

Differences in disease incidence across regions: developing a framework for healthcare policy reform

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Abstract

Maritime piracy is a problem that plagues our navigable seas. This study provides a quantitative understanding of factors that influence the frequency of yearly maritime piracy occurrences. Using a non-probability sampling technique, eleven countries with reported cases of maritime piracy were purposefully selected. Open sourced data from the National Geospatial Intelligence Agency (NGIA), the World Bank (WB), the United Nations (UN), the National Consortium for the Study of Terrorism and Responses to Terrorism (START), and the Center for Systemic Peace (CSP) were utilized in this study. Using regression features, as well as socioeconomic and geopolitical data from these countries over a longitudinal period of thirty-four years (1985-2018), a Time-Series Cross-Sectional Design (TSCS) provides an in-depth understanding of factors that affect the frequency of piracy occurrences. The four factor model concluded that state weakness, total population size, Gross Domestic Product (GDP), and total fish catch tonnage are found to be associated with the frequency of pirating activity worldwide. Policy implications and measures to mitigate piracy are also discussed.

Key words: maritime piracy; hijackings; violence on the high seas; violence within international waters; time-series cross-sectional analysis

Introduction

Contemporary maritime piracy began in the 1980s and continues to the present day. Over this period, more than 6,000 incidents have been reported worldwide (NGIA, 2020). Acts of maritime piracy have had both economic and human consequences. First, maritime piracy occurrences have resulted in an increase of shipping expenses, the theft of maritime cargo, multi-million dollar ransom payments, and increased insurance premiums. As a result, Boyle (2015) estimates that piracy costs the global economy \$15B annually. Second, piracy has resulted in the loss of human lives. Pirate attacks in Somalia, for instance, have accounted for more than 340 mariner deaths (Weir, 2009). Off the coast of West Africa, mortality rates, due to piracy victimization, continue to rise with recent estimates showing that nine percent of regional pirating incidents resulted in death (Twyman-Ghoshal & Pierce, 2014).

Prior research utilizes quantitative methods to examine piracy worldwide (Daxecker & Prins, 2012; 2013; 2015a; 2015b; Gries & Redlin, 2010; Hastings, 2009; Jablonski & Oliver, 2012; Regan, 2019). The results from these studies have outlined specific factors which are correlated with piracy attacks (i.e., poor economic conditions, weak governance, demographic pressures, increased international trade, terrorism, and geography). While the results of these quantitative

studies provide valid contributions toward the understanding of piratic antecedents, they fail to explain why the rates of piracy change year-to-year. Determining why the rates of piracy fluctuate annually provides policymakers with viable options to mitigate this global threat. The purpose of this study is to determine which socioeconomic, demographic, and geopolitical variables feed variability in yearly rates of maritime piracy change.

Review of the Literature

The evidence from extant empirical research permits one to reasonably infer that six factors are associated with maritime piracy: poor economics, increased international trade, increased demographic pressures, geography, terrorism, and state weakness. The following sections will provide a more detailed discussion of these specific factors as well as alternative indicators affecting global pirating events.

Economic Factors Associated with Maritime Piracy

Poor economic conditions are positively associated with incidents of maritime piracy (Daxecker & Prins, 2012; Gjelsvik & Bjorgo, 2012; Gries & Redlin, 2010; Jablonski & Oliver, 2012; Weir, 2009). As economic conditions deteriorate, coastal residents engage in piracy to subsidize their income (Bahadur, 2011; Burnett, 2002; Weir, 2009). Quantitative studies support these claims, concluding that a decrease in Gross Domestic Product (GDP) and GDP per-capita are predictive with acts of piracy (Daxecker & Prins, 2012; Gries & Redlin, 2010; Jablonski & Oliver, 2012).

Research also has examined the relationship between youth unemployment and maritime piracy. For instance, Gries and Redlin (2010) found that youth unemployment rates and acts of maritime piracy were positively related in 149 coastal countries during the period of 1991-2010. Most pirates are young males facing diminished economic opportunities. This demographic, therefore, is at particular risk to be recruited into piracy (Boyle, 2015; Whitman, 2013).

In addition to GDP, GDP per-capita, and youth unemployment, research also has established a link between declines in the fishing sector and acts of maritime piracy (Bahadur, 2011; Boyle, 2015; Schneider & Winkler, 2013; Weir, 2009; Young, 2007). A number of scholars acknowledge that some coastal states lack a proper maritime police force or coast guard to enforce fishing regulations (Bahadur, 2011; Burnett, 2002; Young, 2007). With a decreased government oversight, opportunities for foreign vessels to harvest the local catch increases. This increase in illegal fishing has negatively affected poor coastal residents that depend on this resource (Anderson, 2010; Weir, 2009; Young, 2007). In Somalia, for instance, more than 700 foreign vessels were illegally harvesting fish from their waters in 2005, resulting in \$300M of economic losses (Palmer, 2014; Sugiki, 2012). In Indonesia, the financial damage is more severe, with estimates showing \$2B lost annually from illegal fishing (Liddick, 2014). With a decrease in domestic fish catch, former fishermen have resorted to piracy to earn a living (Bahadur, 2011; Baird, 2012; Sekulich, 2009; Weir, 2009; Young, 2007). Empirical evidence supports this claim. Daxecker and Prins (2012), for instance, discovered that a decreased value of total domestic annual fish catch (USD) had a moderate to strong effect on global maritime piracy from 1995-2007.

