Journal of Conflict Resolution
http://jcr.sagepub.com/

Insurgents of the Sea: Institutional and Economic Opportunities for Maritime Piracy

Ursula Daxecker and Brandon Prins

Journal of Conflict Resolution published online 16 August 2012
DOI: 10.1177/0022002712453709

The online version of this article can be found at:
http://jcr.sagepub.com/content/early/2012/08/14/0022002712453709

Published by:
SAGE
http://www.sagepublications.com

On behalf of:
Peace Science Society (International)

Journal of Conflict Resolution
00(0) 1-26

DOI: 10.1177/0022002712453709
http://jcr.sagepub.com

Insurgents of the Sea: Institutional and Economic Opportunities for Maritime Piracy

Ursula Daxecker[1] and Brandon Prins[2]

Abstract

While piracy may evoke romanticized visions of swashbuckling, rum swigging, and skirt chasing pirates hoisting the Jolly Roger, maritime piracy has changed substantially by taking advantage of modernization and substantial upgrading of the weapons, vessels, and weapons it employs. In addition, as documented by the International Maritime Bureau (IMB), the frequency of pirate attacks has increased significantly, with more than 2,600 piracy incidents occurring since 2004. The authors argue that piracy is a result of permissive institutional environments and the lack of legal forms of employment in states' fishing sectors. The authors investigate these arguments empirically using data for all countries with coastlines in the 1995–2007 period. The empirical analyses show that state weakness and reductions in fisheries production values affect piracy as expected. These findings suggest that international efforts in combating piracy should center on improving the institutional environments and labor opportunities driving maritime piracy.

Keywords

maritime piracy, state weakness, state failure, fisheries

[1]Department of Political Science, Colorado State University, Fort Collins, CO, USA
[2]Department of Political Science, University of Tennessee, Knoxville, TN, USA

Corresponding Author:
Ursula Daxecker, Department of Political Science, Campus Delivery 1782, Colorado State University, Fort Collins, CO 80523, USA
Email: ursula.daxecker@colostate.edu

In 2011, pirates launched 439 attacks against shipping vessels worldwide. This represents an 84 percent increase in piracy from 2006 and over a 300 percent increase from 1991. Of these incidents, there were 105 attempted attacks, 289 actual attacks, and 45 hijackings, and over 800 crew members were taken as hostages (International Maritime Bureau [IMB]). While certain incidents have generated considerable media attention, such as the rescue of Maersk Alabama captain Richard Phillips by US Navy SEALs in April of 2009, maritime piracy remains both underexposed and underexplored. Indeed, a JSTOR search of political science periodicals from 1946 to 2011 for titles of articles brings up 339 using the term ''terrorism'' but only 25 using ''piracy.''[1] This limited research has meant not only that many conjectures have been proposed to explain recent incidents of piracy but also that few of these conjectures have been subjected to empirical evaluation.

Most explanations for piracy involve the interaction of greed and state failure. That is, large increases in goods carried by the world's merchant ships have proved to be lucrative targets for maritime brigands who now have access to high-speed boats and powerful but lightweight weapons. When such greed is coupled with a lack of control of territorial waters, piracy supposedly flourishes. Countries such as Somalia, Indonesia, and Sri Lanka are frequently cited as empirical confirmation of such relationships. Despite significant numbers of pirate attacks off the coasts of these three countries, nearly 60 percent of nonlandlocked states have experienced incidents of piracy in their territorial waters. The problem is considerably more widespread than just the Straits of Malacca, the South China Sea, or the Gulf of Aden.

Unlike terrorism, the public policy response to piracy has been limited. The United States and other countries have sent additional warships to the waters off Somalia and President Obama has publically pledged to ''halt the rise of piracy,'' but as Chalk (2009) notes, such limited actions have largely been ineffectual. While the UN Security Council did admittedly adopt Resolution 1851, which legalizes the pursuit of pirates onto Somali territory, the authority applies only to cooperating states, extends merely for twelve months, and appears dependent on authorization from the Transitional Government of Somalia. Extant research on piracy remains both limited and largely anecdotal in character. Frequently, only the most serious incidents receive attention and scrutiny and as such they present problems for generalization. Other accounts of piracy tend to be solely descriptive in orientation and while temporal trends may be noted, attempts to link piracy to other processes are ignored (e.g., Bradford 2008). With the exception of research in progress by de Groot, Rablen, and Shortland (2011), the few analytical studies that exist limit their analyses to cases that experienced piracy. By selecting cases on the dependent variable, scholars potentially introduce bias into their models. A database only featuring information on pirate incidents cannot offer an accurate assessment of the basic incidence rate across countries and years.[2]

This article makes two contributions to the literature on maritime piracy. First, we propose a general explanation of maritime piracy that emphasizes the importance of institutional and economic opportunities. The presence of a permissive institutional environment is crucial as it provides pirates with safe havens to plan attacks and protect themselves from capture. In weak or failed states, governments lack effective control over their territory on land and sea, which creates conditions conducive for piracy. While recent research by de Groot, Rablen, and Shortland (2011) and Hastings (2009) posits an inverted U-shaped relationship between state fragility and piracy, we find that improvements in governance overwhelmingly reduce the risk of piracy for nearly all countries, especially for countries experiencing the most serious form of piracy namely hijackings. We also hypothesize that cost–benefit calculations affect individuals' decisions to engage in piracy. In particular, we expect that changes in labor opportunities in economic sectors most vital for potential pirate recruits, such as the fishing industry, are correlated with piracy. We find that reduced employment opportunities in states' fishing industries increase piracy as expected, and while this finding confirms other research investigating the effect of economic opportunities and piracy, our analysis captures the incentives of individuals most amenable to engage in piracy (Jablonski and Oliver 2010). Second, we attempt to resolve some of the research design weaknesses in earlier work on the incidence of piracy. Not only do we reduce the risk of selection bias by including all states with coastlines, but we also extend the temporal domain by examining cases from 1995 to 2007. Our exploration involves all piracy incidents (which include attempts and actual attacks), actual piracy attacks, and the more specific, but perhaps less undercounted, subset of hijackings per country-year. With this design, we can better assess whether state weakness and changes in fisheries production values are associated with the incidence of piracy as hypothesized.

We proceed as follows. First, we develop our theoretical explanations on the institutional and economic opportunities for piracy. Next we introduce our data and present descriptive statistics on spatial and temporal trends. We then evaluate the incidence of piracy at the nation-state level of analysis. We find that state weakness and economic motivations influence piracy as expected. Additional robustness tests corroborate these findings. We conclude by discussing the implications of our findings and offer suggestions for moving research on piracy forward.

Opportunities for Maritime Piracy

Research on maritime piracy is mostly limited to case studies of individual piracy events and analyses of countries or regions with particularly pressing piracy problems (such as Somalia or Southeast Asia). Systematic analyses of piracy are rare and present mostly descriptive statistics (Ong-Webb 2007; Murphy 2009). An exception to this is work by Hastings (2009), Iyigun and Ratisukpinol (2010), Jablonski and Oliver (2012), and de Groot, Rablen, and Shortland (2011) who use econometric methods to analyze piracy incidents. Yet, with the exception of de Groot, Rablen,

and Shortland (2011), these studies exclude countries that did not experience piracy in their models, thus raising concerns of selection bias. Indeed, the very selection of cases based on piracy incidents is nonrandom (i.e., the countries with piracy are a nonrandom subset of all countries) and thus any analyses might reflect that systematic selection bias (Lemke and Reed 2001). Our goal in this article is to explain the number of pirate events in countries' territorial waters in a given year, and excluding countries that did not experience piracy would mean truncating the dependent variable to less variation than exists in the real world. Models of piracy that allow for some variation in the number of piracy incidents yet systematically exclude nonevents may produce some insight into what affects changes in the number of events, but such inferences are likely biased (King, Keohane, and Verba 1994, 130). Our sample thus includes all countries with coastlines, which we believe represents a set of cases that could potentially experience piracy. This research design is similar to the empirical analyses of international conflict and political violence in which researchers routinely include nonevents in their samples to avoid selection bias (King 1989).

