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WORKING PAPERS SERIES

Working paper 7/2011

GOV-AARGH-NANCE – "EVEN CRIMINALS NEED LAW AND ORDER"

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Gov-aargh-nance – "even criminals need law and order"[*]

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Keywords: Governance, Crime, Piracy, Informal governance, Law enforcement,

JEL Classification: K42, P48

[*] The research leading to these results has received funding from the European Union Seventh Framework Programme under grant agreement n°218105 (EUSECON). Capable research assistance was provided by Sebastian Wolf. We gratefully acknowledge the helpful comments by Karim Abadir, Svetlana Andrianova, Carlos Bozzoli, Gerrit Faber, Giacomo de Luca, David Fielding, Anthony Garratt, Sourafel Girma, Benton Gup, John Hunter, Peter Leeson, Francesco Martinez Mora, Nicolas Melissas, Jochen Mierau and seminar participants at DIW Berlin, Brunel University, Royal Holloway, and the Center for Strategic and International Studies (CSIS). Any mistakes are our own.

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1. Introduction

International patterns in piracy present an interesting puzzle. Despite public perception that "anarchy on land means piracy at sea"[1], state failure is not a statistically significant predictor of piracy (Coggins, 2010a). In Somalia, a country to which the above argument is often applied, piracy does not primarily originate from the anarchic South, but mostly from the more stable Puntland, and is reduced when violent territorial conflict intensifies (Coggins, 2010b; Percy and Shortland, 2010). In fact, between 1997 and 2009 the top five producers of piracy were countries with low to intermediate levels of governance, namely Bangladesh, India, Indonesia, Malaysia and Nigeria (Figure 1).[2]

These observations contradict the literature on the economic effects of governance, which argues both theoretically (Azuma and Grossman, 2008; Becker, 1968; Friedman *et al.*, 2000; Loayza, 1996) and empirically (Afzar and Gurgur, 2005; Fisman and Wei, 2009; Johnson *et al.*, 1998) that crime and illicit activity are reduced as governance improves. Therefore in this paper we re-examine the relationship between crime and governance, both theoretically and empirically.

We argue that there is a hump-shaped relationship between criminal activity and governance – that even criminals need a minimal level of law and order. The types of criminal activity we consider are those involving the production or acquisition of goods that cannot be directly and immediately consumed, for example piracy and drug production. At a bare minimum, such activities require criminals to be able to enforce their property rights over loot or illegal commodities prior to sale, and require access to markets. For convenience, we therefore refer to such criminal activity as "market-dependent" crime.[3]

We argue that such market-dependent crime is not viable at the bottom end of the governance spectrum. First, criminals need protection from other criminals who may attempt to steal their loot or extort their profits (Gambetta, 1993). Second, criminals need a basic transport and financial infrastructure as well as functioning markets to convert loot into cash or consumables. In collapsed states these requirements are mostly not met, meaning that,

[1] See, for example, Kaplan (2009) "Anarchy on Land Means Piracy at Sea" http://www.nytimes.com/2009/04/12/opinion/12kaplan.html

[2] International Maritime Board Annual Piracy Reports.

[3] We do not argue that all types of crime will exhibit a hump-shaped relationship with governance. For instance, our arguments do not apply to crimes which do not require access to markets or infrastructure (e.g. rape, murder, or the theft of consumables for direct consumption).

despite a higher probability of detection, criminals find better operating conditions in weakly governed countries providing relative stability and a basic infrastructure.

We begin by developing a simple model of the relationship between governance and market-dependent crime. Our principal innovation is to allow for a cost of holding and transacting illegal loot. In line with the existing literature, if this cost is set to zero, or decoupled from levels of governance, our model predicts a negative relationship between formal governance and crime. However, we allow the cost of holding and transacting illegal loot to be a decreasing function of both formal governance (which determines the enforcement of property rights and the provision of infrastructure) and informal governance (the additional enforcement of property rights organized criminal gangs can provide). Under this specification, we show that the particular interaction between formal and informal governance observed across the governance spectrum – informal modes dominate at low levels of governance, while formal modes dominate at high levels of governance – can lead to a breakdown in this negative relationship. Instead, the model predicts a hump-shaped relationship between governance and market-dependent crime.

We also investigate the role of corruption in the relationship between governance and crime. When corruption is allowed to arise endogenously within the model we predict a hump-shaped relationship between government control of corruption and crime. Additionally, the model predicts that more organizationally complex and higher-value crime ("sophisticated crime") develops from simpler and lower-value forms of crime in a limited set of countries where criminals are able to build up "criminal capital" over time. For sophisticated crime, criminals benefit from being able to bribe government officials.

Our main empirical contribution is to test the predictions of the model using a new dataset on global piracy. A unique feature of our dataset – it is reported by ship's captains – allows us to include in our sample countries for which no reliable crime data are collected by national governments. By contrast, the existing empirical literature relies solely on data from countries for which national statistics exist. We find that the inclusion of countries at the lowest levels of governance has important ramifications for the relationship between governance and crime: when such countries are properly included we find strong evidence that the relationship is hump-shaped. However, once these countries are artificially removed from our sample, we recover the negative relationship found in the existing governance literature.

We also show an association between corruption and sophisticated forms of piracy. As predicted theoretically, such piracy occurs mostly in countries with intermediately low levels of governance, specifically countries characterized by relatively effective, yet corruptible bureaucracies and countries where pirates can use informally governed regions for refuge.

