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Enforcing order: Territorial reach and maritime piracy

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Abstract
Existing studies of piracy focus attention on the institutional determinants of maritime piracy, but neglect variation in governments' reach over territory. We argue that the effect of state capacity on piracy is a function of states' ability to extend authority over the country's entire territory. We expect that government reach—a function of geographic factors such as the distance between a country's capital and its coastline—mediates the effect of state capacity on piracy. Weak governments allow for the planning and implementation of attacks and reduce the risk of capture, but particularly so if sufficient distance separates pirates from political authority. An empirical analysis of country-year data on maritime piracy collected by the International Maritime Bureau for the 1995–2013 period shows that capital–coastline distance mediates the effect of institutional fragility on piracy as hypothesized. These results remain robust for alternative operationalizations of state capacity and reach. In addition, the models perform well in terms of predictive power, forecasting piracy quite accurately for 2013. The expectations and evidence presented in this paper help explain why states with intermediate levels of state capacity but low levels of reach—such as Indonesia, Tanzania or Venezuela—struggle with substantial incidence of piracy.

Keywords
Loss of strength gradient, maritime piracy, power projection, state capacity

Introduction

Maritime piracy remains a critical threat to maritime trade despite efforts in recent years by the US, EU and UN to curtail this violent criminal activity. The Suez Canal and Greater Gulf of Aden, for example, became so dangerous in 2008 and 2009 that international shipping companies began sending their vessels along alternative routes.[1] According to the US

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Energy Information Agency, approximately 1 to 1.5 billion barrels of crude oil pass through the Gulf of Aden and Bab el-Mandab waterway each year, which represents 3–5% of global annual consumption. Consequently, even a minor disruption of trade in crude oil and liquid natural gas owing to piracy has the potential to significantly increase energy costs worldwide. Shipping companies have gone so far as to arm ships and outfit protective gunboats (Nelson and Goossens, 2011). While these counter-piracy measures have contributed to an overall decline of piracy incidents, driven primarily by large reductions of piracy in the Gulf of Aden, shifts in regional patterns show increases in piracy in West Africa and Southeast Asia.[2] Piracy thus remains a security threat and pirates continue to take risks to capture valuable transports.

While theoretical and empirical attention to piracy has increased in recent years, conceptual biases hamper efforts to better explain variation in both the incidence and location of pirate activity. Researchers correctly focus on institutional weakness as a critical determinant of piracy, but analyses ignore the extent to which state capacity is a function of government ability to project power over distance. Notice that many of the pirate attacks in South East Asia occur far from Indonesia's capital of Jakarta and attacks off of Mozambique's coast appear mostly far in the north away from Maputo. This suggests that pirates strategically locate themselves in places where governments find it difficult to penetrate.

We argue that Boulding's (1962) concept of loss of strength gradient (LSG) can be applied to maritime piracy as it has been applied to the study of inter-state conflict (Bueno De Mesquita, 1981; Lemke, 2002) and civil war (Buhaug, 2010). This research implies that the reach of government authority over geographic distance should influence the incidence of piracy. A government's ability to eliminate non-state criminal organizations therefore depends not only on the strength of the state vis-à-vis the pirate group where the regime is strong, but also on the ease with which government power can be extended from the capital to the coast. Weak governments allow for the planning and implementation of attacks and reduce the risk of capture, but particularly so if geographic distance separates pirates from political authority.

The contribution of the paper is twofold. First, it contributes to the literature on piracy by emphasizing the importance of reach over territory. We argue that national-level measures of institutional capacity do not sufficiently capture states' ability to extend authority over distance and therefore hypothesize that the distance between a country's capital and its coast affects piracy both directly and indirectly. Our empirical evidence shows that countries with longer capital–coastline distances have an increased risk of piracy, but most importantly, our results demonstrate that statistical associations between measures of government power and maritime piracy are strongly influenced by capital–coastline distance. These findings provide a more nuanced and empirically accurate understanding of modern-day piracy. In addition, capital–coastline distances are potentially less endogenous to piracy than other measures of state strength, and establishing a direct effect of distance helps increase our confidence in the relationship between state strength and piracy.[3] Second, our findings make a contribution to work on the uneven reach of the state in comparative politics, which highlights how territorial variation in state power can affect a variety of outcomes such as democracy and welfare provision, but also crime and political violence (Fortin, 2010; Herbst, 2000; Soifer, 2008). Our results show systematically how a lack of territorial reach correlates with increases in piracy, a form of economic violence with substantial costs to the international economy.

We begin the paper by discussing the concept of governments' territorial reach and connect it to Boulding's (1962) ideas on the LSG. The theoretical discussion applies LSG to piracy and derives testable hypotheses. The next section describes the data and measures used in our analyses and summarizes our findings. We then examine the predictive accuracy of our empirical models and conclude with suggestions for future research.

State capacity and territorial reach

Interstate and intrastate conflict

Models of armed conflict both between and within states identify institutional capacity as a critical driver of political violence. This is largely because strong states by definition possess the means to exert coercive authority through their police and military apparatus (Boulding, 1990, refers to this as threat power). At the interstate level, such material power results in higher hazards of violent conflict since major powers have substantially greater propensities to use military force.[4] At the sub-state level, however, state strength deters challenges to regime power and thus lowers the likelihood of civil war (Fearon and Laitin, 2003; Fjelde and De Soysa, 2009; Hegre et al., 2001).[5] Indeed, Fearon and Laitin (2003: 479) insist that the rise of such insurgencies is a function of "the police and military capabilities and competences of the government, and the reach of government institutions into rural areas."[6] The credible threat by a regime to impose costs on dissatisfied groups within society "increases the value of the status quo" and decreases the likelihood of rebel success both of which, according to Sobek (2010: 267), reduce the opportunity for rebellion.

Despite defining territorial reach as a critical aspect of state capacity, research on the conditions associated with civil war generally conceptualizes and operationalizes state strength in ways that privilege regime capabilities at the center, such as national-level measures of bureaucratic quality, extractive capacity, coercive ability or per capita income (see for example the 2010 special issue of *Journal of Peace Research* on state capacity). Strong states, for example, are assumed to possess the ability to project power over distance while weak states cannot. Yet how such power is projected remains under-specified and the exact geographic extent of regime control is unclear. Indeed, even weak states may have the ability to enforce order around capital cities and regime power centers.