Nevertheless, existing research on piracy is helpful in that it allows us to develop a set of conjectures on the determinants of piracy. We center our theoretical argument on the institutional and economic opportunities for piracy. As outlined in more detail in the following, institutional opportunities create conditions conducive for piracy in that they allow for the planning and implementation of attacks and reduce the risk of capture. The absence of legal forms of employment creates economic opportunities for piracy, particularly when economic conditions threaten the livelihood of individuals most amenable for piracy, such as those employed in states' fishing industries.

Institutional Opportunities for Piracy

Piracy, while implemented at sea, begins and ends on land. Access to a state is essential because pirates need sanctuaries on land to plan attacks, protect themselves from capture, and conduct ransom operations. In addition, piracy groups need access to markets to dispose of their loot. The importance of a permissive political and legal environment is stressed in much of the literature on piracy (Ong-Webb 2007; Murphy 2008, 2009; Hastings 2009). We expect that states with permissive institutional environments, such as weak or failed states, are more likely to experience piracy. State weakness creates an enabling environment in which piracy can flourish. Weak states are states in which corruption, crime, and other social problems are rampant. While weak states can provide basic services such as transportation infrastructures and commodity markets, they struggle to adequately maintain them (Hastings 2009, 214). In failed states, the government exerts little control over its territory and fails to provide public goods to its citizens. Pirates must have access to shores and anchorages to load and unload their cargo and conduct ransom negotiations. Consequently, piracy flourishes in areas with poorly guarded ports and underpaid security

personnel, and such individuals are likely to conspire with pirates for compensation. Weak and failed states thus provide pirate operations with access to sanctuaries and markets necessary to operate. Without access to bases and markets on land, pirates face difficulty in protecting themselves from capture and disposing of their loot. In fact, research argues that piracy is a land-based activity that is implemented at sea (Murphy 2008, 2009).

State weakness also reduces the capacity of states to combat piracy. Murphy (2009), for example, argues that lax antipiracy measures almost always stem from state weakness. Presumably, such states are either unable to fund maritime security measures or think that their resources should be spent on other priorities. Lacking well-trained and equipped police and military forces, weak and failed states cannot protect their waters. Moreover, the international focus on terrorism in recent decades may have exacerbated this situation, as it has forced many states to devote extensive resources into homeland security initiatives (Chalk 2009). The majority of piracy events occur in states' territorial waters, and success in combating piracy thus depends primarily on the capacity and goodwill of individual states (Murphy 2009). Empirical evidence from individual cases such as Somalia or regions such as Southeast Asia largely supports these arguments (Ong-Webb 2007; Lehr and Lehmann 2007; Kraska and Wilson 2009).

Finally, weak institutional environments can create more direct opportunities for piracy by threatening the livelihoods of coastal fishing communities (Bawumia and Sumaila 2010). Weak states' inability to protect their territorial waters can result in illegal, unreported, and unregulated (IUU) fishing, which could result in the redeployment of fishers into illegal activities such as piracy. After the collapse of government institutions in Somalia in the early 1990s, for example, commercial foreign fishing vessels began working off the Somali shoreline, frequently invading its territorial waters and exclusive economic zone, and thus displacing local fishers (Lehr and Lehmann 2007). While such infringement by third parties may increase fish catch for these foreign actors, IUU fishing reduces the fish stock available for local communities and also threatens the long-term health of fisheries through overexploitation.

We thus expect that greater state weakness increases the risk of piracy mostly linearly. This expectation differs from research by Hastings (2009) and de Groot, Rablen, and Shortland (2011), which anticipates a curvilinear or "hump"-shaped relationship. Hastings (2009), for example, suggests that complete state failure could actually undermine the ability of organized groups to carry out pirate operations and collapsed or failed states may therefore be incapable of maintaining the transportation infrastructure necessary for moving piracy loot and may lack markets necessary to find buyers. While Hastings (2009) does not directly evaluate whether the relationship between state weakness and piracy is nonlinear, de Groot, Rablen, and Shortland (2011) find support for a curvilinear relationship between state weakness and piracy and conclude that weakly governed states are most at risk for piracy, but that piracy rarely occurs in failed and well-governed states.[3] We disagree with

Hastings (2009) and de Groot, Rablen, and Shortland (2011) and insist that both state weakness and state collapse should be positively correlated with piracy incidents.

Hypothesis 1: Weak and failed states are more likely to experience piracy incidents in their territorial waters.

Economic Opportunities for Piracy

In addition to state weakness and state failure, economic opportunities are helpful in explaining individuals' willingness to engage in piracy. A lack of economic opportunities is frequently cited as the prime driver of modern-day piracy (Ong-Webb 2007; Murphy 2009; Iyigun and Ratisukpinol 2010; Jablonski and Oliver 2012). Similar to opportunity-cost explanations of insurgency and civil war, this argument expects that the absence of legal or gainful labor employment drives individuals to pursue extralegal appropriation such as piracy (Hirshleifer 1995; Collier and Hoeffler 2004).[4]

Implicit in these arguments is that the gains from piracy outweigh the benefits gained from other forms of economic activity and the risks involved in committing piracy events. In line with this argument, we expect that the absence of legal opportunities is related to individuals' decisions to engage in piracy. Research suggests that economic factors play an important role in piracy recruitment. Based on interviews with pirates in the Straits of Malacca, Frécon (2005, 25) argues that pirates "are recruited among these numerous fishermen, unemployed sailors and taxi-boat captains." Burnett (2002) and Murphy (2009) also emphasize that piracy recruitment occurs frequently among unemployed fishermen. In addition, research on Somalia emphasizes that the depletion of fish stock by Somali and foreign fishing boats after the collapse of the Barré regime in 1991 was a key factor driving the adoption of piracy by Somali fishermen (Weir 2009).

Anecdotal reports on piracy gains support the notion that the payoff from piracy influences individuals' decisions to engage in piracy. Reports often focus on episodes with spectacular gains, such as the $10 million ransom for a South Korean tanker hijacked off the Somali coast in 2010 (Gettleman 2010). However, paying attention to such episodes is potentially misleading as it suggests that piracy would always be preferable to legal forms of employment and also neglects the significant risks involved in criminal activity. While it is difficult to get precise data on piracy takings, two studies present more conservative estimates. Based on original reports faxed from pirated ships, Vagg (1995) analyzes cash takings in 154 pirate attacks occurring in Indonesian waters between 1991 and 1992. He finds that majority of attacks produced a gain between $100 and $5,000, which even if split among several individuals, suggests a substantial return given that Indonesia's gross domestic product (GDP) per capita was around $2,500 at the time. In a more recent study, Valencia and Johnson (2005) estimate the average takings between $5,000 and $15,000 per attack.

Two studies present more systematic evidence for the importance of economic considerations. Iyigun and Ratisukpinol (2010) show that GDP per capita helps explain fluctuations in different types of piracy attacks. Jablonski and Oliver (2012) evaluate the effect of price changes on piracy and show that increases in the price of labor-intensive goods such as sugar and rice result in increases in the number of piracy attacks. However, while we do not dispute that fluctuations in macroeconomic conditions or prices for particular goods influence the frequency of piracy attacks, economic opportunities more specifically linked to piracy are left out in such studies. We expect that individuals employed in fishing sectors should be most amenable to engage in piracy because they have the skill set and equipment necessary for piracy. As Murphy (2009, 370) points out, piracy requires experience in navigation, coastal piloting, and ship handling, and successful piracy operations depend on knowledge of local sea conditions and shipping patterns. Consequently, fluctuations in states' fishing sectors should be most relevant for individuals' decisions to engage in piracy attacks. Reduced economic opportunities in states' fishing sectors should be correlated with increases in piracy events since they affect the individuals with the most relevant skill sets for piracy. Decreases in fish catch could thus lead to the redeployment of fishers into criminal activities such as piracy (Hendrix and Glaser 2011). Whether reduced labor opportunities in fishing are the result of IUU fishing or other causes, such changes should increase motivations to engage in piracy. In line with the preceding discussion, we expect that states with fewer economic opportunities are more likely to experience piracy.[5]

Hypothesis 2: States with fewer economic opportunities for individuals employed in the fishing industry are more likely to experience piracy incidents in their territorial waters.