Although our findings suggest that market-dependent crime decreases as governance improves over much of the governance spectrum, the finding that the relationship is more globally characterized as hump-shaped has some important policy implications for combating sophisticated crime. At low levels of governance, aid targeted at improving (informal) governance and infrastructure[4] may be counter-productive, because it may move criminals toward their "sweet spot" on the governance spectrum.

The paper is structured as follows. In section 2 we motivate a hump-shaped relationship between governance and crime. Section 3 builds on this idea to develop a theoretical model. Section 4 sets out our empirical modeling strategy; section 5 introduces a new dataset on global patterns of piracy; and section 6 presents the results. Section 7 concludes.

2. Governance and Crime

In this section we motivate a hump-shaped relationship between governance and market-dependent crime, using literature from both economics and sociology. We distinguish between "formal" modes of governance (provided by the state), and "informal" modes of governance. Benign informal governance may be provided by citizens (even under anarchy) to structure local social and economic interactions and discourage crime (Leeson, 2007 and 2009a). Examples are village councils, Islamic courts, traditional tribal, caste or clan-based structures and social norms. However, of more relevance to our paper, informal governance may also be provided by organized criminal groups to enable them to operate more effectively and profitably (Leeson, 2009b). In what follows we therefore take the term "informal governance" to refer to this last form of governance.

The complete absence of governance – the classic "jungle economy" where neither property nor human rights are protected (Piccione and Rubinstein, 2006) – is rarely observed in practice and, if so, only briefly during periods of intense civil conflict. Instead, failed states

[4] See, for example, Baker (2010).

are characterized by "informal" or "self-governance", which can deliver a basic level of economic development (Leeson, 2009c). Where there is a pool of young men trained in the use of violence and easy access to weapons, the dominant form of informal governance tends to be organized private protection.[5] However, unless these groups are well entrenched they behave as "roving bandits" - maximizing short-term gains by aggressively expropriating surpluses, thereby undermining investment and trade (Olson, 1993, p. 568). Several sociological studies document how, where territory is contested, protection rackets become unable to provide contract enforcement and physical security at an affordable price (Varese, 2001; Volkov, 2002).

The absence of stable informal governance also affects illegal activity negatively. Without effective protection the anticipation of opportunism, theft or extortion of the proceeds of crime constitutes a strong disincentive to "invest" in committing crime in the first place (Dixit, 2003). Second, criminals need the institutions which underpin the functioning of markets when the proceeds from crime and illicit activity need to be traded. Even a mugger needs to sell a stolen watch or mobile phone. Therefore, at the lowest levels of governance, the conditions for market-dependent crime might improve with increasing governance.

Countries with intermediate levels of governance are characterized by the co-existence of both formal and informal modes of governance. There is evidence that, at these intermediate levels of governance, formal and informal modes of government can act as complements (Ananth Pur, 2007; Boesen, 2007; Lazzarini *et al.*, 2004). If there is stability, informal governance institutions can uphold law and order locally and support a thriving "grey" or "shadow" economy. Organized criminal groups can provide private protection and enforcement of property rights, allowing criminals and non-criminals to transact and enjoy the gains from trade – albeit at a price (Dixit, 2003 and 2004; Gambetta, 1993). It may also be possible to purchase private protection by bribing an official, or, as for example in the case of 1990s Russia, employing the "extra-departmental" services of the official security forces (Varese, 2001; Volkov, 2002). The combination of stable informal and weak or corruptible formal governance may therefore be ideal for market dependent crime.

The countries where we observe the highest levels of governance are characterized by a predominance of formal governance over informal. Purely informal institutions are unsuited to delivering the highest levels of governance as they typically apply the law selectively and

[5] See, for example, Bandiera (2003) on the Sicilian Mafia.

only within their geographical sphere of influence (Dixit, 2004). Informal structures also often provide incumbent firms with protection against new entrants, which means that they are economically less efficient than state-provided "rule of law for all" (Varese, 2001; Dixit, 2004). Consistent with these arguments, the economic literature finds beneficial effects of improvements in the quality of formal governance on legal economic activity (Grossman and Kim, 1995; Kaufmann, 2004).

Crime and opportunities for bribing officials are discouraged by effective police forces and courts. Empirical studies (that, however, exclude countries with the lowest levels of governance) find that increasing levels of governance are associated with falling levels of crimes such as smuggling (Berger and Nitsch, 2008; Fisman and Wei, 2009) and theft (Afzar and Gurgur, 2005). In summary, therefore, the literature we review suggests a hump-shaped relationship between governance and market-dependent crime.

3. Theoretical Model

In this section we present a stylized model of the nexus between market-dependent crime, the costs of holding and transacting loot, and government corruption. A country is characterized by a level of total governance, $g \in [0,1]$, where $g = 0$ denotes a perfectly ungoverned state, and $g = 1$ denotes a state with perfect governance. We think of these two end values as theoretical extremes, between which lie all states that we observe empirically in the world. To distinguish between modes of governance, we assume total governance to be the sum of formal ($f[g]$) and informal ($i[g]$) governance

$$g \equiv f[g] + i[g],$$

where $f[g]$ is an increasing function $f : [0,1] \mapsto [0,1]$. Therefore, an ungoverned state satisfies $f[0] = i[0] = 0$, while under perfect governance all governance is formal: $f[1] = g = 1$, $i[1] = 0$.

To capture the idea that informal governance dominates at the lowest levels of total governance we assume that the first increment of governance above $g = 0$ is purely informal governance, $f_g[0] = 0$. A simple specification of the model satisfying these assumptions is given, for instance, by setting $i[g] = g(1-g)$, $f[g] = g^2$. Formal and informal governance are

complementary at low and intermediate levels of total governance, but act as substitutes at higher levels of total governance.

