greed and grievance: Economic agendas in civil wars* (pp. 69-89). Boulder: Lynne Rienner.
- Enders, W., & Sandler, T. (1996). Terrorism and Foreign Direct Investment in Spain and Greece. *Kyklos*, 49(3), 331-352.
- Gaibullov, K. and Sandler, T. (2009). The impact of terrorism and conflicts on growth in Asia. *Economics & Politics*, 21, 359–383. Retrieved from <http://onlinelibrary.wiley.com.mutex.gmu.edu/doi/10.1111/j.1468-0343.2009.00347.x/abstract;jsessionid=27696048427D8B010F8D2A56C690876E.f04t02>
- Gries, T., Krieger, T., & Meierrieks, D. (2011). Causal Linkages Between Domestic Terrorism and Economic Growth. *Defence and Peace Economics*, 22(5), 493-508. Retrieved from <http://www.tandfonline.com.mutex.gmu.edu/doi/pdf/10.1080/10242694.2010.532943>

- GTD (Global Terrorism Database). (n.d.a). *About GTD*. Retrieved from <http://www.start.umd.edu/gtd/about/>
- GTD (Global Terrorism Database). (n.d.b). *Contact GTD*. Retrieved from <http://www.start.umd.edu/gtd/contact/>
- GTD (Global Terrorism Database). (n.d.c). *Using GTD*. Retrieved from <http://www.start.umd.edu/gtd/using-gtd/>
- Hausmann, R., Hidalgo, C. A., Bustos, S., Coscia, M., Chung, S., Jimenez, J., Simoes, A., & Yildirim, M. A. (2011). *The atlas of economic complexity: Mapping paths to prosperity*. Retrieved from http://atlas.media.mit.edu/static/pdf/atlas/AtlasOfEconomicComplexity_Part_I.pdf
- Keen, D. (2000). Incentives and disincentives for violence. In M. Berdal & D. Malone (Eds.), *Greed and grievance: Economic agendas in civil wars* (pp. 19-41). Boulder: Lynne Rienner.
- Llussá, F., & Tavares, J. (2007). The economics of terrorism: A synopsis. *The Economics of Peace and Security Journal*, 2(1), 62-70. Retrieved from <http://carecon.org.uk/Chula/2007%20Llussa%20Tavares%20EPSJ.pdf>
- Meierrieks, D., & Gries, T. (2013). Causality between terrorism and economic growth. *Journal of Peace Research*, 50(1), 91-104.
- Mercy Corps. (n.d.). *Youth & consequences: Unemployment, injustice and violence*. Retrieved from https://www.mercycorps.org/sites/default/files/MercyCorps_YouthConsequences_Report_2015.pdf
- OECD (Observatory of Economic Complexity). (2015). Observatory of Economic Complexity. Retrieved May 1, 2015, from <http://atlas.cid.harvard.edu/about/glossary/>
- OECD (Observatory of Economic Complexity). (n.d.). *What is economic complexity?* Retrieved from http://atlas.media.mit.edu/en/resources/economic_complexity/
- Powers, M., & Choi, S.-W.. (2012). Does transnational terrorism reduce foreign direct investment? Business-related versus non-business-related terrorism. *Journal of Peace Research*, 49(3), 407–422. Retrieved from <http://www.jstor.org/stable/41721581>
- Robson, C. (2011). *Real world research*. Chichester: John Wiley & Sons Ltd.

- START (National Consortium for the Study of Terrorism and Responses to Terrorism). (n.d.). *About START*. Retrieved from <http://www.start.umd.edu/about/about-start>
- START (National Consortium for the Study of Terrorism and Responses to Terrorism). (2014). *Global Terrorism Database* [Data file]. Retrieved from <http://www.start.umd.edu/gtd>
- START (National Consortium for the Study of Terrorism and Responses to Terrorism). (2015a). *Codebook: Inclusion criteria and variables*. Retrieved from <http://www.start.umd.edu/gtd/downloads/Codebook.pdf>
- START (National Consortium for the Study of Terrorism and Responses to Terrorism). (2015b). *Global Terrorism Database* [Data file]. Retrieved from <http://www.start.umd.edu/gtd>
- USIP (United States Institute of Peace). (2009). *Guiding principles for stabilization and reconstruction*. Retrieved December 1, 2015, from http://www.usip.org/sites/default/files/guiding_principles_full.pdf
- World Bank. (n.d.a) *Ny.gdp.pcap.cd_Indicator_en_excel_v2* [Data file]. Retrieved from <http://data.worldbank.org/indicator/NY.GDP.PCAP.CD>
- World Bank. (n.d.b). *Sp.pop.totl_Indicator_en_excel_v2* [Data file]. Retrieved from <http://data.worldbank.org/indicator/SP.POP.TOTL>

BIOGRAPHY

William Johnson received his Bachelor of Arts from Iowa State University, Ames, Iowa in May 2011. He works in the field of international development and focuses on strengthening tertiary education systems in post-conflict countries. He received his Master of Science from George Mason University in 2016.