Further, research modeling power projection over territory generally gauges only the direct relationship between geographic distance and violent conflict.[7] For example, dyadic studies of interstate interactions show geographic proximity to relate strongly to the onset of militarized disputes (e.g. Russett and Oneal, 2000; Vasquez, 1995). Yet while proximity may relate to power projection, presumably state capacity impacts the relationship as well. Kenneth Boulding (1962: 79) refers to "the amount by which the competitive power of a party diminishes per mile away from home" as the loss of strength (or power) gradient. As a country's LSG decreases (and so power projection ability increases), Boulding anticipates that the likelihood of conflict will increase. So the ease with which a regime can project coercive power creates an incentive to use such power by lowering costs when the opportunity arises. Lemke (2002) applies Boulding's concept by defining countries as being part of the same local hierarchy based on their ability to interact militarily with each other. Drawing as well on work by Bueno de Mesquita (1981), Lemke degrades a country's CINC (Combined Indicator of National Capabilities) score by the distance between pairs of states to more accurately capture power projection and thus the mediating effect of space on state capacity's relationship to conflict onset (see Lemke, 2002: 70–72 for a description of his LSG measure).

At the sub-state level, however, a large LSG permits non-state groups autonomy from central government authority. Indeed, one consequence of regime weakness appears to be regime challenges. However, another consequence is that insurgents strategically consider government power projection in their assessments of rebellion success and locate themselves far from government power centers or behind difficult terrain for added protection. Rustad et al. (2011) and Buhaug and Rød (2006) find evidence of this relationship, showing that most armed conflict within states occurs far away from the capital city. The risk of conflict, for example, remains substantially higher in the outlying provinces of Nepal, India, Pakistan, and the Philippines (Rustad et al., 2011). Examining marginalized ethnic groups, Cederman et al. (2009) find that the risk of conflict increases with the distance of groups from the capital. The evidence relating to terrain remains less robust than distance from capital city, but both Fearon and Laitin (2003) and Collier et al. (2009) conclude that mountainous terrain correlates with the hazard of civil war onset (see Korf, 2011 for an overview). Additionally, O'Loughlin and Witmer (2011) find that forested areas in Chechnya experience more violence.

While research at the sub-state level on both terrain and distance highlights the importance of territorial reach, it mostly fails to connect the effect of these variables to the relationship between state capacity and civil war. Yet Boulding's conceptual framework explicitly considers the mediating effect of distance on state strength (albeit at the interstate level). It is not simply that distance decreases the likelihood of dyadic interstate conflict, but that the effect of institutional capacity on conflict varies over distance. Recent studies by Buhaug (2010) and Hendrix (2011) use Boulding's framework more accurately by examining the conditional relationship between geography, state capacity, and the location and incidence of conflict. Buhaug (2010: 120), for example, suggests that state strength at the center is mediated by the "cost of policy implementation across space."[8] Conflicts that erupt in countries with stable political institutions tend to occur far from the country's geographic core, but the distance between capital city and conflict in anocracies is half as far as it is in stronger autocratic states (Buhaug, 2010: 120). In addition to the opportunity for rebellion, the government's reach also affects the type of civil war. Buhaug (2010: 125) notes that "powerful regimes are relatively more likely to face separatist attempts than coups or revolutions compared to less capable states," and rebel strength enables insurgencies to survive closer to a country's capital city.[9] Related to this, Hendrix (2011) demonstrates that mountainous terrain exacerbates the effect of state capacity on civil war.

We acknowledge that space (be it geographic or cultural) does not necessarily require centralized governing for effective control.[10] Indeed, many ethnically heterogeneous countries have federalized governing institutions to better manage space and provide greater legitimacy. In Somalia, for example, strong local governing institutions in Somaliland helped prevent maritime piracy despite the absence of authority in Mogadishu (World Bank Regional Vice-Presidency for Africa, 2013). Then again, Nigeria has over 700 local governments and, rather than offering stability, this fragmentation has resulted in greater corruption and rent-seeking that help drive criminality, such as piracy (Watts, 2004). Of course, brutality by Nigerian security forces also contributes to separatism and instability that reinforce the very idea of ungovernable spaces.[11] Still, in general, the areas where legitimate authority (be it state or local) is absent tend to be where transnational criminal organizations and rebels locate. Opportunistic non-state groups fill in for government agents by seizing valuable natural resources, extracting rents from local populations (Collier et al., 2009; De Juan and Pierskalla, 2015; Korf, 2011) or trading in illicit goods. In each case, state strength impacts non-state group recruitment by failing to permit insurgent and or crime leaders the ability to buy foot soldiers. Gates (2002: 126) concludes that "sanctuary within a country or within a neighboring country plays an instrumental role in giving the rebel movement a chance to develop and grow. Sanctuary implies a place to retreat away from governmental forces."

LSG and maritime piracy

Existing theoretical explanations for piracy highlight the importance of institutional weakness. Empirical research has shown that state capacity strongly correlates with piracy. State weakness consistently increases the number of pirate attacks off countries' coasts and government actors in weak states frequently aid and abet pirate activities (Daxecker and Prins, 2013; Hastings, 2009; Murphy, 2009).[12] Yet despite the importance of institutional capacity for explaining pirate attacks, it is not clear whether national-level indicators of capacity accurately capture governments' ability to extend authority outside of the state center. While national indicators may be useful for approximating the government's capability of implementing policy close to government centers, this capability may extend irregularly across territory. If rough terrain or distance from government centers can help protect insurgents from state authority, we would expect that long distances between capitals and coastlines, long shorelines, and/or island sanctuaries would help shelter pirates from internal security forces and naval power.[13] Consider, for example, how difficult it must be to control coastal areas susceptible to piracy in Indonesia, with an average capital–coastline distance of almost 2000 km, 53,000 km of shoreline, and over 17,000 islands, of which only 6000 are inhabited (CIA, 2011). The ability to implement policy spatially also seems more broadly relevant for criminal violence like piracy rather than insurgency, since unlike some insurgent groups, pirates do not intend to capture the state center.[14] Not only do we see evidence that crime prevention efforts by public authorities have a deterrent effect, supporting the notion that increasing the hazards of capture and punishment decreases criminal activity (Sherman, 1990; also see Braga, 2001), but evidence also shows that the distance between country capitals and piracy location increases as government capacity improves (Daxecker and Prins, 2015).