Research Design

We use data on piracy incidents collected by the IMB in our empirical analyses. The IMB is a division of the International Chamber of Commerce and frequently considered the most reliable data source on piracy (Ong-Webb 2007). The IMB defines piracy as "an act of boarding or attempting to board any ship with the intent to commit theft or any other crime with the intent or capability to use force in the furtherance of the act."[6] This definition thus includes actual and attempted attacks against ships whether they are anchored, berthed, or steaming in territorial or international waters. Since 1990, the IMB has documented over 5,000 piracy incidents.

Critics have pointed out that the inclusion of attacks against ships in ports (and territorial waters more generally) could inflate the number of incidents recorded by the IMB. Yet, it is also widely suspected that underreporting of piracy incidents underestimates the occurrence of piracy because data collection is dependent on self-reporting (Ong-Webb 2007, 39-40; Chalk 2009; Murphy 2009, 67-69).[7] However, even if underreporting reduces the total number of incidents included in the IMB

data, it does not inevitably mean the ratio of pirate attacks across regions, countries, or years will be biased.[8] Causal models therefore will not necessarily produce inaccurate coefficient estimates. However, to avoid drawing unwarranted conclusions from suspect data, we distinguish among piracy incidents (which include attempted and actual attacks), actual attacks, and hijackings. In particular, hijackings, given their seriousness, do not suffer from the same underreporting that plagues more minor incidents (Hastings 2009).[9] We use all three data series in our empirical analyses below to ensure confidence in our results.

We begin by building a data set, which defines the state-year as the unit of analysis.[10] We have a total of 3,787 cases. In theory, the cases are based on 197 countries over the 1991–2010 period. However, the analyses include only countries with contiguity to ocean waters, which reduces our number of states by 43 and leaves 2,956 observations in the data.[11] In addition, data limitations on some of the independent variables reduce the period under analysis to 1995–2007. Finally, we include only piracy incidents that occurred in states' territorial waters. As mentioned earlier, this seems reasonable since the majority of piracy events happen in territorial waters.[12]

Independent Variables

The first hypothesis involves the relationship between state fragility and piracy. Permissive institutional environments have been the focus of most of the descriptive accounts of piracy. Data for state fragility come from the Center for Systemic Peace and are available from 1995 onward.[13] The fragility data score countries on both the effectiveness and legitimacy of economic, security, political, and social conditions in the state and combine these scores into an index. The index ranges from 0 to 25 with higher scores indicating greater state weakness. Both Afghanistan and Somalia receive scores of 25; Somalia in 2008 and Afghanistan in 1995. Most Organisation for Economic Co=operation and Development (OECD) countries score 0 or close to 0, such as Japan, the United States, Austria, Belgium, and the Netherlands. We lag the fragility measure by one year.

The second hypothesis focuses on economic opportunities for piracy. To evaluate whether decreases in states' fishing industries create economic opportunities for piracy, we include data on fisheries production values (in US dollars) collected by the Food and Agriculture Organization (FAO) Fisheries and Aquaculture Statistics.[14] These data are based on officially reported values of fisheries production from FAO member countries.[15] We include data on fish, crustaceans, and mollusks. The mean yearly value is US$771,378,000 but the standard deviation is US$2,036,015,000, suggesting significant unit heterogeneity. To deal with potential bias from such heterogeneity, we follow Hendrix and Glaser (2011) and calculate the first difference of log(fish commodity value). The variable has a mean of 0.01 and a standard deviation of 0.56 and represents the change in fisheries commodity values from one year to the next.

Control Variables

Several other conjectures discussed in the literature could increase piracy. We model these relationships in the statistical models presented below to offer a more complete picture of the correlates of piracy. We include control variables for geographic location, trade volume, the incidence of terrorism, civil conflict, material power, regime type, and population size.

The need for favorable geography is frequently emphasized in the piracy literature (Ong-Webb 2007; Hastings 2009; Murphy 2009). In particular, states with long coastlines, archipelagic makeup, numerous islands, or located in proximity to strategic shipping lanes offer opportunities for piracy (Ong-Webb 2007, 46). Emphasis on favorable geography also suggests that piracy, while a global phenomenon, tends to be regionally concentrated, particularly in areas close to major shipping lanes such as East Africa and Southeast Asia. Regional dummies are included to test broad geographic trends, and coastline length in kilometers is incorporated to control for variation across countries in the size of territorial waters. Regional classifications come from the Correlates of War project and the *CIA World Factbook* provides data on coastline length.[16]

The literature also argues that large increases in the volume of international trade have contributed to the rise of piracy (Lehr 2007). Considering that between 80 percent and 90 percent of international trade is transported on ships, increases in international trade and maritime traffic create important opportunities for gains from piracy (Bateman 2007). We thus expect that increases in regional trade volumes are important in creating opportunities for piracy.[17] Measures of regional trade come from the World Trade Organization and indicate the value of a region's imports and exports in millions of current US dollars.

Since 9/11, concerns over maritime terrorism have heightened. While existing work on the piracy–terrorism nexus investigates the likelihood of terrorist groups attacking at sea rather than proposing causal relationships between piracy and terrorism, it suggests two possible consequences of terrorism on piracy events. Since the root causes of both phenomena are similar, one may expect that increases in terrorism contribute to increases in piracy and vice versa. Yet, as Bradford (2008) points out, it is also possible that the relationship is more complicated. Since resources are scarce and terrorism is largely seen as the more imminent threat, states may spend more money on combating terrorism, which could subsequently reduce the resources available to counter piracy. In turn, reductions of terrorist events as a result of successful counterterrorism policies could actually lead to increases in piracy attacks. Information on terrorist attacks comes from the RAND Database of Worldwide Terrorism Incidents. We use the RAND measure of total terrorist attacks, which sums domestic and international terrorism.

We also control for internal armed conflict. Civil conflict may exert a positive effect on piracy through the reallocation of resources from counterpiracy efforts to counterinsurgency. We use data on civil conflict from the Uppsala Conflict

Database Program to create a dummy variable coded 1 for years in which countries experience conflict, 0 otherwise (Gleditsch et al. 2002).[18]

Finally, we control for military capabilities, regime type, and population size. States with greater military capacity should be better equipped to fight maritime piracy. Indeed, military manpower remains a critical tool for preventing challenges to state authority, such as those coming from rebel groups and pirates. Further, we expect potential pirates to consider both the economic conditions they confront and the risk of capture and punishment, when contemplating a turn to piracy. Military might, when compared to state fragility, better captures government ability to tackle such problems. We also expect democratic states to experience fewer pirate incidents. Democratic leaders should be more concerned with public goods provision than their authoritarian counterparts and thus have greater incentives to combat criminal activities. Population size may be linked to piracy by providing pirate groups with a larger pool of potential recruits. Control measures of material power, regime type, and population size come from the Correlates of War data set on national capabilities (CINC), Polity IV data, and the Penn World Tables, respectively.[19]

We model piracy incidents using a general estimating equation (GEE) with a negative binomial specification and an AR(1) error structure.[20] We choose a negative binomial specification because the variances of the dependent variables (piracy incidents, attacks, and hijackings) are larger than their means, meaning that event counts are overdispersed. The negative binomial model includes an additional parameter to model overdispersion in the dependent variables. GEE models use a population-averaged approach to correct for correlation in time-series cross-sectional data, meaning that coefficients show whether covariates influence piracy on average.[21] The data include only littoral states and the dependent variable codes the number of piracy incidents per country-year. We have approximately 1,500 observations spread across 118 separate states. We include separate models for all piracy incidents, actual piracy attacks, and the subset of hijackings. We report our findings in Tables 1 and 2. Table 1 includes the linear coefficient estimates across our four separate models while Table 2 offers incidence-rate ratios for models 2 and 3 from Table 1 and evidence on marginal effects.

Results in Tables 1 and 2 show support for our hypotheses. We start by jointly discussing models 1 and 2 for piracy incidents and attacks since results in these models are very comparable. Findings for model 3 on hijackings are discussed separately. We find strong evidence that state fragility substantially increases the incidence of piracy. The results show a positive and significant relationship between state failure and piracy in all models presented in Table 1, demonstrating that permissive institutional environments create conditions conducive for all piracy incidents. Varying the state failure variable from one standard deviation below the mean to one standard deviation above, we observe a 448 percent increase in the number of piracy attacks. Clearly, failed and weak states drive piracy higher as suggested in our first hypothesis.