Individuals within the country have an initial wealth, *w*, and can choose to steal loot with a value of $x \geq 0$. The cost of planning and executing the criminal act required to attain *x* is given by $\phi[x]/k$, where $\phi[\cdot]$ is a cost function satisfying $\phi_x \geq 0$, $\phi_x[0]=0$, and $\phi_{xx} > 0$. The parameter k denotes an individual's level of "criminal capital", by which we refer to an individual's know-how in stealing loot. Having stolen *x*, a criminal nevertheless faces further hurdles. First, a criminal may be detained by the police authorities; second, a criminal must trade the loot for consumable goods.

The probability that a criminal is detained by the authorities, $d[\ f\ ]$, is a function of formal governance

$$d : [0,1] \mapsto [0,1],$$

which we assume to be strictly increasing.

If a criminal evades the authorities the implied transaction cost incurred in holding loot and trading it for consumables depends on the degree of law and order and functioning markets. The latter requires the enforcement of a minimum level of property rights, and the provision of a minimum level of infrastructure to get loot to market. While both markets and law and order are associated with formal governance, criminals can also use modes of informal governance to protect loot themselves.[6] We therefore assume that the share of the loot lost in holding and transaction costs is a function of total governance, $m[g]$, given by the mapping

$$m : [0,1] \mapsto [0,1],$$

which we assume to be strictly decreasing. The criminal is therefore able to consume a proportion $(1-m[g])$ of the loot.

The potential for corruption of the authorities arises endogenously within the model. If a criminal is detained by the police, the criminal can offer a bribe $b \in [0, x]$.[7] The behavior of officials is described by the function

[6] They can also provide public goods such as the physical infrastructure required for their business. However, in most cases this would be prohibitively expensive.
[7] Although the criminal can offer a bribe of any magnitude, it is never an equilibrium to offer a bribe $b > x$.

$$a:\ [0,x] \times \mathrm{P}_{+} \mapsto [0,1],$$

where $a[b,c]$ is the probability that a bribe of size b is accepted, given the ability of the state to control corruption c. In turn, we assume the ability of the state to control corruption, $c[f]$, to be a strictly increasing function of formal governance, $c:[0,1] \mapsto \mathrm{P}_{+}$.

We assume, first, that higher bribes are more attractive to officials than lower bribes, $a_b > 0$, but at a diminishing rate such that $a_{bb} < 0$. Second, stronger controls against corruption reduce the propensity of officials to accept bribes, $a_c < 0$. Last, $a[0,c] = a[b,c[1]] = 0$, so a zero bribe is always rejected, and a bribe of any size is always rejected in a state with perfect governance. A simple specification that satisfies these properties is given by, for example, $a[b,c[f]] = 1 - c[f]^b$, $c[f] = e^{-(1-f)}$.

If the authorities reject the bribe, the loot is confiscated.[8] If the authorities accept the bribe, the criminal is permitted to keep the loot.[9] The resulting structure of the model is illustrated in Figure 2, where the payoffs (Z_A, Z_R, Z_N) are given by

$$\begin{aligned} Z_A &= w - \frac{\phi[x]}{k} + (1 - m[g])x - b; \\ Z_R &= w - \frac{\phi[x]}{k}; \\ Z_N &= w - \frac{\phi[x]}{k} + (1 - m[g])x. \end{aligned}$$

Along the lines of Becker (1968), individuals choose (b,x) to maximize their expected utility. For simplicity, we assume individuals are risk neutral, so expected utility is written as

$$EU = w + d[f]\{a[b,c]((1 - m[g])x - b)\} + (1 - d[f])(1 - m[g])x - \frac{\phi[x]}{k}.$$

The first order conditions for (b,x) are therefore

[8] In de Groot *et al*. (2011) we show that the main qualitative results also extend to the case where the criminal is additionally punished (fined) in proportion to the size of the loot, at a rate $p > 0$.

[9] More generally, the authorities might agree to actively assist the criminal in trading the loot for consumables. The value of this assistance would presumably reflect the capability of the authorities to enforce property rights more generally, as measured by the level of formal governance *f*. In de Groot *et al*. (2011) we show that the model can be extended to this case, while preserving the main qualitative results.

$$x: d[f](1-m[g])(1+a[b,c]-d[f]) = \frac{\phi_x[x]}{k};$$

(1)

$$b: d[f]\{a_b[b,c](x(1-m[g])-b)-a[b,c]\} = 0. \qquad (2)$$

These, together with the boundary conditions $(b,x) \geq 0$, implicitly define the equilibrium level of crime and bribes as functions of governance $(b[g], x[g])$. It is straightforward to verify that the associated Hessian matrix is negative definite, so (1) and (2) are sufficient for an interior maximum.

We can now state the following proposition:

Proposition. *At a stable equilibrium, the following hold:*

i) There is no market-dependent crime at both extremes of total governance: $x[0] = x[1] = 0$*;*

ii) Crime is initially increasing in total governance: $x_g[0] > 0$*;*

iii) If crime is hump-shaped in total governance, then it is also hump-shaped in formal governance (f) and corruption control (c).

iv) Experienced (high-k) criminals commit higher value crime ($x_k[g] \geq 0$*), offer larger bribes (*$b_k[g] \geq 0$*), and have more bribes accepted (*$b_k[g]a_b \geq 0$*).*

Part (i) of the Proposition establishes that there is no market-dependent crime at either extreme of the governance scale. In the absence of governance, although there is no probability of being detained by the police, criminals are unable to consume the loot, because of the absence of law and order and a functioning market. Under perfect governance, there is again no crime, but for different reasons: opportunities for crime are closed down by effective policing, and officials cannot be bribed.