Drawing on Boulding's (1962) seminal contribution as well as recent work in comparative politics emphasizing the territorial dimension of state capacity (see Soifer, 2008 for an overview), we anticipate that space interacts with institutional capacity to influence the incidence of pirate attacks.[15] Weak governments allow for the planning and implementation of piracy and reduce the risk to pirates of capture, but we would expect this effect to be much more pronounced if large distances separate pirates from political authority. Boulding's LSG is well suited to capture the ability of states to enforce order over geographic distance. While conventional concepts of state capacity focusing on qualities such as coercive ability, extractive capacity, or bureaucratic quality reasonably capture the capability of the central state (Soifer, 2008), these conceptualizations do not adequately reflect states' ability to exercise "authority over distance" (Herbst, 2000).[16] Common conceptualizations thus neglect that power decreases as distance from the state's power center increases. We therefore argue that it is not simply state strength or weakness that matters, but rather the extent to which a government can penetrate areas that are attractive locations for pirates to organize and launch their attacks from.[17] The importance of both state capacity and territorial reach can be captured by an examination of the combined effect of these factors on piracy. Weak states have a higher expected probability of piracy, but this effect becomes more pronounced in states where long distances between state capitals and coastlines limit the complete exercise of government authority. The projection of political power over distance also affects the demand for piracy. Potential pirates view government authority that extends across space to the coast differently than that of governments who struggle to control territory outside of a country's capital or other power centers. The risk of capture and punishment is much higher when governments are able to project authority over large distances. Therefore, we expect potential pirates to consider the extent of government authority and the subsequent likelihood of being jailed or killed for their criminal actions. This discussion leads us to posit the following hypothesis:

> **H_1**: The influence of state capacity on piracy is mediated by the distance between capital cities and coastlines. We expect that the effect of state capacity on piracy increases with longer capital–coastline distances.

Research design and empirical findings

We explore whether institutional determinants of piracy are conditioned by government reach across territory. Drawing on Boulding's concept of countries' LSG, we hypothesize that the effect of state capacity on piracy is mediated by variation in state authority over distance. To test our expectations, we create a dataset that includes all countries with coastlines for the 1995–2013 time period. In these data, country-years are the units of analysis. Data for the incidence of piracy, our dependent variable, come from the International Maritime Bureau.[18] The dependent variable is a count of the number of piracy incidents (including attempted attacks, actual attacks, and hijackings) for each country-year.[19] To examine whether the conditional relationships hypothesized above change as a function of the intensity and severity of attacks, we represent robustness tests with the number of hijackings per country-year.[20]

Our primary independent variables operationalize state capacity and its interaction with authority over distance. We measure state capacity with data on government effectiveness from the World Bank Governance Indicators, but account for additional indicators such as relative extractive capacity, state fragility, and GDP per capita in robustness tests (Hendrix, 2010).[21] Government effectiveness measures "perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies" (Kaufmann et al., 2009: 6). The data are based on "surveys of firms and individuals, as well as the assessments of commercial risk rating agencies, non-governmental organizations, and a number of multilateral aid agencies and other public sector organizations" (Kaufmann et al., 2009: 7). Countries are scored in percentile rank terms, which range from 0 to 100, with higher values corresponding to better outcomes.

Our key contention is that authority over distance conditions the importance of state capacity on piracy. Our primary indicator measures the average distance between the capital and coastline.[22] To calculate distances, we used ArcGIS to calculate the minimum and maximum distance in kilometers between state capitals and their coastlines and then took the average of these two values.[23] We then log distance because of skewness. We focus on average rather than maximum distances because we are interested in capturing the average difficulty in extending control across a state's territory.[24] To examine the conditional relationships outlined in the hypothesis, we interact government effectiveness with the distance variable. Empirical results using coastline length and land area as alternative measures of territorial reach show that our findings are consistent with the findings for distance.

We include four additional control variables in our models. Existing research on piracy shows that GDP per capita, regional trade levels, and the number of ports significantly affect piracy (Coggins, 2012; Daxecker and Prins, 2013, 2015; Hastings, 2009; Jablonski and Oliver, 2013). GDP per capita is used as an indicator of economic opportunity and we use data from the World Bank.[25] Second, regional trade volumes are measured with data from the WTO and represent the value of a region's imports and exports in millions of current US dollars.[26] Third, we measure the number of ports for each country with data from Coggins (2012). We take the natural log (+ 1) because the data are skewed. Finally, we control for the spatial diffusion of piracy by calculating the spatial lag of piracy based on inverted distance.[27] Marchione and Johnson (2013) find that piracy clusters in space. The spatial lag indicates whether the risk of piracy in a country's waters is influenced by piracy in proximate states and accounts for spatial dependence. The variable is a continuous indicator ranging from 0.63 to 9.43. We control for additional factors that could influence state capacity and piracy in robustness tests. All independent variables except time-invariant ones are lagged by one year to avoid simultaneity bias.

We use a general estimating equation (GEE) with a negative binomial specification and an AR(1) error structure as our estimation method. We choose a negative binomial specification because the variances of our piracy data are larger than their means, indicating that each of our event counts are over-dispersed. The negative binomial model includes an additional parameter to model over-dispersion 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.[28] We account for temporal dependence by specifying an AR1 lag structure.[29] Spatial dependence is modeled with the spatial lag discussed above.

Results

Table 1 presents our findings for state capacity, distance, and piracy incidents. The first two models examine the direct and indirect effect of distance on piracy. While the model including the effectiveness–distance interaction corresponds most closely to the theoretical argument, model 1 examines the direct effects of capacity and distance on piracy. The model corroborates previous findings about the effect of state capacity, showing that more effective governments experience a lower risk of piracy. The model also establishes a direct effect of distance on piracy. The coefficient for the capital–coastline distance measure is positive and significant, indicating that states with longer distances experience more piracy. Figure 1 shows the marginal effect of distance on piracy across all empirical values of distance.

Yet as hypothesized, when adding the interaction term in model 2, results show that the effect of capacity on piracy is conditional on distance. The coefficient for the effectiveness–distance interaction is negative and significant, meaning that the piracy-reducing effect of government effectiveness decreases with greater capital–coastline distances. This finding supports hypothesis 1, which expects that the effect of state strength on piracy will be more pronounced for states with longer capital–coastline distances. Permissive institutional conditions are thus more consequential for piracy when states lack territorial reach. Since interactions