Table 1. GEE Models of Piracy Events at the Monadic-Year Level

	Model 1 All piracy incidents	Model 2 Only piracy attacks	Model 3 Only hijackings	Model 4 Only piracy attacks
Fragility Index (Lagged)	0.125***	0.111***	0.184***	0.082***
	(.015)	(.016)	(.031)	(.022)
Ln Fish Value Differenced	−0.304**	−0.256***	−0.759***	−0.258***
	(.093)	(.098)	(.268)	(.097)
Ln Coast Length	0.242***	.180***	.814***	.188***
	(.054)	(.056)	(.095)	(.057)
Ln Regional Trade (WTO)	.160	.035	.567**	.016
	(.153)	(.162)	(.288)	(.163)
Terrorism Incidents	−.0007	−.001	.003**	−.001
	(.001)	(.001)	(.002)	(.001)
Democracy	−.037	−.073	−.790***	−.748**
	(.139)	(.146)	(.272)	(.342)
Fragility × Democracy	—	—	—	.054**
				(.024)
Ln Population	.546***	.622***	.136	.624***
	(.059)	(.063)	(.104)	(.064)
UCDP Conflict	−.102	−.125	−.276	−.106
	(.133)	(.139)	(.275)	(.140)
Material Power (CINC)	−17.20***	−17.63***	−20.03***	−17.39***
	(3.18)	(3.27)	(6.77)	(3.32)
Western Hemisphere	−.221	−.177	−1.54***	−.068
	(.186)	(.192)	(.449)	(.199)
Europe	−2.57***	−2.44***	−2.02***	−2.23***
	(.355)	(.367)	(.653)	(.378)
Africa	−.696*	−1.02**	.030	−.906**
	(.404)	(.427)	(.734)	(.430)
Middle East	−1.82***	−2.36***	−.117	−2.31***
	(.441)	(.490)	(.741)	(.492)
Constant	−11.99***	−8.67*	−27.36***	−7.86*
	(4.50)	(4.77)	(8.49)	(4.82)
N	1,508	1,508	1,508	1,508
Wald χ^2 (p <)	413.37	378.67	211.96	370.70
	(.000)	(.000)	(.000)	(.000)

*Note.*Y is the number of total piracy incidents, attacks, or hijackings. We use an xtgee estimator with negative binomial specification and an AR(1) error structure.
*p < .10. **p < .05. ***p < .01 two-tailed tests.

We also find support for our hypothesis on economic opportunities. The variable measuring changes in fish value is negative and significant in models 1 and 2, thus indicating that increases in fisheries production values reduce opportunities for piracy as expected. Our finding confirms the importance of decreased labor opportunities in states' fishing sectors as a driver of piracy emphasized in many case

Table 2. Marginal Effects for Models of Piracy Events

	Model 1 IRR Only piracy incidents	Model 1 Δ in predicted count	Model 1 Percent Δ in predicted count	Model 3 IRR Only hijackings	Model 3 Δ in predicted count	Model 3 Percent Δ in predicted count
Fragility Index (Lagged)	1.133*** (.017)	0.932	+448.1	1.201*** (.037)	0.057	+1140.0
Ln Fish Value (Differenced)	0.738*** (.068)	0.12	−21.9	.468*** (.125)	0.011	−45.8
Ln Coast Length	1.274*** (.069)	0.392	+119.5	2.257*** (.215)	0.061	+1220.0
Ln Regional Trade (WTO)	1.173 (.179)	—	—	1.764** (.508)	0.029	+362.5
Terrorism Incidents	.999 (.001)	—	—	1.003** (.002)	0.004	+25.0
Democracy	.963 (.134)	—	—	.454*** (.123)	0.015	−53.6
Ln Population	1.726*** (.102)	0.99	+495.0	1.146 (.120)	—	—
UCDP Conflict	.903 (.120)	—	—	.759 (.209)	—	—
Material Power (CINC)	$3.38e^{-08}$*** ($1.07e^{-07}$)	0.379	−53.5	$1.99e^{-09}$*** ($1.35e^{-08}$)	0.017	−60.7
Western Hemisphere	.802 (.149)	—	—	.215*** (.096)	0.019	−79.2
Europe	.077*** (.027)	0.779	−92.3	.133*** (.087)	0.023	−85.2
Africa	.499* (.201)	—	—	1.03 (.757)	—	—
Middle East	.163*** (.072)	0.498	−83.7	.890 (.659)	—	—
N	1,508			1,508		
Wald χ^2 (p <)	416.37 (.000)			211.96 (.000)		

Note. Changes in predicted counts are calculated by varying continuous variables ±1*SD* from the mean and dichotomous variables from 0 to 1. WTO = World Trade Organization; UCDP = Uppsala Conflict Database Program; CINC = Correlates of War data set on national capabilities; IRR = Incidence rate ratio.

studies. For example, the depletion of Somalia's fishing grounds and subsequent decline in labor opportunities following the collapse of the regime in 1991 is frequently cited as a cause of the rise of piracy in Somalia (Lehr 2007; Weir 2009). Our results confirm these expectations across time and space. In substantive terms, the effect of changes in fish values is rather small, showing that varying this variable $\pm$ one standard deviation reduces piracy attacks by 22 percent. Yet arguably there are some weaknesses in the fish value data provided by FAO. Most problematic for our purposes are value data that are based on estimates rather than officially reported numbers. Failed and weak states may be less capable of reporting such data, and while estimates by experts and international organizations likely capture general trends, they may miss short-term fluctuations in fish values. It is thus possible that the substantive effect of changes in fish values would be greater with more accurate and reliable data. We compare results on changes in fish values to a more general indicator for economic opportunities in the robustness tests.

Arguments on favorable geography in the piracy literature are also supported. The coast length variable is positive and significant, and varying this indicator $\pm$ one standard deviation increases piracy by 119.5 percent. Overall, piracy varies across regions as one would expect from anecdotal accounts of specific incidents. Asia, in particular, accounts for a substantial amount of the piracy observed. The countries of Southeast Asia and the Far East experience nearly 50 percent of piracy events occurring in territorial waters. The waters off of Africa also produce high levels of piracy, which has been increasing since 2006. The Americas experience considerable piracy as well with seventy-two incidents in 2003 and thirty-seven in 2009. Europe witnesses the fewest pirate attacks, but still confronts a real foreign policy problem. Europe as a whole suffered thirty-one total attacks and three hijackings over the twenty-year period from 1991 to 2010. Of these, Italy faced six incidents and Albania five.

Population and material power also correlate strongly with piracy. The substantive effect of changes in population size is strong. If we vary the population variable from one standard deviation below the mean to one standard deviation above, the expected number of piracy attacks increases by more than 495 percent. Varying the Composite Indicator of National Capabilities by $\pm$ one standard deviation decreases pirate events by 53.5 percent. It seems safe to conclude that material power, particularly in the form of military might, enables governments to deter and contest piracy in their territorial waters. While the coefficient for regional trade is positive, it does not reach conventional levels of statistical significance in the first two models. This finding is similar to Iyigun and Ratisukpinol (2010), who also do not find a significant effect of trade on piracy attacks. We also do not find evidence of a relationship between civil conflict and piracy. The coefficient for this variable is negative but not statistically significant in any of the models.

Findings for control variables also demonstrate the importance of avoiding truncation bias. For example, Hastings (2009, 218) does not find evidence for a significant relationship between coast length, population size, and hijackings, which

likely stems from the exclusion of countries without piracy and piracy incidents other than hijackings. Yet, as our models show, increases in countries' coastline length and population size significantly increase the likelihood of various piracy types once other types of incidents and countries without piracy are included.

Our models of hijackings also show support for the main hypotheses. Hijackings, like overall piracy, show that state weakness robustly pushes the incidence of hijackings higher. The substantive relationship between state weakness is stronger for hijackings than all types of piracy attacks. In fact, a one-unit increase in the fragility index from fifteen to sixteen increased piracy incidents by 13 percent, yet a similar one-unit increase in fragility raises the number of hijackings by 20 percent. Varying the fragility index from one standard deviation below to one standard deviation above the mean produces a 1,140 percent increase in hijackings. Our findings thus show that state fragility is associated with a greater risk of all piracy incidents, including hijackings. We also find support for our hypothesis on economic opportunities in the hijacking model. Changes in fish value reduce the incidence of hijackings. Varying changes in fish values $\pm$ one standard deviation produces a 45.8 percent decrease in hijackings.