International Trade Factors Associated with Maritime Piracy

A second area that has been identified as being associated with maritime piracy is that of international trade. Estimates show that eighty percent or more of all international trade is

transported by ship (Daxecker & Prins, 2013; Nikolic & Missoni, 2013). With increased ocean traffic, pirates will seize the opportunity to profit (Coggins, 2012). Jablonski and Oliver (2012) found that increased boat traffic through the Suez Canal was correlated with acts of Somali piracy from 2000-2009. A second empirical study, Daxecker and Prins (2012), examined a broader variation of trade: regional imports and exports. After conducting an assessment of the monetary value of regional imported and exported goods, Daxecker and Prins (2012) concluded that an increased regional trade had a moderate effect on global hijackings from 1995-2007.

Demographic Factors Associated with Maritime Piracy

Increases in domestic population are also predictive of acts of piracy (Daxecker & Prins, 2012; Gries & Redlin, 2010; Jablonski & Oliver, 2012). Increased demographic pressures (i.e., population size) place additional burdens on the state to financially support social programs and sufficient sources of employment. Given these governmental constraints, resource deprived individuals engage in piracy (Daxecker & Prins, 2012; Gries & Redlin, 2010; Jablonski & Oliver, 2012).

Geographic Factors Associated with Maritime Piracy

A fourth area that has been identified as being associated with piracy is that of geography. Countries with interior capitals, long coastlines, narrow channels, and remote islands are favorable for pirates (Daxecker & Prins, 2012; 2013; 2015b; Gries & Redlin, 2010; Hastings, 2009; Murphy, 2009). Today, pirating incidents have been reported where those geophysical characteristics are present (e.g., Bangladesh, Somalia, Nigeria, Brazil, and Indonesia). Such spatial characteristics (i.e., capital coastline distances and coastline length) are positively related to piracy (Daxecker & Prins, 2013; 2015a; Gries & Redlin, 2010).

Geopolitical Factors Associated with Maritime Piracy

A fifth area empirically demonstrated to be associated with maritime piracy are political characteristics: state weakness and acts of terrorism. There is positive relationship between state weakness (i.e., poor governance) and maritime piracy (Daxecker & Prins, 2012; 2013). Weak states provide opportunities for pirates to operate with low risk of apprehension. As a country becomes politically weaker, the likelihood of piracy increases (Daxecker & Prins, 2012; 2013; 2015b). Somalia, as an example, has not had a strong functional government since the collapse of the Siad Barre Regime in 1991. Since then, the country has reported over 1,600 piracy attacks (NGIA, 2020).

Research has also examined the relationship between pirate and terrorist organizations (Annati, 2009; Nelson, 2012; Regan, 2019). Pirates and terrorists may work together to ensure that states remain politically weak, allowing for such alliances to operate with low risk of capture (Annati, 2009; Nelson, 2012). Pirates and terrorists may also associate with one another to protect financial assets and secure firearms necessary for future attacks (Annati, 2009; Nelson, 2012). Studies support such claims, citing a positive correlation between incidents of maritime piracy and terrorism events. Regan (2019), for instance, examines this relationship in Nigeria, Somalia, and Indonesia from 1985-2014. Regan (2019) concluded that acts of piracy and terrorism positively correlate in both Indonesia and Nigeria. As piracy attacks increase, so do acts of terrorism (Regan, 2019). A second study, Daxecker and Prins (2012), provides a broader

perspective on this issue. Using regression analysis, the authors found that acts of terrorism had a moderate effect on global maritime hijackings from 1995-2007.

Alternative Factors Affecting Global Piracy Incidents

To avoid being the victims of hijackings and robberies, global shipping companies have spent billions of dollars on situational crime control techniques (i.e., increased lighting, thermal cameras, barbed wire, slippery foam, high pressure hoses, loud acoustic devices, etc.), Best Business Practices (i.e., alternative transit routes, increased navigation speed, etc.), and private military security companies (Burnett, 2002; Chalk, 2010; Rengelink, 2012; Shane, Piza, & Mandala, 2015; Stavridis & LeBron, 2010; Warner, 2010). These defensive tactics have significantly reduced the number of successful hijackings by as much as eighty percent (Shane et al., 2015; Warner, 2010).