Part (ii) establishes that, initially, crime is an increasing function of governance. The intuition is that the first increment of governance is purely informal governance, which acts to improve the conditions required for the operation of criminal markets, while leaving the probability of detention unchanged.

Together, these results predict a hump-shaped relationship between total governance and crime. Our hypothesis is therefore that there is a "sweet spot" for criminal activity on the governance spectrum. It occurs where the combination of formal and informal governance is strong enough to sustain a reasonable infrastructure and prevent violent conflict between rival (criminal) groups over resources and territory. Governance is mainly informal and the state ineffective in reigning-in illicit activity.

Part (iii) of the Proposition is a simple corollary of parts (i) and (ii). It follows from the observation that, as crime is hump-shaped in total governance, any increasing function of total governance (of which formal governance and corruption control are two) will also have a hump-shaped relationship with crime.

Last, part (iv) of the Proposition summarizes the role of criminal capital. Experienced (high-*k*) criminals incur less cost to steal a given value of loot, and, therefore, optimally steal more. Although ours is a static model, in practice criminal capital is accumulated over time with successful criminal operations. The equilibrium level of crime at both extremes of the governance spectrum is low, thereby limiting capital accumulation. However, at the sweet spot the high equilibrium rate of crime offers the opportunity for a more rapid accumulation. Empirically, therefore, we should expect to see an escalation in the value and sophistication of criminal activity over time in countries at the sweet spot.

4. Empirical Modelling

Piracy is an ideal case study of the relationship between market-dependent crime and governance. Sörenson (2008) points out that boarding and hijacking a ship does not present a real problem to a determined criminal with basic firepower or good knife-skills, as merchant ships are traditionally unarmed. The real challenge is to remain in control of the ship for a sufficiently long time to extract a profit through extortion or sale of the cargo and (at best) hull. Profitable piracy therefore requires access to secure refuges and an infrastructure for unloading cargo and providing the ship with a new identity - as well as markets for the loot.

In this section we describe how we can quantitatively test the propositions derived in section 3 using a new dataset on the incidence of maritime piracy. Figure 3 illustrates the hypothesized relationship between piracy and governance. As the quality of governance improves the intensity of piracy initially increases. Other things equal, better governed

territories attract more shipping traffic and increase opportunities for piracy. Infrastructure and markets improve and pirates worry less about their profits being contested by rival gangs. At the sweet spot sophisticated forms of piracy (such as hijack and ransom and cargo theft) become feasible for high-*k* criminals and occur alongside minor theft.

Beyond the sweet spot, other forms of economic activity become increasingly attractive and there is a natural attrition out of piracy and into other forms of business. Additionally the state begins to assert control over its territorial waters and port facilities – not least because it has increasing interest in safeguarding its imports and exports – causing more pirates to go straight (or to prison). A highly effective government will see only occasional incidents of petty forms of piracy. For the empirical modeling we therefore split the dependent variable into petty maritime crime and sophisticated forms of piracy.

4.1. Empirical Modelling

4.1.1. Logit Model of Presence / Absence of Piracy

First, we examine the probability of pirate activity being reported from a location. For this we construct a dummy variable that indicates whether or not a particular form of piracy takes place in a country during a particular year. To examine the drivers of piracy we use logit model of the form:

$$\Pr\left(piracy_{it} = 1 \right) = \frac{e^{\eta_{it}}}{1 + e^{\eta_{it}}},$$

where $piracy_{it}$ is a dummy variable that takes value 1 if an act of piracy takes place in country *i* during year *t* and

$$\eta_{it} = \beta_0 + \beta X_{it} + \upsilon_i + w_t + \varepsilon_{it},$$

where X_{it} is the set of proxies for governance quality and our controls for motive and opportunities; υ_i and w_t are zero-mean random effects associated with group and time features; and ε_{it} is the residual error term. A unique aspect of our empirical approach is that we allow measures of governance to enter in a non-linear way by the inclusion of a quadratic term. The implicit null hypothesis of the existing literature is that the co-efficient on the linear governance term is negative, and the co-efficient on the quadratic term is zero. On the

basis of our model, we hypothesize that this null can be rejected against the alternative hypothesis that the co-efficient on the linear term is positive, and the co-efficient on the quadratic term is negative (in which case piracy is hump-shaped in governance).

We use random effects in our estimation because of the characteristics of the data. In several countries piracy is endemic, while no piracy is reported for others at all. Employing fixed effects reduces the sample by about two-thirds, with most of the interesting observations dropping out. Additionally, fixed effects are unlikely to be informative because the levels of governance within countries do not change much over the thirteen-year period of data. For instance, government effectiveness changed by more than one standard deviation in only 8 countries between 1996 and 2008.[10]

4.1.2 Sample Selection

We then check how our result relates to the previous empirical literature on governance and crime. Countries at the very bottom of the governance spectrum are systematically excluded from existing studies, because state collapse results in the complete breakdown of data collection. Even when a state has some data collection capacity, there may be severe concerns about data quality: Soares (2004) and Azfar and Gurgur (2005) show that the willingness to report crime is positively correlated with institutional quality and negatively with corruption. As we cannot restore missing observations to previous studies, we instead re-run some of the piracy models excluding the very badly governed countries. We show that, beyond a certain cut-off, the hump-shaped relationship breaks down and the established result of the governance literature is convincingly resurrected.