Results for other control variables such as population, material power, and regional patterns are very similar to the first two models. In addition, geographic factors influence piracy as in earlier models although it is interesting to observe that the substantive effect of geography on hijackings is much larger. Varying the coast length variable increases hijackings by more than 1,220 percent compared to only 119 percent in the incidents model. Piracy in the form of hijackings seemingly demands more forceful responses by governments and the international community. As such, the length of a country's coastline measures the difficulty state authorities confront in policing territorial waters. Pirates presumably recognize their ability to evade government authorities and seize upon the opportunity to obtain large ransom payments.

Interestingly, there is a positive and significant effect of regional trade on hijackings. Apparently, increases in regional trade volumes result in increases in hijackings, but not other types of piracy attacks. We also observe significant effects coming from terrorism, although this finding is less robust and holds only for hijackings. Increases in terrorism appear to increase hijackings. As with the finding on regional trade, however, caution with the interpretation of this result is warranted since we do not observe it for any other type of piracy event. Results for the democracy variable in the hijacking model support the expectations. Compared to autocratic states, democratic regimes reduce the incidence of hijackings by 54 percent. While we do not uncover the same effect of democracy for other types of piracy events, it is possible that there are interactions between the democracy variable and other covariates, which we evaluate in more detail in the following.

The final model presented in Table 1 explores possible interactions among the covariates of piracy. Presumably, many of our variables could interact with each other in their effect on piracy. In a preliminary analysis of such conditional

relationships, we include an interaction term between the fragility index and the democracy variable in model 4. Results show that the effect of democracy on piracy attacks is conditional on states' fragility level. The result shows that democracies with low state fragility have lower expected counts of piracy, but that the relationship is reversed for democracies with high levels of fragility. We present this finding in a more intuitive manner in Figure 1. As can be observed in the graph on the left-hand side, democracies have higher rates of piracy attacks than nondemocracies once fragility levels reach values of 18 or higher.[22] Consequently, the effect of state weakness is stronger in fragile democratic states, making such countries particularly prone to maritime piracy. The illustration on the right-hand side of Figure 1 evaluates whether the interaction term included in model 4 is statistically significant across the range of the fragility measure. Using a one-tailed test, we observe that the combined effect of fragility and regime type is significant only when fragility is at low or moderate levels (values between 0 and 12) and nearly significant when fragility is at its highest value (value of 25). Results for control variables in this model are very similar to our other models.

Robustness Tests

We present additional models to evaluate whether our results are influenced by the operationalization of some of the independent variables, potential outliers, the inclusion of countries that did not experience piracy, and the specification of a linear relationship between state strength and piracy. We use piracy incidents as the dependent variable in all but one of the robustness tests since we lack space to present models for all types of piracy events. The first robustness test measures economic incentives for piracy more generally rather than the changes in states' fishing industries we emphasize in our argument. To account for general economic conditions, we use data for current year GDP per capita provided by the Penn World Tables Version 6.3. We log-transform the GDP per capita variable to reduce the impact of highly skewed values. Model 1 in Table 3 presents results for GDP per capita (log) as an alternative operationalization of economic opportunities for piracy and removes the fish value measure. The variable is negative and significant, thus confirming that economic opportunities in general reduce individuals' incentives to engage in piracy. Nevertheless, our emphasis on opportunities in countries' fishing sectors more suitably captures motivations for engaging in piracy since these individuals possess the necessary skills.

Second, while the Correlates of War Composite Indicator of National Capabilities represents the most commonly used measure of state power, we model independently three of the component parts of the power measure: iron and steel production, number of military personnel, and military expenditures. We present results for the number of military personnel in model 2, which shows that the coefficient remains negative and significant. No other results change as a result of using any of the component parts to the CINC score.

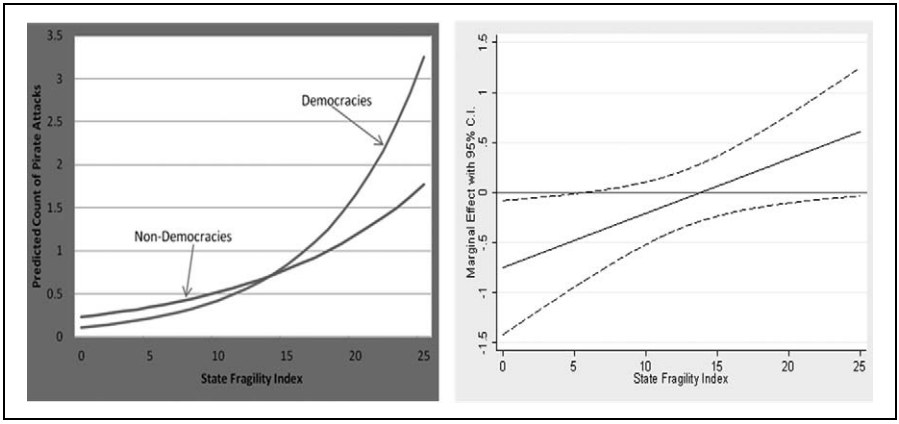

Figure 1. Influence of state fragility on piracy attacks controlling for regime type

The third robustness test controls for the influence of possible outliers. Arguably, pirates in countries such as Somalia and Indonesia are responsible for a large number of piracy attacks, and it is thus warranted to reestimate our models by including dummy variables for these two states. Although other models account for regional heterogeneity by including regional dummy variables, we want to ensure that state-level variation resulting from countries with high rates of piracy is not unduly influencing our findings. Unsurprisingly, results for model 3 in Table 3 show that the coefficients for Somalia and Indonesia are positive and significant. Coefficients for key variables of interest remain mostly unchanged, thus increasing our confidence in the robustness of these findings. The effect of state weakness on piracy remains positive and significant, and increases in fish values produce reductions in the rate of piracy attacks (albeit only at the 90 percent confidence level).[23]

While our results from the negative binomial models support our hypotheses, the cause of overdispersion in the dependent variable could be the result of an unmodeled data generating process. Overdispersion in our dependent variable stems from excess zeroes in the data and it is possible that the underlying process determining whether a country can experience any piracy at all is different from the process that determines the number of piracy incidents (Zorn 1998, 371). While we are uncertain whether it is reasonable to expect that some countries simply cannot experience piracy, we specify a zero-inflated negative binomial model to account for this possibility as an additional robustness test.[24] The inflation stage evaluates whether countries experience at least one piracy event using inverse logistic regression. A positive estimate thus means that an increase in the explanatory variable *reduces* the probability of observing at least one piracy event. We include a variable for GDP per capita in the inflation stage since country's level of development likely influences whether they are at risk of experiencing piracy. In addition, we include variables for the length of countries' coastlines and regional dummy variables in the inflation

Table 3. Robustness Tests for Models of Piracy Events

	Model 1 GDP per capita	Model 2 Military personnel	Model 3 Country dummies	Model 4 Zero inflated	Model 5 Fragility squared	Model 6 Hijackings
Lag of Piracy	—	—	—	.077***	—	—
				(.012)		
Fragility Index (lagged)	.060***	.131***	.088***	.084***	.272***	.0414
	(.021)	(.015)	(.016)	(.015)	(.037)	(.065)
Fragility Index Squared (lagged)		—	—	—	−.006***	.006**
					(.001)	(.003)
Ln GDP per capita	−.504***	—	—	—	—	—
	(.109)					
Ln Fish Value Differenced	—	−.296***	−.150*	−.439**	−.315***	−.726***
		(.092)	(.088)	(.171)	(.092)	(.271)
Ln Coast Length	.295***	.234***	.020	—	.263***	.792***
	(.056)	(.054)	(.058)		(.055)	(.094)
Ln Regional Trade (WTO)	.224	.153	.015	.267***	.172	.598**
	(.157)	(.153)	(.155)	(.075)	(.153)	(.296)
Terrorism Incidents	−.0001	−.0004	−.0008	.00009	−.0007	.003**
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Democracy	−.123	−.031	−.090	−.183	−.063	−.818***
	(.141)	(.141)	(.142)	(.125)	(.137)	(.285)
Ln Population	.553***	.512***	.623***	.354***	.522***	.182*
	(.060)	(.061)	(.062)	(.045)	(.059)	(.108)
UCDP Conflict	−.118	−.098	−.170	−.262*	−.107	−.264
	(.135)	(.132)	(.135)	(.147)	(.134)	(.276)
Material Power (CINC)	−17.898***	—	−15.568***	−10.548***	−16.631***	−21.046***
	(3.324)		(3.197)	(2.478)	(3.232)	(7.055)
Military Personnel	—	−.0008***	—	—	—	—
		(.0002)				
Indonesia	—	—	1.884***	—	—	—
			(.480)			
Somalia	—	—	2.193***	—	—	—
			(.483)			