Table 1. GEE models of piracy incidents, 1995–2012

Variables	(1) Main	(2) Interaction	(3) Coastline	(4) Land area	(5) No log	(6) Max distance	(7) Capacity spatial lag
Government effectiveness	–0.010**	0.034**	0.035**	0.040**	–0.004	0.041**	0.039**
	(0.004)	(0.013)	(0.013)	(0.010)	(0.004)	(0.014)	(0.013)
Capital–coast distance	0.150*	0.440**					0.538**
	(0.071)	(0.107)					(0.111)
Effectiveness × Distance		–0.008**					–0.008**
		(0.002)					(0.002)
Coastline length			0.521**				
			(0.091)				
Effectiveness × Coastline			–0.006**				
			(0.002)				
Land area				0.623**			
				(0.079)			
Effectiveness × Area				–0.008**			
				(0.002)			
Capital–coast distance, no log					0.000**		
					(0.000)		
Effectiveness × Distance, no log					–0.000**		
					(0.000)		
Maximum distance						0.492**	
						(0.111)	
Effectiveness × Maximum distance						–0.008**	
						(0.002)	
Ports	0.926**	0.992**	0.728**	0.746**	1.080**	0.954**	0.963**
	(0.092)	(0.096)	(0.123)	(0.099)	(0.090)	(0.100)	(0.099)
Spatial lag	0.032	0.052	0.066†	0.056	0.024	0.059†	0.046
	(0.035)	(0.035)	(0.036)	(0.036)	(0.035)	(0.036)	(0.035)
GDP per capita	–1.232**	–1.214**	–1.100**	–1.201**	–1.241**	–1.196**	–1.132**
	(0.083)	(0.082)	(0.083)	(0.084)	(0.084)	(0.082)	(0.084)
Regional trade	0.276**	0.272**	0.202**	0.354**	0.272**	0.271**	0.364**
	(0.055)	(0.056)	(0.056)	(0.057)	(0.058)	(0.055)	(0.059)
Effectiveness spatial lag							–0.067**
							(0.016)
Constant	–0.042	–1.947	–1.598	–4.649**	0.412	–2.546†	–2.319†
	(1.246)	(1.325)	(1.256)	(1.406)	(1.266)	(1.350)	(1.342)
Observations	1944	1944	1944	1927	1944	1944	1944
Number of countries	117	117	117	116	117	117	117

$^{**}p < 0.01$, $^{*}p < 0.05$, $^{\dagger}p < 0.1$ (two-tailed tests), standard errors in parentheses.

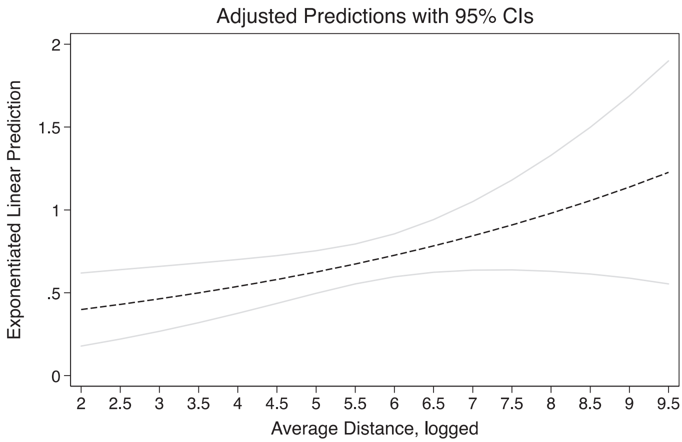

Figure 1. Direct effect of capital–coastline distance on piracy.

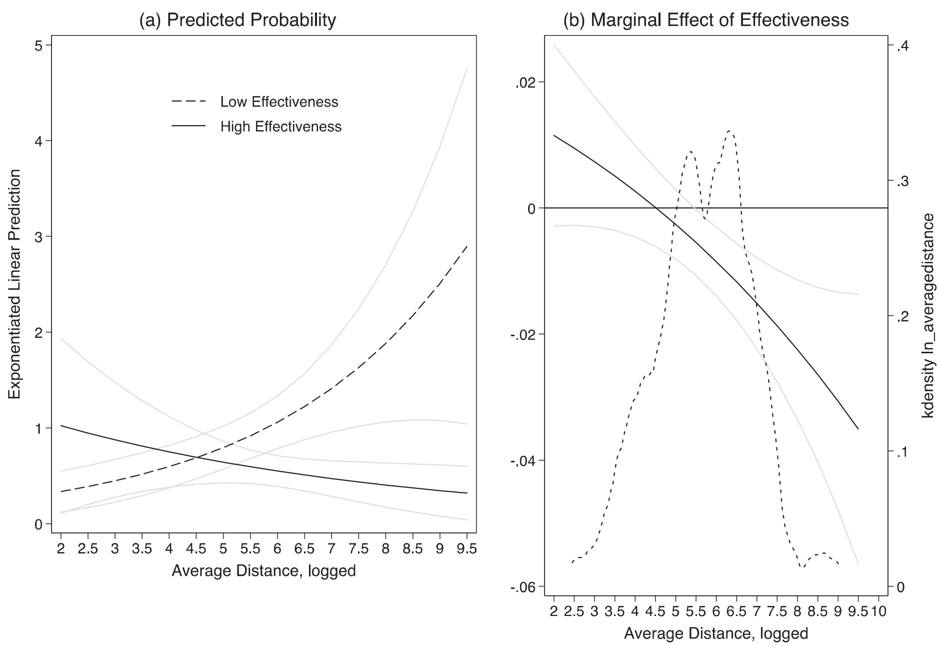

Figure 2. Interaction between government effectiveness and capital–coastline distance.

between continuous variables are difficult to interpret by examining the coefficient values, particularly in maximum-likelihood estimation models, Figure 2 presents a visual depiction of this relationship.

Figure 2 shows the effectiveness–distance interaction and includes two graphs, with Figure 2a showing the effect of distance on piracy for low (-1 SD) and high ($+1$ SD) values of effectiveness, and Figure 2b showing the marginal effect of government effectiveness on piracy conditional on distance.[30] Figure 2a shows that even less effective states (the dashed line) do not experience high numbers of piracy incidents up until distance approaches its mean ($\mu = 4.5$ or ~250–275 km). Yet for weak states with long or very long capital–coast distances, the probability of piracy increases quite dramatically, thus supporting the expectation that state weakness is a much more important predictor of piracy for countries that have to project authority across large distances. The figure also shows that effective states are not at risk of experiencing piracy regardless of distance. Figure 2b plots the effect of a one-unit change in effectiveness on the probability of piracy for the range of the capital–coastline distance measure. It shows that the marginal effect of effectiveness on piracy decreases initially as distance increases, but we also see that this effect is statistically significant once distance reaches mean values. Starting at about 250 km (i.e. mean values), the effect of state capacity becomes statistically significant and begins to increase. The effect is relevant for empirically relevant observations of distance as shown in the overlaid kernel density plots.