In addition to these defensive measures, national governments have also deployed naval patrols to monitor pirate-prone waters (Chalk, 2010; Eichstaedt, 2010; McKnight & Hirsh, 2012; Warner, 2010). The government intervention strategy appears to have had a positive impact. In Somalia, for example, as naval patrols have increased, attacks have subsided (McKnight & Hirsh, 2012; Sugiki, 2012). Other regional naval task forces, however, have not witnessed a similar pattern, as pirating activity continues to climb in such area as Nigeria and Southeast Asia.

Methodology

Beyond the economic, demographic, geographic, and geopolitical factors causing piracy, limited research has determined why annual rates of piracy change. The purpose of this study is to examine similar variables to assess whether such factors also explain why the base rates of maritime piracy incidents change year-to-year.

Selecting countries where piracy is or was prevalent is essential. Excluding countries where piracy is or was absent is justified given that the objective is not to assess causation, but rather temporal variations in piracy incidents. Using a purposive sampling technique, eleven countries were selected: Bangladesh, Brazil, Ecuador, Indonesia, Malaysia, Nigeria, the Philippines, Somalia, Sri Lanka, Venezuela, and Vietnam. These countries were chosen based on a thorough examination of academic and legal sources documenting incidents of maritime piracy within their spatial waters. Figures 1 and 2 provide spatial representation of these countries and where acts of piracy have occurred from 1985-2018.

INSERT FIGURES 1 AND 2

Incidents from 1985 and 2018 were selected for two reasons. First, since piracy reemerged from its dormant period in the 1980s, it is important to document its progression over time. Second, many of the reported variables used in the analysis are computed annually only. According to Fields (2013), thirty observations or more are recommended for time-series analysis in order to provide results that are more robust and generalizable.

Operationalizing Piracy

Two organizations have working definitions of piracy: the United Nations (UN) and the International Maritime Bureau (IMB). The UN's classification of piracy is narrowly defined, suggesting that such acts are exclusive to those that involve one ship attacking one other in international waters with the sole intent of economic gain (Lucas, 2013; Murphy, 2009; Tepp,

2012; Young, 2007).¹ Cases that do not fulfill these criteria are not classified as acts of piracy. As an example, a commercial vessel approached and hijacked by pirates on two skiffs within the territorial waters of Somalia would not fit the definitional parameters of piracy under UNCLOS, as the commercial vessel was attacked by more than one ship and the hijacking had not occurred within international waters.

The International Maritime Bureau, meanwhile, has a broader interpretation. *Piracy*, according to the IMB, is defined as “an act of boarding or attempting to board any ship with the apparent intent to commit theft or any other crime” (Commercial Crime Services, 2020, p. 1). Given that the IMB definition is more comprehensive, this operational definition of piracy is adopted for the purpose of this study.

Data Sources

Most economic and demographic variables were collected from the World Bank. The World Bank has a public dataset containing a unique assortment of socioeconomic and demographic indicators. These figures start in 1961 and are computed annually for most countries. For this study, male youth unemployment rates (ages 15-24), GDP, GDP per-capita, and total population were collected for each country from 1985-2018.

A second source utilized in this study was the United Nations Food and Agriculture Organization (FAO). FAO compiles an array of agriculture and fisheries data on those countries affiliated with the United Nations (UN). The dataset contains annual figures starting in 1950. For

¹ The United Nations (2020) defines *piracy* as:

- a) “any illegal acts of violence or detention, or any act of depredation, committed for private ends by the crew or the passengers of a private aircraft and directed:
 - i) on the high seas, against another ship or aircraft, or against person or property on board such ship or aircraft;
 - ii) against a ship, aircraft, persons or property in a place outside the jurisdiction of any state;
- b) any act of voluntary participation in the operation of a ship or of an aircraft with the knowledge of facts making it a pirate ship or aircraft;
- c) any act inciting or of intentionally facilitating an act described in subparagraph (a) or (b).”

this study, total fish catch tonnage as well as the value of fish exports (USD) were collected for the eleven sampled countries during the surveyed period.²

In addition to the economic and demographic figures, political data were also gathered. State weakness and acts of terrorism were collected from two open data sources: the Center for Systemic Peace and the Global Terrorism Database. State weakness data were computed from the Center for Systemic Peace (CSP), which provides a State Fragility Index (SFI) evaluating the overall effectiveness and legitimacy of most national governments annually from 1995 onward. An increase in the SFI implies the country, overall, has become weaker.

Terrorism data, meanwhile, originated from the Global Terrorism Database (GTD), overseen by National Consortium for the Study of Terrorism and Responses to Terrorism (START) based at the University of Maryland. A general search was completed for terrorism events in each of the eleven sampled countries from 1985-2018 and compiled into a yearly-count fashion. Terrorism events not occurring within these states were excluded from the study.