4.1.3. Intensity of Piracy

Second, we investigate the factors determining the intensity of piracy, where our model again predicts a hump-shaped relationship with governance. Although the intensity variables are counts of different types of incidents occurring each year, they do not follow the traditional distribution associated with count data, e.g. the Poisson distribution or a variant thereof (Figure 1). First, the dataset is dominated by zero observations – i.e. no acts of piracy are reported for about half of the countries, and many more only see piracy occasionally. Second, when the conditions are very favorable for carrying out acts of maritime crime, a large

[10] Government Effectiveness worsened in Cote d'Ivoire, North Korea, the Comoros, Mauritania and Eritrea. It improved in St. Vincent and the Grenadines, Malta and Dominica.

number of acts are reported. To avoid the few locations with large observations dominating the results, and to take into account the zero observations, we use a log transform of the intensity variable $log(1 + piracy_{it})$ and perform a panel Tobit regression. This assumes that there is a linear relationship between the independent variables in X_{it} and an unobserved (latent) variable y_{it}^*. We only observe y_{it}^* if it is positive, otherwise we observe a zero:

$$y_{it} = \begin{cases} y_{it}^* \text{ if } y_{it}^* > 0 \\ 0 \text{ if } y_{it}^* \leq 0 \end{cases};$$

where $y_{it}^* = \beta_0 + \beta X_{it} + \upsilon_i + w_t + \varepsilon_{it}$. In what follows we report the results for two samples: the complete sample (i.e. all countries with coastlines, where non-zero observations make up about 20% of total observations) and a sample of all countries in which at least one act of piracy was reported during the period (here non-zero observations make up just under 40% of the total observations).

4.1.4. Persistence of Piracy

Our model also makes predictions about the pattern of piracy over time. The countries where piracy can persist (and intensify) are predicted to be those which function relatively well, but have corruptible bureaucrats. Where governance is highly effective we would expect piracy to be tackled quickly, while in collapsed states opportunities for piracy arise infrequently and the booty could be contested or difficult to sell, lowering the gains from piracy. We therefore estimate a series of dynamic models with a lagged dependent variable, as well as interaction terms between the lagged (dummy) variable and the quality of governance.

5. Data

5.1. Piracy dataset

We construct a new dataset from the Annual Piracy Report compiled by the International Maritime Bureau (IMB). Incidents of piracy are directly (and voluntarily) reported by the victims to the IMB. Concise narratives of each incident including the position, mode of attack, its success or failure and the extent of the damage caused are posted on a website and published in the IMB's annual report. This ensures that ship-owners and captains are aware

of current piracy hotspots and can increase vigilance, adjust routes or arrange insurance accordingly. The dataset therefore provides a unique opportunity to study the prevalence of a particular type of crime all across the world, regardless of the quality of each country's police and statistical services. We use annual observations of all 148 countries with a coastline observed for the years 1997-2008.[11]

The IMB defines piracy as any "armed maritime crime", which includes attacks on ships at anchor and against steaming ships in territorial waters.[12] We use the narratives to extract the following information. First, we create an annual dummy for whether or not piracy is reported for a country as well as an annual count of the number of incidents in each country.[13] Second, we code "successful" attacks according to their severity into petty maritime crime and sophisticated forms of piracy.[14] We code as "petty crime" any theft from boats in quantities that can be carried by a small number of people – most of these attacks are on boats at anchor. Sophisticated forms of piracy include hostage-taking, large-scale thefts, hijacking for ransom and the disappearance of entire ships with their cargo. These forms of piracy require a greater level of organization and criminal capital – but also access to markets and an infrastructure (or at least protection for hostages while negotiations take place). Last, we split attacks in which pirates failed to board their target into "attempted" attacks on stationary ships (likely to be attempted petty theft) and attacks on steaming ships (requiring greater sophistication).

The IMB's data on piracy are not perfect and we take this into account in our statistical models. For instance, there may be under-reporting: not every incident is necessarily reported to the IMB. Shipping companies sometimes prefer not to report a pirate attack, because it is thought to reflect badly on them (Murphy, 2007). Additionally, reporting incidents of successful boarding can lead to lengthy forensic investigations confining ships to harbor (Chalk, 2009). Last, ship-owners may not want to alert insurance companies to an emerging piracy hotspot (which could justify a hike in insurance cost) and instead cover minor

[11] We exclude countries exclusively bordering the Black Sea and Caspian Sea as piracy is rare there and cannot be attributed to a particular country with certainty.
[12] This is a more inclusive definition than that provided by the United Nations Convention on the Law of the Sea in Article 101, which, for instance, restricts piracy to violent acts that occur on the high seas, or outside the jurisdiction of any state (http://www.un.org/Depts/los/convention_agreements/texts/unclos/part7.htm).
[13] We exclude all piracy events where the nationality of the pirates is not clear. This occurs mostly in the South China Sea, where acts of piracy are reported for all the littoral states in addition to a number of non-attributable attacks on the "high seas". Excluding the high seas events therefore only affects the intensity of piracy measure.
[14] The IMB considers attacks "successful" if the pirates board the ship. We consider attacks successful if the pirates obtain at least some loot from the operation. We count as unsuccessful those attacks where pirates were chased off a ship without loot.

expenses arising from pirate attacks themselves.[15] However, the IMB piracy reporting centre points out that there are strong norms and ethics regarding the warning of fellow Masters within the international shipping community. It is therefore highly unlikely that a country which regularly experiences piracy directed at ocean-going vessels would be missed by the piracy reporting centre altogether, though in some locations it is estimated that only 30% of attacks are reported.[16] For this reason we use the dummy variable for whether or not piracy occurs in a country in our main models instead of the intensity of piracy variable.