Models 3–6 examine whether these results are sensitive to our measurement of power projection across distance.[31] Model 3 uses coastline length as an alternative indicator, which captures the difficulty of extending authority over distance in ways relevant for piracy.[32] The interaction term for the capacity–coastline length variable is significant and negative as in earlier models, showing that weak states with longer coastlines have a greater incidence of piracy. Model 4 presents yet another operationalization of LSG by including total land area and its interaction with effectiveness in the model.[33] The coefficient for the interaction is again significant and negative, indicating that less effective states with large (and thus difficult to police) land mass experience more piracy. Model 5 examines whether the log transformation of the distance measure influences our findings. Arguably, while helpful in making capacity more normally distributed, the log transformation increases the size of short distances while reducing long distances. Our results show that the interaction term remains negative and significant for unlogged values of distance. Model 6 assesses whether results remain consistent with maximum capital–coast distances. In this model, distance represents the longest capital–coast distance rather than the average, but the coefficient for the interaction term is again negative and significant. Model 7, the final model in Table 1, includes a spatial lag of government effectiveness (again using a weighted measure of inverted distance). Maritime piracy is probably not only influenced by an individual state's capacity, but also by the capacity of neighboring countries. Model 7 finds support for this spatial relationship. The coefficient for the government effectiveness spatial lag is negative and statistically significant, indicating that increases in the capacity of proximate states help reduce piracy. None of the other results are affected by the inclusion of this capacity spatial lag. In fact, the main interaction results are somewhat strengthened with the inclusion of this spatial control.

Results for control variables in models 1–6 broadly confirm existing research. Countries with a greater number of ports and in regions with higher trade volumes experience more piracy, whereas higher GDP per capita reduces piracy. Interestingly, we do not find consistent support for spatial diffusion effects from piracy itself. The coefficient for the spatial lag is positive but attains significance only in two of the six models.

While the results in Table 1 have shown that state capacity is conditional on distance, and remains so across a variety of measures of distance, we now assess whether empirical results are robust to other measures of state capacity, alternative specifications of the dependent variable, controlling for Somalia, and alternative estimation methods. In these robustness tests, we use average capital–coastline distances as the distance indicator.

Model 8 includes a measure of state capacity that is a composite indicator of state fragility from the Center for Systemic Peace. The indicator scores countries on the effectiveness and legitimacy of economic, security, political, and social conditions in the state.[34] The state fragility index ranges from 0 to 25, with higher scores indicating lower state capacity. State fragility is coded inversely from the other capacity measures (since it ranges from least to most fragile), meaning that the positive and statistically significant coefficient for the interaction in model 8 also supports our theoretical expectations. Longer distances exacerbate the effect of state fragility on piracy incidents. In model 9, we measure state capacity as the state's ability to extract taxes from society (Buhaug, 2010; Hendrix, 2010; Herbst, 2000). In order to account for structural differences between economies, we use data on relative extractive capacity rather than absolute taxing capacity since they compare "actual levels of extraction to their predicted values based on economic endowment" (Arbetman-Rabinowitz et al. in Kugler and Tammen, 2012: 17). The relative extractive capacity measure ranges from 0.11 to 2.18, with higher values corresponding to better extractive capacity. The negative and significant coefficient for the interaction shows that less capable states with longer capital–coast distances experience more piracy.

Model 10 examines whether territorial reach affects economic opportunity considerations similarly to institutional capacity. Research shows that the absence of employment opportunities in the legal economy creates incentives to turn to piracy (Daxecker and Prins, 2013; Jablonski and Oliver, 2013; Knorr, 2015), but the observed relationship could be exacerbated in states where pirates anticipate the threat of punishment to be low, such as in states with low territorial reach. One difficulty with assessing and interpreting the conditional effect of economic opportunity on piracy is that GDP per capita has been suggested as a measure of state capacity (Fearon and Laitin, 2003). Regardless, our findings show that there is a conditional effect, where larger capital–coastline distances decrease the piracy-reducing effect of GDP per capita.

Model 11 examines whether a conditional relationship for capacity and distance exists for piracy hijackings. Concerns about underreporting in the study of piracy are quite serious because the International Maritime Bureau (IMB) relies on self-reporting of incidents from the crew, ship owners, or government authorities, all of which may face incentives against reporting piracy (Murphy, 2009).[35] Yet such underreporting should be less common for more serious piracy such as attacks or especially hijackings (Hastings, 2009). Results for these models again support our theoretical expectation regarding the mediating effect of distance on piracy. The coefficient for the government effectiveness–distance interaction is negative and significant in the hijacking model. Model 12 examines whether Somalia is driving our results, but results show that it does not, since the coefficient for the interaction remains negative and significant. Model 13 uses feasible generalized least squares (GLS) instead of the GEE specification presented in other models. GLS allows accounting for serial and cross-sectional correlation and panel heteroskedasticity. Our results remain robust to this more restrictive modeling strategy. Finally, in model 14, we again include a spatial lag of state capacity, this time using the Fragility Index. Our results remain robust to the inclusion of this spatial control and in fact are again even somewhat stronger.[36] Overall, we take the results presented in Tables 1 and 2 as evidence supporting our main theoretical claim regarding the importance of territorial reach. Our findings show that institutional conditions associated with piracy are more important for governments that have to project authority over large distances.

Table 2. Robustness tests, 1995–2012

Variables	(8) Fragility	(9) Extractive capacity	(10) GDP	(11) Hijackings	(12) Somalia	(13) GLS	(14) Capacity spatial lag
Government effectiveness				0.050†	0.026*	0.005**	
				(0.030)	(0.012)	(0.001)	
Capital–Coast Distance	–0.320*	0.562**	1.350**	0.904**	0.233*	0.040*	–0.374**
	(0.126)	(0.145)	(0.292)	(0.198)	(0.100)	(0.018)	(0.124)
Effectiveness × Distance				–0.014**	–0.005**	–0.001**	
				(0.005)	(0.002)	(0.000)	
Fragility	–0.131*						–0.199**
	(0.056)						(0.057)
Fragility × Distance	0.034**						0.048**
	(0.009)						(0.009)
Extractive capacity		2.307**					
		(0.874)					
Capacity × Distance		–0.519**					
		(0.146)					
GDP × Distance			–0.162**				
			(0.038)				
Ports	0.995**	0.959**	0.956**	0.601**	1.051**	0.070**	0.913**
	(0.085)	(0.083)	(0.089)	(0.160)	(0.089)	(0.011)	(0.088)
Spatial lag	0.055	0.057	0.035	0.143†	0.085*	0.004	0.020
	(0.036)	(0.040)	(0.035)	(0.074)	(0.037)	(0.004)	(0.036)
GDP per capita	–1.150**	–1.360**	–0.414†	–0.589**	–1.265**	–0.072**	–0.952**
	(0.082)	(0.068)	(0.235)	(0.131)	(0.079)	(0.013)	(0.084)
Regional trade	0.383**	0.339**	0.250**	0.006	0.336**	0.009†	0.701**
	(0.057)	(0.054)	(0.055)	(0.094)	(0.054)	(0.005)	(0.077)
Somalia					2.340**		
					(0.469)		
SFI spatial lag							0.405**
							(0.063)
Constant	–2.044	–2.977*	–5.895**	–3.809†	–2.518*	0.073	–14.964**
	(1.765)	(1.425)	(1.927)	(2.298)	(1.239)	(0.137)	(2.656)
Observations	2059	1875	2059	1944	1944	1944	2059
Number of countries	117	112	117	117	117	117	117