(continued)

Table 3. (continued)

	Model 1 GDP per capita	Model 2 Military personnel	Model 3 Country dummies	Model 4 Zero inflated	Model 5 Fragility squared	Model 6 Hijackings
Western Hemisphere	.0012	−.337*	−.115	—	−.187	−1.625***
	(.199)	(.187)	(.189)		(.190)	(.456)
Europe	−2.324***	−2.603***	−2.553***	—	−2.280***	−2.197***
	(0.364)	(.359)	(.357)		(.357)	(.666)
Africa	−.620	−.824**	−1.065**	—	−.509	−.207
	(.415)	(.407)	(.412)		(.4025)	(.755)
Middle East	−1.146**	−1.754***	−1.972***	—	−1.771***	−.065
	(.472)	(.442)	(.444)		(.440)	(.756)
Constant	−9.539	−11.401**	−6.602	−11.374***	−13.013***	−27.814
	(4.578)	(4.50)	(4.572)	(2.183)	(4.493)	(8.707)
Inflation stage						
Ln GDP per capita	—	—	—	.941***	—	—
				(.207)		
Ln Coast Length	—	—	—	−.734***	—	—
				(.151)		
Western Hemisphere	—	—	—	−1.974	—	—
				(1.281)		
Europe	—	—	—	2.080***	—	—
				(.522)		
Africa	—	—	—	.154	—	—
				(.578)		
Middle East	—	—	—	.670	—	—
				(.576)		
Constant	—	—	—	−3.574*	—	—
				(1.942)		
N	1,510	1,509	1,508	1,536	1,508	1,508
Wald χ^2 (p <)	397.87	402.87	439.75	514.51	413.59	200.39
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)

Note. *N* is the number of total piracy incidents in models 15 and hijackings in model 6. We use an xtgee estimator with negative binomial specification. GDP = gross domestic product; WTO = World Trade Organization; UCDP = Uppsala Conflict Database Program; CINC = Correlates of War data set on national capabilities.
*p < .10. **p < .05. ***p < .01 two-tailed tests.

stage since such time-invariant factors are more likely to influence piracy onset rather than incidence.[25] The negative binomial stage evaluates how many piracy events occur using negative binomial regression, and a positive estimate represents the increase in the log number of events associated with a one-unit increase in the explanatory variable. With the exception of time-invariant covariates, we include the same independent variables as in previous models in the negative binomial stage. Because zero-inflated models for GEEs are not available, we include the lag of piracy incidents and robust standard errors to control for temporal and cross-sectional correlation. Results for key independent variables and controls are very similar to findings from earlier models and support our main hypotheses. In addition, the positive and significant coefficient for GDP per capita in the inflation stage of model 4 suggests that higher GDP lowers countries' risk of experiencing any piracy as expected. Finally, we find that longer coastlines increase the risk of piracy onset, whereas countries located in Europe are less likely to experience any piracy.

Models 5 and 6 evaluate whether there is evidence for a nonlinear, inverted U-shaped relationship between state strength and piracy as suggested in the work by Hastings (2009) and de Groot, Rablen, and Shortland (2011). While only de Groot, Rablen, and Shortland empirically evaluate this expectation, they find that countries with the lowest levels of state strength are less likely to experience piracy than states with higher levels of governance quality. To account for this possibility, we include a squared measure of state fragility in the models. The coefficient for the squared term in model 5 is negative and significant, thus seemingly supporting Hastings's (2009) and de Groot, Rablen, and Shortland's expectation. However, while a significant coefficient for the squared term shows support for some nonlinearity in the relationship between two variables, a visual depiction of the relationship can more conclusively document the nature of such nonlinearity. We thus calculate and plot the expected count of piracy incidents for all values of the state fragility and state fragility squared variables.[26] As the graph on the left-hand side of Figure 2 shows, the relationship between state fragility and piracy incidents is fairly linear up until values of fragility of 22. For values of state fragility of 23 and higher (which correspond to empirical values of fragility greater than two standard deviations above its mean), the risk of piracy declines slightly, but this decrease does not go below the expected number of piracy incidents for other high values of state fragility. Consequently, the figure shows that states with the highest levels of state fragility have slightly lower expected numbers of piracy events, but their risk of piracy is still much higher than that of countries with moderate or low levels of state fragility. In addition, the confidence intervals for high values of state fragility are fairly wide, given the relatively small number of cases with such high values.

We also included the squared fragility measure in models of attacks and hijackings. Findings for the attacks model were virtually identical to the incidents model and are thus not presented here. For hijackings, we also find evidence for nonlinearity, but in the opposite direction than predicted in Hastings (2009). The

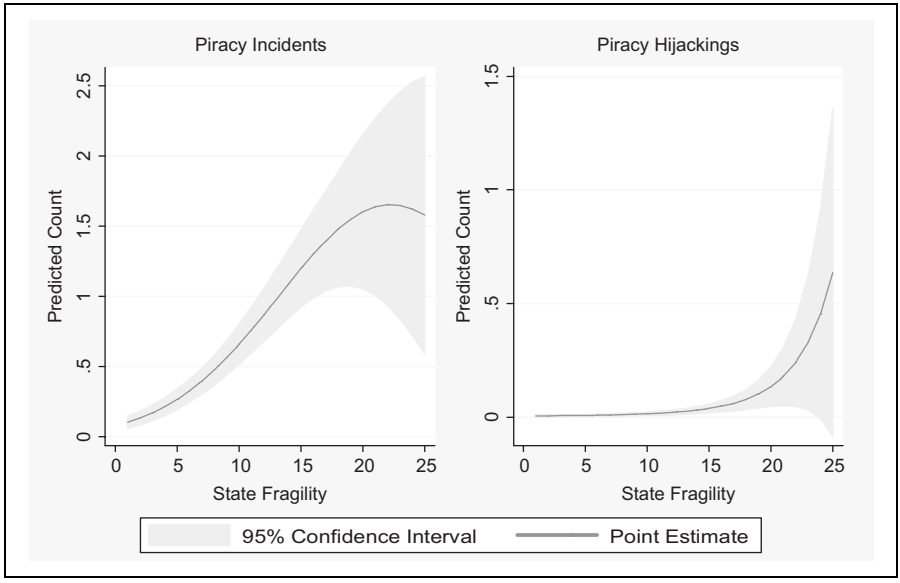

Figure 2. Nonlinearity in the relationship between state fragility and piracy

coefficient for the squared term is positive and significant, suggesting a U-shaped relationship and not an inverted U-shaped relationship as Hastings (2009) and de Groot, Rablen, and Shortland (2009) expect. A plot of predicted counts of hijackings for all values of state fragility and the squared term shows that the nonlinearity results from a relationship whose shape resembles an exponential function. As the graph on the right-hand side of Figure 2 shows, the number of hijackings remains very low for values of state fragility of less than 15, increases moderately until values of 18, and increases exponentially thereafter.

We thus find some evidence for an inverted U-shaped relationship between state fragility and piracy incidents, but a visual representation of the relationship shows that nonlinearity is limited to extreme and empirically rare values of state fragility, and further documents that even these rare cases have substantially higher risks of piracy than states with low or moderate state fragility. In addition, we find that higher values of state fragility exponentially increase the expected number of hijackings. Consequently, while Hastings (2009) and de Groot, Rablen, and Shortland (2011) are correct in suspecting a nonlinear relationship between state capacity and piracy, our findings do not support the conclusion that improvements in governance quality will inadvertently increase opportunities for piracy. Our findings show that countries with high levels of state fragility are much more likely to experience all forms of piracy than states with low or moderate state fragility and as such improvements in governance should almost uniformly reduce the risk of piracy, especially for states that experience hijackings in their territorial waters.