In piracy hotspots we risk the opposite problem: over-reporting. Attack figures can be exaggerated by captains reporting "suspicious vessels" which may well be innocently fishing or trading. This is an additional reason for de-emphasizing the weight of piracy hotspots by taking logarithms of the intensity measures.

5.2. Measures of Governance Quality

The exogenous variable of interest is the quality of governance. For this, we primarily use the Kaufmann *et al.* (2009) dataset on governance. It summarises the opinions of a large number of country experts regarding the quality of public goods provision and law enforcement by central government, and the extent to which political power is exercised for private gain. The "Rule of Law" index captures the phenomenon we seek to cover most closely. However, the measure is partially based on country expert's opinions of the pervasiveness of crime and the occurrence of piracy could influence expert opinions on the overall quality of law enforcement. For this reason we use "Corruption Control" (analogous to the variable *c* in our theoretical model) and "Government Effectiveness" as our main proxies for institutional quality and use "Rule of Law" only as a robustness check. Pirates only provide governance and public goods locally (if at all) and the Kaufmann data pertain specifically to formal governance provided by the "state". Therefore the corruption and effectiveness variables are unlikely to be biased by the existence of piracy in a country.

Kaufmann *et al.* (2009) report estimates for each country from 1996 to 2008,[17] and Kaufmann (2004) shows that it is feasible to treat these estimates as panel data. We use these data to test part (iii) of the Proposition – that crime is hump-shaped in formal governance.

[15] (http://www.usatoday.com/news/world/2010-07-03-nigeria-privacy_N.htm)
[16] Personal communication from Captain Mukundan, IMB, London.
[17] For the years 1997 and 1999, Kaufmann *et al.* unfortunately do not report any data. In order to be able to use these years nonetheless, we chose to interpolate the missing years from the reported data. Knowing that the

There are, as yet, no comprehensive global indices of informal governance. We do, however, have two variables providing further indicative information about the conditions within countries that might influence the ability of criminals to establish modes of informal governance. The first of these is the occurrence and intensity of conflict. This may indicate that the governance score reported by Kaufmann is not uniformly applicable across the country, because some regions are not governed by the central authority. To capture conflict intensity, we use the MEPV dataset (Marshall and Cole, 2009), which reports on political violence in all countries in the world. This database is particularly useful for our purpose, because it reports the magnitude of societal impact of civil or ethnic violence in each year varying from 1 (sporadic political violence) to 10 (extermination and annihilation).[18] We look at the effect of different levels of conflict; the idea being that intense contest over territory is not helpful for pirates, while abdicated governance and low level conflict may well aid piracy.[19]

The other variable – drug production – builds on the idea that (sophisticated) piracy might flourish in countries where we observe other types of organized crime: corrupt officials and protection rackets, which are helpful to the drug trade, could also be used by pirates. For this we use the annual International Narcotics Control Strategy Report (1997 to 2010) of the Bureau for International Narcotics and Law Enforcement Affairs. Each year the report identifies a list of countries that significantly contribute to the production or distribution of non-synthetic prohibited drugs. We create a dummy variable of whether or not a country is included on this list in a specific year.[20]

5.3 Control variables

In order to test our hypotheses regarding governance and piracy, we control for other possible determinants of piracy suggested by the existing – largely qualitative – literature (e.g. Murphy, 2007 and 2010; Sörenson, 2008). The first common theme in these analyses is "opportunity", such as a favorable geography, busy harbors and / or proximity to trade routes. Second, would-be pirates need access to the "means" of piracy, such as boats, capable sea-

quality of governance does not change very quickly and recognizing that we are mostly interested in major differences in the quality of governance, we believe this is safe.

[18] Within the time period that we are looking at, the maximum level of conflict intensity is 7.

[19] Both because abdicated governance can result in pirate havens and conflict means easy access to weapons.

[20] We only include countries producing non-synthetic drugs. We also considered the possibility of using the presence or size of counternarcotics aid provided by the US government as an indicator for drug production, but, as counter-narcotics aid is used as a political tool, there is a very strong correlation between distance from the US and the likelihood of receiving such aid. For the other drugs variable, this correlation is much less strong.

men, weapons and men trained in their use ("maritime tradition"). Third, the "profit motive" of piracy might be stronger in poor countries or during economic crises. Fourth, the ability and willingness of a government to intervene to stop piracy is a final factor in determining the emergence and the amount of piracy in a location.[21] State failure is argued to be positively associated with at least some forms of piracy (Hastings, 2009).

To capture opportunity (and maritime tradition) we first use the number of deep ports per country, defined as ports large enough for ships that adhere to the New Panamax standard (World Sea Ports, 2010). Second, we include a dummy for countries that border one of the following choke points: the Suez Canal and Bab-el-Mandeb, the Panama Canal, the Malacca Straits, the Strait of Hormuz and the Bosphorus (Rodrigue, 2004).[22] Each of these passages can only be circumvented at great economic cost, whereas otherwise it is possible to avoid the coastline of piracy-prone states. Moreover, busy, narrow shipping lanes cause ships to slow down, making them easier to board. The presence of a choke point therefore improves conditions for piracy.[23]

To capture the effect of poverty as a motive for piracy we use the indicator of poverty which is most widely available regardless of the level of governance (GDP per capita).[24]

To specifically test for the role of state failure, over and above our other measures of governance, we also include a dummy indicating whether a country in a particular year is considered to suffer from state failure. We define state failure using the Polity IV dataset (Marshall *et al.*, 2010), which gives an error value of -77 for country-years where the situation is so chaotic that it is impossible to judge institutional quality. If our measures of governance are valid, we would not expect to find any additional relationship between state failure and piracy.