**$p < 0.01$, *$p < 0.05$, †$p < 0.1$ (two-tailed tests), standard errors in parentheses.

Table 3. Event count prediction results: out-of-sample 2013

Prediction	True piracy incidents Low risk	Moderate risk	High risk	Total
Low risk	**43 (51.8%)**	1 (6.7%)	0 (0%)	44
Expected count	**33**	6	5	
Moderate risk	28 (33.7%)	**11 (73.3%)**	6 (50.0%)	45
Expected count	34	**6**	5	
High risk	12 (14.5%)	3 (20.0%)	**6 (50.0%)**	21
Expected count	16	3	**2**	
Total	83 (100%)	15 (100%)	12 (100%)	110

Low risk = 0 piracy incidents; moderate risk = 1–3 piracy incidents; high risk = 4 or greater piracy incidents.

Forecasting maritime piracy

To assess the predictive capacity of our analytical model, we compare a model forecast for 2013 with actual piracy incidents data. The empirical results presented in Table 1 are based on piracy data from the years 1995–2012. We can use our model to predict piracy incidents for 2013 and then evaluate the accuracy of our predictions country by country. Such an assessment allows us measure where our model forecasts well and where it does not, thus enabling recalibration if necessary. Our hope is of course to produce both understanding and concise predictions of the data generating process.

We begin by using model 2 in Table 1 to forecast piracy incidents for year 2013. We round our predictions to the nearest whole number and create a three-category risk index from the counts. Given that we are modeling piracy over 112 different countries, we do not expect to be able to forecast exact piracy counts country by country. What we hope to do is accurately forecast a range of incidents that successfully corresponds to the true range we observe in 2013. Our data on piracy incidents follow a negative binomial distribution with approximately 71% zeroes, 16% counts one to three and about 13% counts four or greater. We define low risk as countries where our model predicts zero incidents for 2013, moderate risk as countries where our model predicts between one and three incidents, and high risk as countries where our model predicts four or more piracy incidents. We then establish a true risk index based on actual piracy data from 2013.

Table 3 compares our predicted risk index with the actual risk index. There were a total of 242 incidents that occurred in 2013 in our sample spread across 110 separate countries. Of those 110 countries, 83 experienced no piracy incidents in their waters, 15 experienced between one and three incidents, and 12 countries had four incidents or more. Our model successfully predicts 52% of low-risk countries, 73% of moderate-risk countries and 50% of high-risk countries (bold cells in Table 3).

This compares favorably with the predictive accuracy of other recent event count predictions, such as Metternich et al.'s (2013) network event count model, which on average predicts 56% of cells correctly. Table 3 also shows an expected frequency of piracy for each cell if the relationship between our predictive risk index is completely independent of the true risk index. The expected frequency thus provides an idea of what one would expect if our empirical model provided no leverage in explaining and forecasting piracy incidents. For the true values of low, moderate, and high risk of piracy our model produces substantially improved

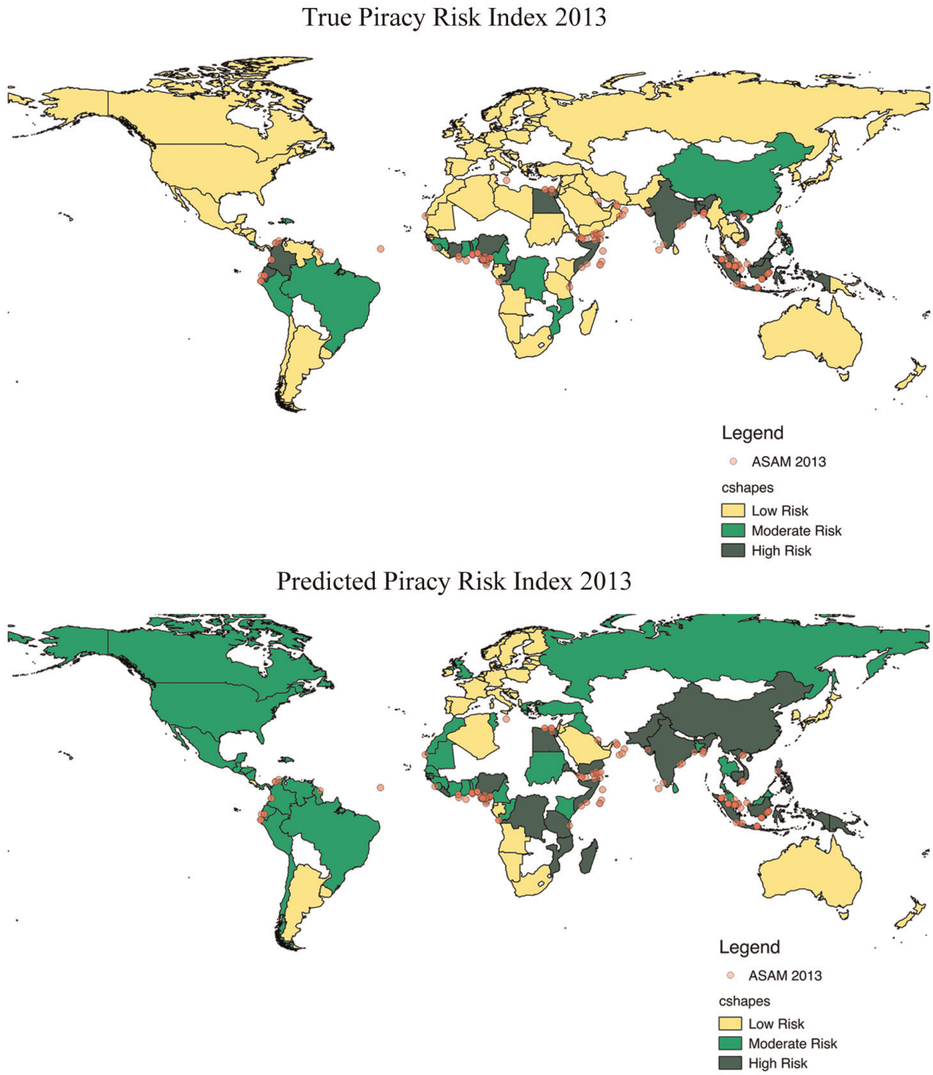

Figure 3. Map of true piracy risk index and forecast piracy risk index, 2013. Figure is reproduced in color in online version.