The dependent variable, acts of maritime piracy, were gathered from the National Geospatial Intelligence Agency (NGIA). While the International Maritime Bureau was considered, the dataset primarily only accounts for piracy incidents targeting commercial vessels (Burnett, 2002; Stavridis & LeBron, 2010). The NGIA dataset is more comprehensive, containing attacks on personal yachts, commercial vessels, oil tankers, fishing boats, tug boats, and more (Twyman-Ghoshal & Pierce, 2014). This dataset provides greater inferences as to the understanding of this phenomenon and thus was utilized. In this study, yearly piracy incidents reported within the spatial sub-waters for each of the eleven countries were gathered from 1985-2018.

Research Design

A Time-Series Cross-Sectional (TSCS) Design, treating each country as a panel, will provide greater inferences on why the base rates of piracy attacks change year-to-year. TSCS designs have two benefits. First, the design feature allows the researcher to capture variance across time and space (Raffalovich & Chung, 2014; Sayrs, 1989). In this case, all variables within the eleven countries can be evaluated simultaneously over a t period of thirty-four years (Sayrs, 1989). This increases the sample size ($n=374$) and likely the coefficient of determination (Sayrs, 1989). Second, the design allows the model to contain missing observations as long as there are a few recorded for each variable (Worrall & Pratt, 2004). This is beneficial for this study given that there are gaps in the dataset, especially for Somalia.

Estimation Concerns

TSCS designs are prone to independence violations (i.e., heteroscedasticity, temporal autocorrelation, nonstationarity, and spatial autocorrelation). A series of tests to determine if these assumptions are violated were undertaken.

The first estimation concern, nonstationarity, infers that observations are integrated rather than independent. In time-series analysis, observations should regress back to a mean score

² To better infer a possible relationship between maritime piracy and the fishing sector, fresh water aquatic species were excluded from this study. Only oceanic marine species were collected.

(Marvell & Moody, 2008; Worrall & Pratt, 2004). Integrated data prohibits this data shift as observations are retrospectively driven (Marvell & Moody, 2008; Worrall & Pratt, 2004). This is an inherent problem as yearly pirating activity is a condition of retrospective occurrences (e.g., the number of Somalian pirating acts in 1999 influenced pirating incidents the following year). To assess nonstationarity, the Im-Pesaran-Shin Test was utilized. This test is recommended for those datasets containing missing observations (Birkel, 2014). The Im-Pesaran-Shin Test was statistically significant, concluding that stationarity violations are inherent. This confirms that acts of maritime piracy do not regress back to a mean score (i.e., acts of piracy are retrospectively driven). To mitigate this issue, the data was transformed to stabilize error variances (Kaufman, 2013; Worrall & Pratt, 2004).

A second estimation issue is temporal autocorrelation. In time-series analysis, observations may cluster, suggesting temporal autocorrelation. In this case, the base rates of piracy at T1 are a strong predictor of the observations at T2 (e.g., Nigerian piracy in 2006 was influenced by reported occurrences in 2005). The Drukker-Wooldridge Test is an appropriate test to assess temporal autocorrelation within panel studies (Worrall & Pratt, 2004). The findings from this test validates that temporal autocorrelation is problematic in this study as all independent variables, with the exception of GDP and fish export values, had temporal autocorrelation (see Table 1). To mitigate this threat, a lagged dependent variable will be applied (i.e., using the prior year's observation) (Pickup, 2015; Worrall & Pratt, 2004).

INSERT TABLE 1

A third estimation concern is panel heteroscedasticity. This study has eleven independent panels (each panel is represented as a country). Given that there might not be homogeneity of variance between all countries, it is possible that the model may predict piracy occurrences better for some countries than others. The Breusch-Pagan Test assessed panel heteroscedasticity and found that homogeneity of variance assumptions were violated. This suggests that the model does not predict piracy occurrences equally for all countries. To mitigate this methodological issue, the standard error was adjusted as suggested by Worrall and Pratt (2004).

The fourth estimation issue is spatial autocorrelation. This implies that pirating observations from one country may correlate with those from another country (Worrall & Pratt, 2004). Given that countries are geographically widespread with few spatial boundary overlaps, this estimation issue is absent in the current study. For example, piracy in Brazil has no direct effect on piracy occurrence in Vietnam. Tests for spatial autocorrelation were not conducted.

Data Analysis

The primary objective of this study is to determine which socioeconomic, demographic, and geopolitical factors affect the frequency of pirating activity. Based on prior published research, eight independent variables were selected to further understand why the base rates of maritime piracy attacks change year-to-year: GDP; GDP per-capita; male youth unemployment rates; total

fish catch tonnage; fish export value (thousands USD); total population (millions); state weakness and; acts of terrorism.³

Understanding that each of the eleven countries have a number of quantitative differences (e.g., over time the GDP of Somalia differs from that of Brazil), the researcher applied fix-effect variables to the model. In this study, it was necessary to fix the cross-sectional variation to isolate country disparities. Fixing the cross-sectional effect has three benefits. First, fixed-effect variables will absorb heteroskedastic differences in the model, promoting robust findings (Allison, 2009). Second, fixed-effect variables will control for any omitted variable biases (i.e., extreme values) and eliminate contaminated variation (Allison, 2009; Raffalovich & Chung, 2014). In this instance, it would ensure that the researcher is documenting the true effect that specific indicators have on the year-to-year fluctuations of piracy attacks (Allison, 2009). Third, fixed-effect variables will capture variations that are unique to the cross-sectional periods, vital to understanding why the annual rates of piracy change (Allison, 2009; Sayrs, 1989).