Conclusion

Our goal in this article was to provide an explanation of maritime piracy that highlights institutional and economic opportunities. Focusing on attacks in states' territorial waters, we show that state weakness consistently increases the incidence of all piracy events. State weakness provides an environment that allows pirate groups to flourish as it reduces the capacity of states to combat piracy. We also find support for our arguments on economic opportunities for piracy. States with reduced values of fisheries production are more likely to experience piracy, indicating that threats to the livelihoods of coastal communities drive individuals to piracy. Our results thus confirm that the lack of labor opportunities in sectors most amenable to piracy is influential in driving individuals to piracy. A series of robustness tests confirm our confidence in this article's main findings. Results for the effect of state weakness and variation in fish values on piracy remain mostly unchanged in robustness tests for alternative operationalizations of independent variables, controls for outliers, and additional estimation methods. For example, while we find some evidence for nonlinearity in the relationship between state weakness and piracy, our findings support the contention that improvements in governance quality should reduce the occurrence of piracy.

Additional findings show support for a variety of theoretical conjectures presented in the literature. We find empirical support for favorable geography and regional variation. Population size and states' military power also affect piracy as expected in the literature. Findings for regime type, terrorist attacks, and regional trade are less consistent across different types of attacks. Democracy reduces the rate of hijackings, but is not significant in all models. Yet a preliminary analysis of possible interaction effects shows that regime type may have important conditional effects on other piracy events. We show that democracy reduces piracy attacks when state fragility is low, but that the relationship is reversed for democracies with high levels of state fragility.

To our knowledge, this study is one of the first systematic assessments of institutional and economic opportunities for piracy. Previous research focuses predominantly on countries in which piracy actually occurred, a limitation we overcome by including all countries with coastlines in our empirical analysis. In addition, our analysis accounts for a variety of additional explanations emphasized in the emerging literature on maritime piracy. Taken together, our article suggests a set of general mechanisms that help understand the incidence of maritime piracy. Having established these patterns, future research could investigate more specific explanations of maritime piracy. For example, the literature on cases such as Somalia and Sri Lanka suggests that gains from piracy have helped support violent insurgencies (Lehr and Lehmann 2007). Consequently, maritime piracy might function as a source of income for insurgent groups, an explanation neglected in the literature on civil wars. The availability of location data on piracy incidents and armed conflict events could allow for empirical investigation of such expectations.

Author's Note

The authors thank two anonymous referees and Paul Huth for detailed comments on earlier drafts. For helpful suggestions, the authors are grateful to Michele Betsill, Halvard Buhaug, and Colter Kinner. Remaining errors or omissions are the authors'. Author ordering is alphabetical and does not imply differing levels of contribution. Data and do files for empirical analyses are available at http://jcr.sagepub.com/.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Notes

1. The parameters of the JSTOR search are as follows: advanced search, terms terrorism and piracy (separately), only item titles, narrowed by selecting only articles, from 1946 to 2011, and only political science periodicals.
2. Research by Hastings (2009), Iyigun and Ratisukpimol (2010), and Jablonski and Oliver (2012) examines variation in piracy only for cases that experienced at least one incident. As King, Keohane, and Verba (1994, 130) point out, truncating variation in the dependent variable to less than its full range likely produces biased inferences that underestimate the causal effect of covariates.
3. We examine potential nonlinearity in the robustness tests, but expect that improvements in state capacity, in particular at the national level, decrease piracy. While we do not dispute that regions with intermediate levels of government control within states may be more prone to piracy than the most unstable areas within states, such subnational variation is likely not captured at the national level. For example, Somalia is considered a failed state by any measure of state capacity at the national level, yet much piracy originates in regions with intermediate political stability (Percy and Shortland 2011). We plan to explore more disaggregated analyses of state capacity and piracy in the future.
4. Empirical evidence on civil war supports such arguments. Collier and Hoeffler (2004), for example, show that civil war is a phenomenon that primarily affects poor countries. More recent micro-level analyses of insurgency also demonstrate that individuals are sensitive to the costs associated with rebel activity as compared to legitimate activity. A study of the Colombian insurgency by Dube and Vargas (2007) shows that price increases in labor-intensive goods correlate with increases in insurgent activity.
5. In empirical tests not reported, we also evaluated whether there is a conditional relationship between changes in states' fishing sectors and institutional weakness. While an interaction between changes in fisheries values and institutional weakness was not significant, a visual inspection of the relationship showed that increases in fisheries values

consistently decreased piracy in fragile states, but did not affect piracy in countries with stable institutional structures. We plan to explore such relationships in future research.

6. International Maritime Bureau, Piracy and Armed Robbery Against Ships: Annual Report, January 1 to December 30, 2010, p. 3.
7. Data collection depends on reporting from authorities, ship owners, or the victims of an attack, which suggests several reasons for why underreporting might be common. First, states may not want to be characterized as having a piracy problem. Similarly, ship owners have reasons to omit incidents to avoid subsequent costly security features or increases in insurance premiums (Hastings 2009). Finally, victims were likely exposed to duress and may not be able to provide detailed descriptions of an incident. In addition to including piracy events regardless of where they occur, the definition used by the IMB has the advantage of putting emphasis on the intent of actors to use force, which is useful in that it focuses on the threat or use of violence and excludes cases of petty theft.
8. To increase our confidence that the IMB data are not biased, we compared them to data on piracy collected by the Regional Cooperation Agreement on Combating Piracy and Armed Robbery against Ships in Asia (ReCAAP), a regional IGO founded in 2007. Because of the limited number of years for which ReCAAP data are available, we cannot estimate our models on these data, but compared piracy incidents collected by ReCAAP for the year 2007 to incidents listed in the 2007 IMB report. All incidents reported by ReCAAP in 2007 were also in the IMB report.
9. Hijackings typically involve the seizure of a vessel, its crew, or both.
10. We use EUGene to create the monadic data file (Bennett and Stam 2000).
11. These landlocked countries obviously cannot experience piracy in their territorial waters (since they have none) and thus are removed from the analyses. In point of fact, there is no landlocked country that experiences a pirate attack according to the IMB data.
12. We could add these piracy incidents on the high seas by including them for the country closest to the location of the incident, but we do not actually know whether pirates are based in that state.
13. Data are available online at www.systemicpeace.org/.
14. www.fao.org/fishery/statistics/global-capture-production/en. This operationalization is similar to variables measuring changes in commodity values used in the civil war literature (Ross 2006). Unfortunately, production values are available only for all fisheries products and not just marine fisheries values, which arguably might be more relevant in motivating individuals to engage in piracy. FAO publishes data on marine fish catch production in tons (but not values) which we added to our data set to calculate changes in marine fish catch. We find a negative and significant relationship between changes in fish catch and piracy. In addition, we included a measure that represents the ratio of fish values and fish production per country in separate models. Results for this alternative operationalization also showed a negative and significant relationship.
15. In cases where national statistics are not available, FAO estimates figures based on national figures for most recent years, expert analysis, and trade returns from trading partners.
16. The *CIA World Factbook* was also used to identify landlocked and littoral states.