We are also concerned about possible reporting bias: relations with the IMB reporting centre might be particularly good in Asia as the IMB data are collected in Kuala Lumpur. We

[21] Both practitioners and academic commentators agree that foreign naval and private defense measures cannot resolve piracy (see e.g. Percy and Shortland, 2010; Shortland and Vothknecht, 2010).
[22] Somalia is judged to benefit from the Bab-el-Mandeb choke point despite not technically bordering it, as Somali pirates operate in the Red Sea as well as the Gulf of Aden.
[23] We were unable to access data on the intensity of shipping traffic on the various trade routes. A dummy variable indicating whether a country is an oil exporter, which would generate shipping traffic regardless of governance issues, was not significant in any regressions specification and is omitted from the reported results.
[24] As GDP per capita is highly correlated with quality of governance indicators, multicollinearity may occur. Where we found GDP per capita to be significant, we report the results both with and without this variable to show that the statistical relationship for the governance variables is not spurious.

therefore include a variable measuring the distance between each country's capital city and Kuala Lumpur to control for this potential bias.[25]

Table 1 contains a summary of the descriptive statistics of all our variables and Table 2 summarizes their sources.

6. Results

6.1. Small-scale Maritime Crime

6.1.1. Logit Model

Table 3 reports the results for small-scale maritime crime.[26] The three dependent variables are dummies that indicate whether the following types of attack occurred at least once during the year: 1) successful small-scale theft, 2) successful and unsuccessful small-scale theft and 3) all attacks on stationary ships, regardless of whether or not they were successful. We observe a hump-shaped effect in governance quality: the governance term has a positive coefficient and the quadratic governance term has a negative coefficient, significant at the 5% level in all model specifications. It does not matter which proxy we use for the quality of governance: qualitatively, the same result is obtained for rule of law, corruption control and government effectiveness. We also test the validity of the assumption that $\alpha = 2$ in $governance^{\alpha}$ by varying α and finding the value for which the Akaike Information Criterion is minimized. The optimal value of α differs between models, but is always close to 2. For conciseness and convenience of interpretation, we report the regressions using $\alpha = 2$.

In addition we have two further governance-related variables which increase the probability of maritime crime: 1) the existence of low-level civil conflict, which undermines the quality of governance, at least locally, and raises the availability of weapons in a country, and 2) an acknowledged problem with drug production and distribution, which means that (armed) criminal gangs are already organized in the country. However, the drug dummy is not robustly significant across regression specifications.

[25] This control is only significant in one model. Therefore it is otherwise excluded from the reported results.
[26] All reported results are calculated using Stata 11. Slight differences in the estimation results occur depending on the version of Stata used, the starting estimates and number of quadrature points used by the program. Using the "quadchk" routine we find that there may be relative differences in the estimated coefficients of up to 1%. To make the reported results replicable we set the quadrature points to 24 in all specifications. Our main result on the relationship between governance and piracy is robust to the version of Stata and the number of quadrature points used.

As hypothesized, the state failure dummy is not significant in any regression specification. The finding is consistent with the earlier study of Coggins (2010a), which found almost no support for state failure as a driver of piracy.

As for the control variables, the small-scale piracy dummy appears to be linked to poverty, in that the *log(GDP per capita)* variable is highly significant (in addition to the governance variables). Foreign ships are a tempting target in poor countries. The final relevant factor is the opportunity arising from ships berthed in harbors. Interestingly here we have another quadratic effect: deep sea ports create opportunities, but countries with a strong maritime tradition (and hence several deep sea ports) appear to invest in effective deterrents against piracy.[27] The optimal arrangement for pirates probably occurs if all of a country's shipping traffic is concentrated in a few congested ports with busy anchorages.

6.1.2. Sample Selection

We test how our result relates to the previous literature on governance and crime by artificially increasing the governance threshold at which countries enter our sample. Table 4 replicates model 3a. The significance of the coefficient in the quadratic relationship initially improves when we exclude observations from the very bottom of the governance spectrum. This is because we discard an obvious outlier - Somalia - which produces persistent and intense piracy despite its low governance score. However, the governance score for Somalia as a whole reflects conditions in Southern and Central Somalia: the governance score of the pirate province, Puntland, would probably be somewhat higher if measured separately.

When increasing the cut-off for inclusion to -0.7, we retain the previous result (column 4a in Table 4). But once we increase the government effectiveness threshold to exclude all countries below -0.6 (model 4b in table 4), we see that the hump-shaped relationship breaks down - the quadratic term is no longer significant.[28] Instead the previous result of a negative, linear relationship is once again highly significant (column 4c). We therefore conclude that the effects of governance obtained from empirical estimations in the medium to high governance range seem not to hold for countries towards the bottom of the governance spectrum.

[27] When we control for GDP per capita this effect disappears, however.
[28] Table 8 lists the countries with government effectiveness scores below -0.7 that are therefore excluded from this analysis.

6.2. Intensity of Piracy

Table 5 summarizes the results on the intensity of (small-scale) maritime crime. We find a robust result that at the bottom end of the governance spectrum criminals actually benefit from improvements in security, stability and public services and reduced corruptibility of government officials. As governance improves further, the incidence of theft from ships begins to fall. This main result does not depend on whether we use all countries or only countries from which piracy was reported at least once, nor on the definition of governance (we see very little difference between the three proxies in models a, b and c).[29] Once again we confirm the importance of opportunity (major ports give easy access to targets) and of poverty as a motive for small-scale theft from ships (the number of incidents is reduced as GDP per capita increases). The intensity regressions therefore confirm the results from the probability regressions.