Using fixed-effect variables, the research adopts a least square dummy variable (LSDV) regression model. This regression model will control the cross-sectional variations between countries, elucidating the true effect that these independent variables have on incidental rates of maritime piracy.

Results

Using collected data from eleven countries, a least square dummy variable regression model was adopted. To control for estimation issues inherent in this study, the researcher: 1) applied a lagged dependent variable to address temporal autocorrelation; 2) adjusted the standard error to control for panel heteroscedasticity; and 3) transformed the data to address nonstationarity. An absorb feature was also incorporated to control for cross-sectional variations.

The results (see Table 2) concludes statistical significance. At least one variable predicts the frequency of maritime piracy occurrences. The coefficient of determination (r) was 0.5073, suggesting that fifty percent of piracy attacks were explained using these eight variables. Of these variables, four were statistically significant: 1) state weakness; 2) total population; 3) GDP; and 4) total fish catch tonnage. GDP had a negative linear relationship (coefficient = -0.0289). Total fish catch tonnage, total population, and state weakness, meanwhile, were positively related to piracy (coefficient = 0.000023, 1.034, and 4.328 respectively).

³ International trade data could not be assessed as Somalia had no available data. Additionally, the researcher did not utilize geographic variables in this study. Geographic variables are constant and the goal of this research is not to determine causality but temporal variation. Finally, while situational crime prevention, Best Business Practices, and private military security companies play a role in deterring global piracy incidents, measuring this effect was not feasible for all sampled countries during the surveyed period, and thus, could not be tested.

INSERT TABLE 2

Discussion

The research findings provide an understanding of why the annual rates of piracy fluctuate. Four factors explain the frequency of this phenomenon: 1) increases in state weakness; 2) decreases in GDP; 3) increases in total population; and 4) increases in total fish catch tonnage.

It was first discovered that increases in state weakness was positively associated with global maritime piracy attacks. A one unit increase in state weakness corresponded with 4.328 ($p < 0.05$) more pirating events across all countries from 1985-2018. Weak or corrupt states, historically, are prone to illicit activities such as human trafficking (Studnicka, 2010), drug cartel operations (Brown, 2012; Wainwright, 2016; Yeh, 2012), terrorism (Howard, 2010; Piazza, 2007; 2008), and piracy (Murphy, 2009; Daxecker & Prins, 2012; 2013). The absence of a strong government allows for illicit industries to prevail (Daxecker & Prins, 2012; 2013; Howard, 2010; Piazza, 2007; 2008; Studnicka, 2010; Wainwright, 2016). Murphy (2009) claims that states with weakening institutions, in particular, are susceptible to piracy activity. The lack of strong institutions creates a conducive environment for pirates to operate with low risk of apprehension.

Somalia, as an example, lacks a proper coast guard to enforce fishing regulations and protect commercial maritime transits (Bahadur, 2011). The absence of this comprehensive law enforcement presence provides opportunities for maritime theft. This finding was quantitatively supported by Daxecker and Prins (2012; 2013) who concluded that increases in state weakness causes piracy. This study aligns with those findings, concluding that as countries become weaker, pirating events also increase.

Strengthening state institutions will have the adverse effect on piracy. Adding coast guard and naval forces within pirate-prone waters is one recommendation to deter piracy. Research has shown that naval patrols have had a positive effect on reducing piracy incidents around the Horn of Africa (McKnight & Hirsh, 2012; Sugiki, 2012). A second recommendation is judicial reform. Reports from the European Union Naval Task Force (EUNAVFOR), have found that ninety percent of all Somalian pirates have been released upon capture (Massarella, 2011). Somalia's weak institutions fail to eliminate piracy as these criminals are not being prosecuted. Somalia lacks trained judges to preside over these cases as well as prisons to incarcerate suspected pirates (Bahadur, 2011; Boyle, 2015; Massarella, 2011). In recent years, Somalia has addressed some of these shortcomings, including the construction of additional correctional facilities and cooperating with neighboring states (e.g., Kenya, Mauritius, and the Seychelles) who are prosecuting individuals accused of pirating offenses (Bahadur, 2011; Boyle, 2015; Gilmer, 2014; Sterio, 2012).

A second finding associated with the frequency of piracy occurrences was total population. Countries witnessing unsustainable population increases (i.e., population strains) are ill-equipped to provide sufficient services to their constituents. These constituents opt to engage in criminal activity (i.e., theft and burglary) to secure resources that the state cannot provide. The pirates of Somalia, Bangladesh, the Philippines, and Vietnam fit into this category as these impoverished states lack sufficient social services, jobs, and economic resources. This explains, in this model, why increases in state weakness was also associated with incidents of maritime piracy.