predictions. For example, for true high-risk countries (those that experienced more than four piracy incidents in 2013), our model correctly predicts six out of the 12 countries while randomness expects only two. We do under-predict six cases, but our under-prediction is only in one category (moderate risk rather than high risk). In fact, we do not predict any low-risk countries that actually were high risk, which increases confidence in our analytical model.

Figure 3 maps our predictions and compares those predictions with true piracy in 2013. The maps also plot the actual location of piracy incidents for 2013. The map on the left displays the true piracy risk index while the one on the right displays our model predictions. One can see that our model tends to err on the side of slight over-prediction of risk rather

Table 4. Prediction accuracy for true high-risk countries (four or more incidents) and true moderate-risk countries (one to three incidents), 2013

Model prediction low risk	Model prediction moderate risk	Model prediction high risk
True high-risk countries		
None	Colombia	**Nigeria**
	Peru	**Somalia**
	Ivory Coast	**Egypt**
	Togo	**India**
	Malaysia	**Vietnam**
	Bangladesh	**Indonesia**
True moderate-risk countries		
Gabon	**Dominican Republic**	Tanzania
	Guyana	Mozambique
	Ecuador	Philippines
	Brazil	
	Mauritania	
	Guinea	
	Sierra Leone	
	Ghana	
	Congo	
	Kenya	
	Morocco	

than under-prediction. Countries such as Russia, Canada, Turkey and the US receive a moderate-risk score, but actually experienced no piracy incidents in their waters in 2013.

Table 4 conveys similar information about the accuracy of our forecasts. The top half of the table shows true high-risk countries in 2013 and the precision of our model. We correctly forecast six high-risk countries, such as Nigeria, Somalia, Egypt, and India (the top-right cell in bold type). We under-predict six countries that actually experienced four or more piracy incidents in 2013 including Colombia, Peru, Ivory Coast, Malaysia, Bangladesh, and Togo. Our model does best with true moderate-risk countries, where we correctly forecast 11 of the 15 cases (middle cell in bold type), under-predict only one and over-predict three. The three over-predicted cases might be ones to closely monitor in the future. Our model suggests these are countries that should have more piracy than they currently do, and therefore our predictions could be a useful early warning signal of increasing risk for policy makers.

Conclusion

We have argued in this paper that Boulding's (1962) concept of the LSG can be successfully applied to maritime piracy. In particular, the LSG suggests that countries' ability to exert authority is affected not only by governments' extractive capabilities at the center but also by the cost of extending authority across space. Drawing on applications of LSG to international and intrastate conflict (Buhaug, 2010; Lemke, 2002), we pointed out that explanations of piracy highlighting states' institutional capacity neglect the importance of the decline of authority over distance. We therefore hypothesized that the territorial reach of states mediates the effect of institutional or economic conditions on piracy, and empirical analyses showed support for these conditional relationships. Operationalizing reach by measuring the average capital–coastline distance, we show that capacity has little effect when distances are short (and LSG is small), but piracy increases substantially for states with long or very long distances. Our findings also show that these conditional relationships are not limited to specific operationalizations of independent and dependent variables. Finally, in response to recent research emphasizing the importance of examining predictive accuracy (Daxecker and Prins, 2015; Ward et al., 2010), we create an index categorizing countries as low, moderate or high risk from piracy, and show that our model correctly predicts more than 50% of cases in each of these categories, which is a substantially improvement over a naive prediction.

Our argument and findings have implications for future research and policy. First, they have implications for the relationship between capacity, distance, and piracy at the micro level. It would, for example, be interesting to examine whether pirate groups locate themselves in geographically distant and difficult to govern areas, which could provide micro-level evidence for our argument. An additional implication with regard to piracy location is that pirates in less capable states should locate closer to countries' power centers, since weak states struggle to extend authority across distance. Third, there are potentially countervailing tendencies for the effect of capacity and reach on piracy that remain unexplored. On the one hand, pirate groups should be attracted to ungoverned spaces because it is easier to organize and plan attacks. On the other hand, proximity to ports—generally centers of economic activity with higher state reach—is also important for pirates. For policy, while countries cannot easily change their geography, our findings suggest that the strategic positions that administrative and marine enforcement bodies take can counteract some of the implications of difficult geography.

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Notes

1. Chip Cummins, 2008, "Piracy grips Gulf of Aden", *Wall Street Journal*, 8 September, http://online.wsj.com/article/SB122083029536208391.html. Cummins reports that MISC-Berhad, which operates a very large number of tanker ships (especially ones that transport liquid natural gas), has ceased transports through the Gulf of Aden owing to piracy.
2. The total number of incidents globally has declined from nearly 450 incidents in 2010 to fewer than 250 in 2014 (data from the International Maritime Bureau).
3. Since decisions to relocate capital cities are rare, concerns over reverse causality should be considerably lower than those for common measures of state capacity. With regard to selection into treatment, capital cities are arguably strategically located based on ex ante assessments of threats to power projection (Campante et al., 2014). However, the direction of this selection bias is unclear. Most threatening for our inferences would be if states with higher capacity to project power chose locations close to coastlines to protect trade or other interests, since reduced piracy in states with short capital–coast distances would then simply reflect greater ex ante capacity. Yet the reverse claim seems more plausible; that is, weaker states should have more incentives to select

coastal capitals because capitals' proximity to coasts facilitates the protection of economic interests. This selection effect, however, would suggest that shorter capital–coast distances reflect lower ex ante power projection, which should make it more difficult to establish the hypothesized positive effect of distance on piracy.