17. We evaluate the impact of increases in regional trade rather than national trade for two reasons. First, we have emphasized the importance of economic opportunities and permissive institutional environments as explanations for piracy. Presumably, weak or failed states are unlikely to experience strong economic growth and increases in trade, making regional patterns more important. Second, the targets of piracy attacks are international ships and their cargo, not domestic goods, which could be more easily intercepted on land.
18. Data are available at www.pcr.uu.se/research/UCDP/.
19. To create a dichotomous variable for democracy-non-democracy, we use the Polity2 measure and a cutoff of 6.
20. To ensure that the method to correct for autocorrelation is not influencing our results, we also specified models with a lagged dependent variable. Results were similar to the ones presented here.
21. An alternative approach would to specify a negative binomial model with fixed effects. However, Beck and Katz (2001) insist that fixed effects models frequently produce seriously misleading results when many of the unit dummies never vary on the dependent variable (i.e., in our case, the countries experience no incidents of piracy over the time frame covered in the analyses). These cases essentially get dropped from the analysis and therefore have no effect on the coefficient estimates. For example, running a fixed effects model on piracy incidents drops 38 units (or 32 percent of the countries) from the analysis. The effects are considerably worse for attacks and hijackings where 37 percent and 77 percent, respectively, of the units are dropped. Beck and Katz (2001, 489) find it odd that one would be satisfied explaining the absence of piracy with "some unmodeled idiosyncratic feature" of the unit (the monad in our data set), rather than allow the substantive independent variables to do the explaining. Even if we had fewer zeroes on our dependent variable, which would reduce the number of dropped cases when modeling fixed effects, many of our independent variables also do not vary temporally (or vary very little). Some of these variables, such as coastline length or regime type, are important to our explanation of maritime piracy and their effects would be essentially accounted for by the unit dummies.
22. Such countries include Guatemala in 1996, Mali and Niger in 1995, Bangladesh in 1997, and Pakistan in 1996. Except for Guatemala and Pakistan, each of these countries scores a 6 on the Polity2 measure. Guatemala and Pakistan both receive Polity2 scores of 8.
23. The empirical results also remain largely unchanged if we casewise delete Somalia and Indonesia from the analyses.
24. A zero-inflated negative binomial model rather than a Heckman selection model is appropriate since we cannot empirically distinguish between the two processes but rather only observe the final number of piracy events for each country and year.
25. We experiment with a number of model specifications in the inflation stage, but results were comparable to the ones presented. Evaluations of model fit using vuong, AIC, and BIC tests showed that the zero-inflated model is preferred over the negative binomial model. However, since we lack strong theoretical priors suggesting that some cases have no probability of experiencing piracy events, we are not convinced that the zero-inflated

model is more appropriate. Importantly, our arguments on institutional weakness and economic opportunity are supported in both model specifications.

26. The predicted number of piracy events was calculated using Stata 11's margins command. The state fragility measure and squared term were varied across their entire range while all other independent variables were held at their means.

References

Bateman, Sam. 2007. "Outlook: The New Threat of Maritime Terrorism." In *Violence at Sea: Piracy in the Age of Global Terrorism*, edited by P. Lehr, 241–59. New York: Routledge.

Bawumia, Mahamudu, and U. Rashid Sumaila. 2010. "Fisheries, Ecosystems, and Piracy: A Case Study of Somalia." Working Paper # 2010-04. Fisheries Centre, University of British Columbia, Vancouver, Canada.

Beck, Nathaniel, and Jonathan N. Katz. 2001. "Throwing Out the Baby with the Bath Water: A Comment on Green, Kim and Young." *International Organization* 55:487–95.

Bennett, Scott D., and Allan Stam. 2000. "EUGENE: A Conceptual Manual." *International Interactions* 26:179–204.

Bradford, John F. 2008. "Shifting the Tides Against Piracy in Southeast Asian Waters." *Asian Survey* 48:473–91.

Burnett, John S. 2002. *Dangerous Waters: Modern Piracy and Terror on the High Seas*. New York, NY: Plume.

Chalk, Peter. 2009. "Maritime Piracy: Reasons, Dangers, and Solutions." Testimony before the Committee on Transportation and Infrastructure, Subcommittee on Coast Guard and Maritime Transportation. U.S. House of Representatives, February 4.

Collier, Paul, and Anke E. Hoeffler. 2004. "Greed and Grievance in Civil War." *Oxford Economic Papers* 56:563–95.

de Groot, Olaf, Matthew D. Rablen, and Anja Shortland. 2011. "Gov-aargh-nance: Even Criminals Need Law and Order." Working Paper 11-01. Centre for Economic Development & Institutions. Brunel University, Middlesex, UK.

Dube, Oeindrila, and Juan F. Vargas. 2007. "Commodity Price Shocks and Civil Conflict: Evidence from Colombia." Typescript. Havard University.

Frécon, Eric. 2005. "Pirates Set the Straits on Fire . . . Causes and Context of Pirate Arsons in the Malay Archipelagos Since the Nineties." In *Covering Maritime Piracy in Southeast Asia*, edited by W. Vom Busch and T. Rettig, 17–43. Singapore: Konrad Adenauer Stiftung.

Gettleman, Jeffrey. 2010. "Money in Piracy Attracts More Somalis." *New York Times*, November 10, p. 10.

Gleditsch, Nils Petter, Peter Wallensteen, Mikael Erikson, Margareta Stollenberg, and Havard Strand. 2002. "Armed Conflict 1946-2001: A New Dataset." *Journal of Peace Research* 39:615–37.

Hastings, Justin V. 2009. "Geographies of State Failure and Sophistication in Maritime Piracy Hijackings." *Political Geography* 28:214–23.

Hendrix, Cullen S., and Sarah M. Glaser. 2011. "Civil Conflict, Crowding-Out Effects and World Fisheries, 1952-2004." *Journal of Peace Research* 48 (4): 481–95.

Hirshleifer, Jack. 1995. "Theorizing about Conflict." In *Handbook of Defence Economics*, Vol. 2, edited by K. Hartley and T. Sandler, 165–92. Amsterdam: Elsevier.

Iyigun, Murat, and Watcharapong Ratisukpimol. 2010. *Learning Piracy on the High Seas*. Typescript. University of Colorado, Boulder.

Jablonski, Ryan S., and Steven Oliver. 2010. The Political Economy of Plunder: Economic Opportunity and Modern Piracy. *Journal of Conflict Resolution*.

King, Gary. 1989. "Event Count Models for International Relations: Generalizations and Applications." *International Studies Quarterly* 33 (2): 123–47.

King, Gary, Robert O. Keohane, and Sidney Verba. 1994. *Designing Social Inquiry*. Princeton, NJ: Princeton University Press.

Kraska, James, and Brian Wilson. 2009. "Maritime Piracy in East Africa." *Journal of International Affairs* 62 (2): 55–68.

Lehr, Peter. 2007. "Introduction." In *Violence at Sea: Piracy in the Age of Global Terrorism*, edited by P. Lehr, 7–11. New York: Routledge.

Lehr, Peter, and Hendrick Lehmann. 2007. "Somalia – Pirates' New Paradise." In *Violence at Sea: Piracy in the Age of Global Terrorism*, edited by P. Lehr, 1–23. New York: Routledge.

Lemke, Douglas, and William Reed. 2001. "War and Rivalry among Great Powers." *American Journal of Political Science* 45 (2): 457–69.

Murphy, Martin N. 2008. "Piracy and the Exploitation of Sanctuary." In *Armed Groups: Studies in National Security, Counterterrorism, and Counterinsurgency*, edited by J. Norwitz, 161–73. Newport, RI: US Naval War College.

Murphy, Martin N. 2009. *Small Boats, Weak States, Dirty Money: The Challenge of Piracy*. New York: Columbia University Press.

Ong-Webb, Graham Gerard. 2007. Piracy in Maritime Asia: Current Trends. In *Violence at Sea: Piracy in the Age of Global Terrorism*, edited by P. Lehr, 37–95. New York: Routledge.

Percy, Sarah, and Anja Shortland (2011). The Business of Piracy in Somalia. DIW Discussion Paper 1033. DIW Berlin, German Institute for Economic Research.

Ross, Michael. 2006. "A Closer Look at Oil, Diamonds, and Civil War." *Annual Review of Political Science* 9:265–300.

Vagg, Jon. 1995. "Rough Seas? Contemporary Piracy in South East Asia." *British Journal of Criminology* 35 (1): 63–80.

Valencia, Mark, and Derek Johnson. 2005. *Piracy in Southeast Asia: Status, Issues, and Responsibilities*. Singapore: ISEAS.

Weir, Gary E. 2009. "Fish, Family, and Profit: Piracy and the Horn of Africa." *Naval War College Review* 62 (3): 15–30.

Zorn, Christopher J. W. 1998. "An Analytic and Empirical Examination of Zero-Inflated and Hurdle Poisson Specifications." *Sociological Methods Research* 26 (3): 368–400.