Prior empirical studies have reported a positive correlation between demographic pressures (i.e., increases in total population) and acts of maritime piracy (Daxecker & Prins, 2012; 2013; Jablonski & Oliver, 2012). The hypothesis that increases in total population corresponds with increases in year-to-year piracy attacks is confirmed. A population increase of one million leads to 1.034 ($p < 0.05$) more piracy attacks within sampled countries from 1985-2018.

Fortunately, the impact that demographics play on piracy should diminish in the coming years. In the future, developing countries, including those sampled, are expected to see a decline in their birth rate. As countries economically develop, birth rates decline. A decrease in the birth rate means there will be fewer youths. With fewer youths, research suggests that crime rates will diminish (Carrington, 2001; Rosenfeld, 2011).

A third variable associated with the fluctuation of global maritime piracy attacks was decreases in Gross Domestic Product (GDP). The relationship between GDP and criminality has been explored. Andresen (2015), for example, reports that decreases in GDP correspond with increases in select criminal activities within Canada from 1981-2009. Under-employed or unemployed individuals, in this instance, were motivated to theft for financial gain (Andresen, 2015).

Detotto and Otranto (2010) explored another element of the economy. Their study identified that increases of criminal activity in Italy (1979-2002) are negatively associated with economic growth. A one percent increase in reported crime decreases monthly GDP by 0.0004 percent. Enders and Sanders (1996) echoed similar findings, reporting that terrorism incidents negatively affects the amount of financial investment and tourism. As investment declines resulting from terrorism, a country's GDP diminishes (Enders & Sanders, 1996).

Prior research has found that downturns in the economy cause piracy (Burnett, 2002; Samatar, Lindberg, & Mahayni, 2010; Young, 2007). The 1997 Financial Crisis and the 2004 Tsunami are two events contributing to decreases in GDP and increases in the number of piracy attacks within select countries (Burnett, 2002; Samatar et al., 2010; Young, 2007). These events also weakened the institutional strength of domestic governments, explaining why increases in state weakness corresponded with more piracy.

A reduction in GDP may also be linked to an overall decline in regional maritime trade. In Somalia, some shipping companies elected to bypass the Horn of Africa for fear of being hijacked (Rengelink, 2012; Warner, 2010). Reduced regional trade negatively affects the GDP for coastal communities, such as Somalia. Again, desperate coastal residents see piracy as a means of offsetting these economic losses (Weir, 2009).

Assessing GDP and its relationship to piracy, Jablonski and Oliver (2012) quantitatively supported that decreases in GDP is positively associated with acts of maritime piracy. This finding was replicated in this study. A one million dollar decrease in GDP increases piracy attacks by 0.0289 ($p < 0.05$) within sampled countries from 1985-2018.

To mitigate this issue, countries should continue to invest in and improve their economies. Increased regional trade, foreign direct investment, and job creation are viable options that promote economic growth and can offset piracy attacks. As an example, the Somali sub-region of Puntland is establishing an oil petroleum sector (Palmer, 2014). This will provide legitimate jobs, increase Somalia's poor GDP, and reduce piracy attacks.

A fourth factor associated with the intensity of maritime piracy is increases in total fish catch tonnage. The model concluded that a one ton increase in the annual fish catch increases piracy across all countries by 0.0000227 incidents ($p < 0.05$). Prior research identified that declines in the fishing industry are association with more piracy (e.g., Bahadur, 2011; Baird, 2012; Daxecker & Prins, 2012; Sekulich, 2009; Weir, 2009). Daxecker and Prins (2012), for instance, illustrated that a decreased value of total domestic annual fish catch (USD) had a moderate to strong effect on global maritime piracy. This study provides new evidence regarding this, showing a positive effect between fish catch tonnage and piracy. Two theories support this claim. First, the harvesting of fish garners more opportunities for pirates. In Bangladesh, Malaysia, Ecuador, and Somalia, fishing vessels, including those belonging to local fishermen, have been targeted by regional pirates (Murphy, 2009; Schneider & Winkler, 2013; Sekulich, 2009). An increase in the number of fishing vessels increases the total fish catch, but consequently, increases the possibility of a hijack.

Second, increases in total fish catch initiates overfishing, a problem reported within several of the sampled countries (Bahadur, 2011; Boyle, 2015; Burnett, 2002; Murphy, 2009; Weir, 2009). Long term, overfishing exacerbates this industry, intensifying economic decline (i.e., decreases in GDP). Desperate coastal residents affected by overfishing see piracy as a means to offset these economic losses (Bahadur, 2011). This explains why GDP was significant in this model. Additionally, as GDP declines the strength of governmental institutions also decline, supporting again why increases in state weakness was associated with more piracy. Building on that, elevated quantities of fish catch may occur because some states are politically weak and lack a proper maritime police force or coast guard to enforce fishing regulations. This too supports why increases in state weakness was also significant in this model. Finally, overfishing places strain on available sources of food (e.g., fish). All sampled countries longitudinally reported increases in their overall population. Again, desperate coastal residents engage in piracy and seek fishing vessels to fulfill their dietary needs. This conveys an understanding of why increases in total population was also significant in this model.