4. In the post-Second World War period the US and Russia alone account for over 30% of the total armed conflicts witnessed globally.
5. Arguably state weakness helps drive transnational crime too. Transnational criminal organizations flock to conflict zones where corruption and disorder are widespread (see Riley and Kiernan, 2013).
6. Institutional capacity also implies a welfare role where societal wealth is redistributed to alleviate inequality and reduce grievance (MacCulloch, 2004; Taydas and Peksen, 2012; Thyne, 2006).
7. The concept of politically relevant dyads revolves explicitly around the ability to project power over distance.
8. This corresponds closely to Boulding's (1962) ideas of LSG. Boulding (1962: 78–79) writes, "the general principle applies that each party can be supposed to be at his maximum power at home (this may be an area rather than a point) but that his competitive power, in the sense of his ability to dominate another, declines the farther from home he operates." Boulding generally uses the term "home base" to refer to a country's power center and so does not explicitly refer to the capital city. However, the capital city seems a logical place to originate LSG.
9. Mason et al. (2011) find evidence that following civil wars government military strength deters former rebels from again challenging the regime, although admittedly rebel victory in the war produces a longer duration of peace than government victory.
10. The absence of the state does not necessarily mean the absence of governance. Informal arrangements can provide order and stability (Rabasa, et al., 2007; also see Mitchell, 2010). Generally for us, state capacity refers to the ability of a state to enforce its will and this requires both manpower, in the form of police and security forces, and revenue, to provide public goods.
11. The international community remains concerned about ungoverned and ungovernable spaces inasmuch as they offer places where terrorist organizations can both hide and train even if at times this narrative reinforces militarism that fuels grievance (Mitchell, 2010).
12. In addition to institutional weakness, research has shown the importance of economic considerations for piracy. Poverty or unemployment increases the individual demand for piracy, and lucrative rewards from the capture of valuable cargo ships provide pirate groups with resources necessary to attract new recruits (Daxecker and Prins, 2013; Jablonski and Oliver, 2013). While we think that the mediating effect of reach also applies to economic explanations, measures of economic opportunity such as GDP per capita have been used as measures of state capacity in research in insurgency (Fearon and Laitin, 2003: 274). We include robustness tests that examine the conditional relationship between economic opportunity, distance, and piracy, but do not focus on economic explanations because of the difficulty distinguishing this concept from measures of capacity.
13. New data on naval power should be of particular interest for piracy scholars (see Crisher and Souva, 2014).
14. If maritime piracy represents a source of funding for rebel groups, then attacks against ships (both steaming and stationary) may be less opportunistic than previously thought. Several clear examples of the insurgency–piracy connection have been noted, such as MEND in the Niger Delta and Abu Sayyaf in the Southern Philippines.
15. While our argument emphasizes the interaction of geographic distance and capacity, we also anticipate that distance increases piracy directly and find empirical support for this independent effect. Yet an emphasis on the mediating relationship is arguably most consistent with Boulding's LSG.
16. State capacity revolves around both coerciveness and legitimacy.

17. The fact that local governments may be indifferent to, or even complicit with, piracy is consistent with this expectation because such collusion is a result of state weakness and lack of power projection. Such institutional corruption also impacts criminal activity more generally (see Coggins, 2010). Indeed, crime prevention efforts have shown success both where policing has increased but also where trust in governing institutions has improved (Greene, 1990).
18. We follow the IMB's coding procedure in assigning incidents to states. Incidents in territorial waters are assigned to the countries in which they occurred, whereas incidents in international waters are assigned to countries as a function of geographic proximity and the origins of the pirates (email conversation with IMB, December 2012). Data are collected from annual IMB reports for the time period under analysis, http://www.icc-ccs.org/piracy-reporting-centre
19. The number of incidents ranges from 0 to 160 per country-year, but the data are right-skewed with a mean value of 2.37.
20. The number of hijackings ranges from 0 to 33 per country-year, but the data are again right-skewed with a mean value of 0.15.
21. While we considered using measures of military capability as an additional measure of capacity, we decided against it because heavy investment in the military could be a sign of state instability and also correlates with lower economic growth (Buhaug, 2010: 112). In addition, we do not include per capita GDP as an indicator of state capacity because it also serves as a measure of economic opportunity. Indeed, GDP per capita arguably correlates with the presence or absence of legal employment opportunities, which creates an alternative causal pathway to piracy (Daxecker and Prins, 2013; Jablonski and Oliver, 2013). For this reason, we only include a model with GDP per capita and its interaction with distance in robustness tests. However, we include per capita GDP as an indicator of the demand for piracy in each of primary models.
22. If we had systematic location information on pirate groups, then we could simply measure the average distance between capital and pirate group location. Unfortunately, other than for a few groups in a few countries (Somalia and Indonesia mostly), we do not know where pirate groups are located. Therefore, while our argument applies to the location of pirate groups, we measure the average distance between capital and coastline as a proxy for how far governments must project power over distance to affect pirates and piracy. The greater the distance, the more difficult it is to affect piracy, but this relationship also depends on state capacity.
23. Minimum and maximum distances were calculated as planar distances (i.e. as if the coastline was projected on a two-dimensional Cartesian coordinate system). Overseas territories (such as Guam for the US) were not included in these distance calculations.
24. Measuring only the maximum distance risks overestimating the effect of distance in states with long coastlines, but that also have capitals proximate to the coast. However, we present a robustness test that shows our results to be consistent when using a maximum distance measure.
25. As discussed, GDP per capita has also been used as an indicator of state capacity. We examined pairwise correlation coefficients between GDP per capita and measures of state capacity but found no problematic values. The variable is log-transformed (ln + 1) to reduce skewness in the data. Data are available at http://data.worldbank.org/.
26. The measure is log-transformed because of high skewness. Data are availabler= at http://www.wto.org/english/res_e/statis_e/statis_e.htm.
27. The CShapes dataset was used to create the inverted distance interdependence matrix (Weidmann et al., 2010).
28. A robustness test in Table 2 using feasible GLS for autocorrelation within and across panels and panel heteroskedasticity shows results consistent with the GEE estimator.
29. A robustness test (not presented) showed that results remained consistent with an AR2 specification.
30. We used the marginsplot routine in Stata 13 to create the interaction figures.
31. Pairwise correlation coefficients indicate a 0.63 correlation for distance and coastline length, and 0.75 for distance and land area, respectively.

32. Data on coastline length (in kilometers) come from CIA (2011).
33. Data on land area (in square kilometers) come from CIA (2011).
34. http://www.systemicpeace.org/inscr/inscr.htm
35. Insurance fraud, however, may contribute to over-reporting at times.
36. We ran each and every model in Tables 1 and 2 with the spatial lag of state capacity. The results remained consistent with those presented in models 1–6 and 8–13 and in most cases were a little stronger.

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