To reduce piracy and strengthen the fishing sector, countries should impose more fishing restrictions and regulations. In 2001, 110 countries endorsed the *International Plan of Action to Prevent, Deter, and Eliminate IUU Fishing* (IPOA-IUU). This initiative was drafted by the United Nations Food and Agriculture Organization (Liddick, 2014). IPOA-IUU formulated more fishing preserves and enacted trade restrictions on certain fish while also creating greater transparency with fish licensing and more stringent regulations on fish trade (Liddick, 2014). An agreement such as this promotes a more sustainable outlook for the fishing sector and a means to reduce maritime piracy.

Somalia has taken a more extensive approach to regulate the fishing sector and mitigate piracy. The Somaliland Fishing Association (SOMFISH) is a multi-facet organization providing oversight on the local fishing industry (Gilmer, 2014). This agency provides job training skills for those who are interested in fishing as a prospective career (Gilmer, 2014). This training program can sway individuals from engaging in piracy. Additionally, SOMFISH provides identification cards for local fishermen (Gilmer, 2014). These identification cards, written in English, confirm that these fishermen are not pirates. With more oversight of the fishing sector, pirates can return to their previous maritime profession, help stabilize the economy, and increase the region's GDP. Such programs are also a means of strengthening local institutions, also a necessary means of combatting piracy.

Conclusion

Using a Time-Series Cross-Sectional Design with least square dummy variable regression techniques, this research identified a four-factor model describing why the base rates of piracy fluctuate year-to-year within eleven countries: 1) increases in state weakness; 2) increases in total population; 3) decreases in GDP; and 4) increases in fish catch tonnage. These findings contribute to the academic body of literature by pinpointing specific factors associated with this recurring threat as well as proposing strategies to isolate future attacks. The application of this model delivers an understanding as to why piracy activity fluctuates year to year throughout the world. Thus, these findings provide policymakers with a better-honed tool to use in calculating policy shifts that could reduce the frequency of these attacks.

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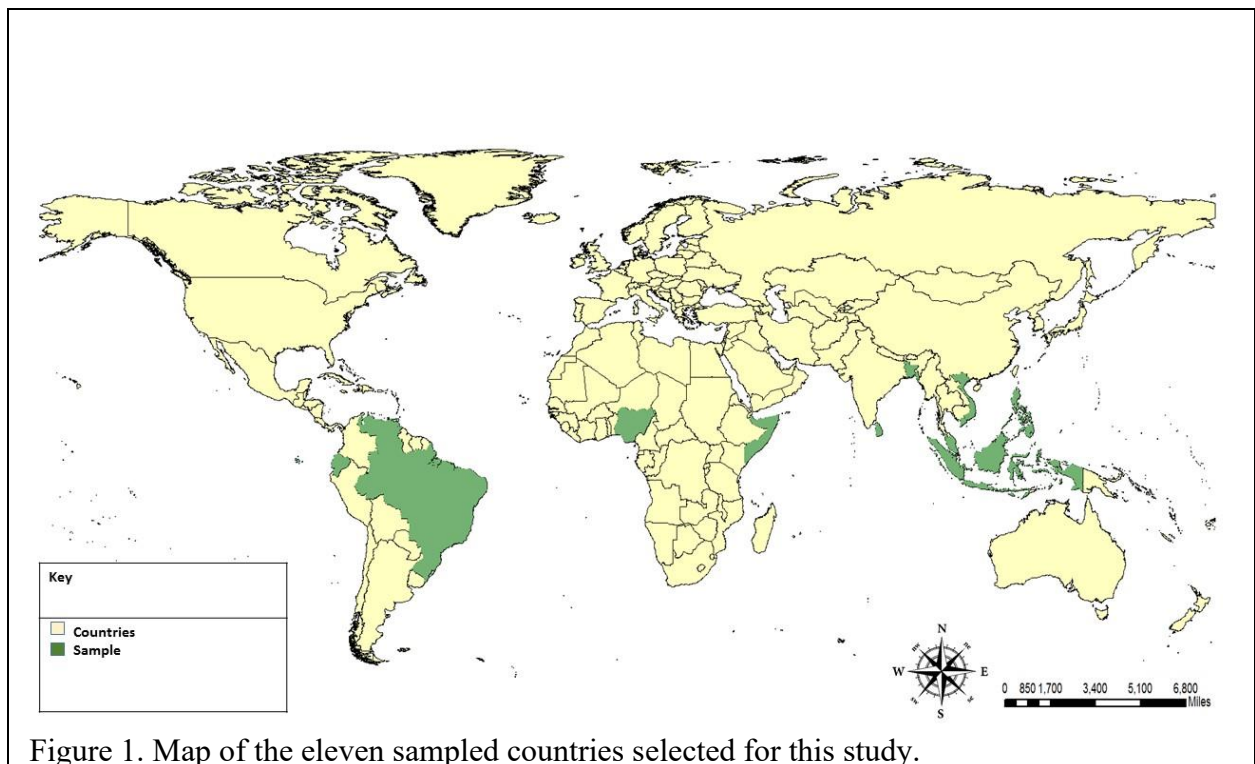
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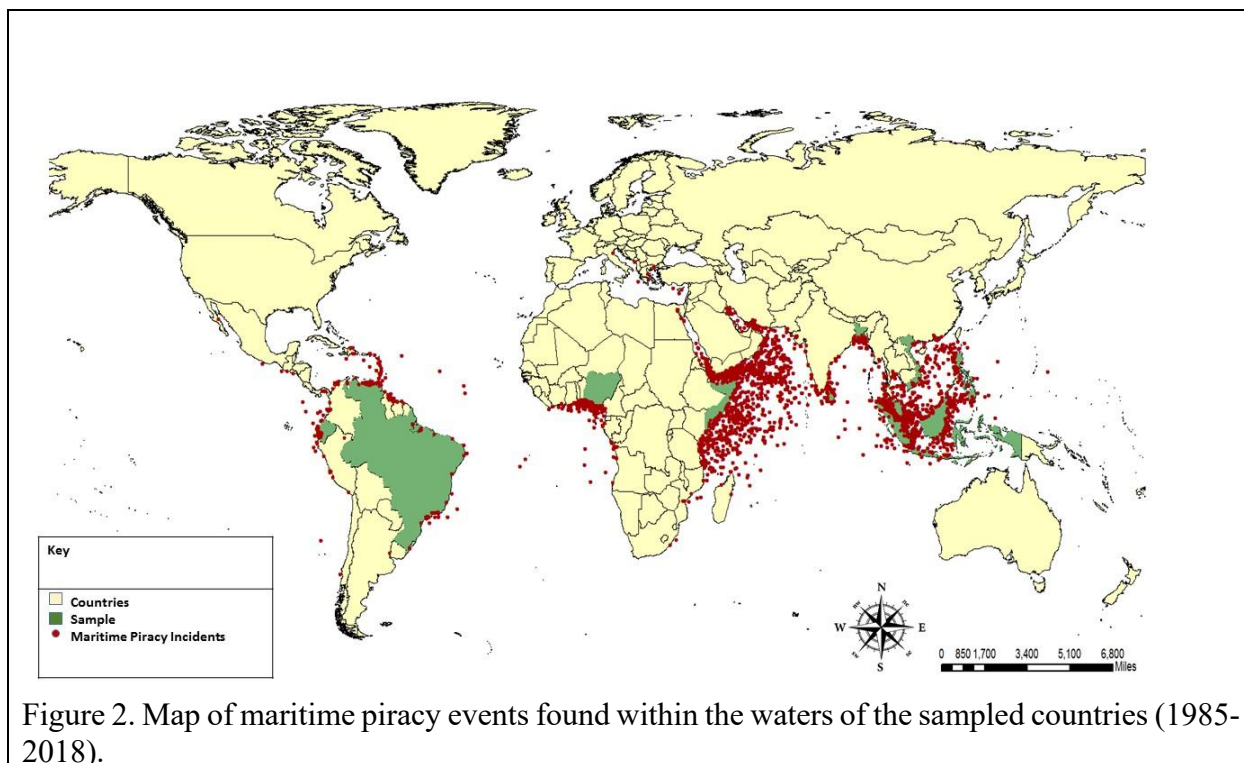


Figure 2. Map of maritime piracy events found within the waters of the sampled countries (1985-2018).

Table 1
Drukker-Wooldridge Test Using Panel Linear Regression

Variable	P-Value
GDP	0.167
GDP per-capita	0.002
Male youth unemployment rate	0.000
Fish catch tonnage	0.000
Fish export value	0.119
Total population	0.000
State weakness	0.000
Acts of terrorism	0.040

Table 2
Least Square Dummy Variable Regression Model Summary with Countries Absorbed into the Model, a Lagged Dependent Variable, a Data Transformation, and an Adjusted Standard Error.

Variable	Coefficient
Constant	-148.9929**
GDP	-0.028869*
GDP per-capita	0.0012872
Male youth unemployment rate	0.669852
Fish catch tonnage	0.0000227*
Fish export value	-0.0000685
Total population	1.033713*
State weakness	4.327894*
Acts of terrorism	0.0401522

Notes: The model was statistically significant (sig= 0.00) and the coefficient of determination (r) was 0.5073

*= p < 0.05; **= p < 0.01.