6.3. Dynamics of Piracy

Table 6 includes a lagged dependent variable in both the small-scale and large-scale piracy logit regressions to investigate the persistence of piracy. In model 8a we see that the persistence of small-scale piracy depends on the institutional quality in the country. The interaction terms between lagged small-scale piracy and the governance variables are highly significant. Persistence becomes more likely with increasing governance initially and then decreases with better governance – i.e. we see occasional opportunistic piracy in high and very low governance countries and regular piracy in the middle. The raw governance variables are no longer significant in this model (8b). We therefore find a hump-shaped relationship between governance and the persistence of piracy.

6.4. Sophisticated Piracy

For the sophisticated forms of piracy we look at the different types of attacks separately. The results are presented in Tables 7 and 8. The most lucrative type of piracy is the theft of entire ships and / or major amounts of cargo. This is the turning point on the curve pictured in

[29] The result is also confirmed when we use a panel ordered probit (*reoprob* in Stata 11) instead of the Tobit model. We grouped countries according to whether piracy was not, rarely, occasionally or frequently reported.

Figure 3, and while the quadratic effect in governance is preserved in the coefficients, it is (as expected) no longer significant. Instead we observe a very interesting interaction between two aspects of quality of governance (models 9 and 10). Major theft increases in government effectiveness, which measures (among other things) the quality of public goods provision. This would include infrastructure, such as the port and dock facilities pirates need to unload the cargo and give a ship a new identity. On the other hand, there is a strong negative effect on major theft as the government increases its control of corruption. This result is consistent with our model: part (iv) of the Proposition shows that experienced criminals account for a disproportionate share of successful corruption, as they offer the highest bribes, which, in turn, have a higher probability of being accepted. Sophisticated crime – the type performed by experienced criminals – could therefore be expected to exhibit especial sensitivity to the ease of corruption.

Last, the existence of petty forms of maritime crime increases the likelihood of more ambitious forms of piracy occurring. This provides evidence for part (iv) of the Proposition (criminals take advantage of favorable conditions to build criminal capital) and fits in well with explanations of Somali piracy, which focus on Somali fishermen initially stealing from ships, and eventually moving on to extortion and large-scale hijack and ransom (Jasparro, 2009; Tharoor, 2009).[30]

Among the control variables, we find evidence for the importance of choke points and major ports in generating opportunities for pirates. The log of GDP per capita (as an indicator of a poverty motive) is not significant alongside the governance variables (which maintain significance in specifications which include GDP per capita). Our interpretation is that sophisticated piracy is organized crime and not driven by extreme poverty.

Model 11b in Table 8 shows that the effects of governance on the hostage taking form of piracy are similar to those for major theft: both corruption and a reasonable level of government effectiveness are helpful for this form of piracy. Pirates need stability to keep their hostages safe from other groups while negotiating ransoms – if this security can be provided by corrupt government officials so much the better. However, model 11a indicates that this result is not completely robust, and should therefore be treated with caution: when we control for possible reporting bias the government effectiveness variable loses

[30] Table 7 reports the result for the contemporaneous petty piracy variable. Very similar results are obtained when using the same variable lagged by one period.

significance and distance from Kuala Lumpur takes on significance instead. However, the low-level ethnic conflict dummy is robustly significant; indicating that pirates take advantage of areas where government control is compromised but not violently contested. Major ports also provide opportunities for hostage taking. As with major theft, there is again no evidence for a poverty motive from the GDP per capita variable for hostage taking.

The main governance variable determining the probability of hijacking of ships and their ransom without theft of cargo is low-level conflict. This indicates the importance of ungoverned territories for anchoring ships while ransoms are being negotiated. While there appear to be benefits from corruption in specifications (12 and 13), these disappear if we control both for Somalia as a special case and for the existence of petty forms of piracy, which are in themselves linked to institutional weakness (model 14).[31] As with major theft, we again have evidence that sophisticated piracy develops from petty forms of piracy when the conditions are right. Again there are no GDP per capita effects indicating that sophisticated pirates are not the opportunistic poor but relatively well resourced.

6.5. Summary and Interpretation

The results show a clear hump-shaped relationship between governance and the probability, intensity and persistence of (maritime) crime. In addition we have evidence that when parts of a country are governed by criminal or insurgent / dissident groups, these may well engage in piracy to increase the profitability of their operations. The Kaufmann governance indicators, which provide a broad picture of institutional quality at the national level, may not adequately represent institutional quality in these pockets of lawlessness.

Looking at the coefficients, the models predict that the best conditions for petty maritime criminals exist in countries where the government effectiveness score is in the region between -0.9 and -0.5 and the corruption score between -1.3 and -0.9. Countries like Bangladesh, Cambodia and Cameroon are exactly in this range, while countries such as Liberia, Haiti, and Sierra Leone are "too dysfunctional" for a thriving piracy business.[32]

[31] Eleven of the 45 observations of country years with hijack and ransom are generated by Somalia and the Somalia dummy is highly significant.

[32] Institution-building measures in Indonesia are reflected in the considerable improvements in its governance scores, moving pirates from being right in the sweet spot up until 2003 to well beyond it by 2008.

7. Conclusions

We have provided both a theoretical model and empirical evidence showing a hump-shaped effect of governance on market-dependent criminal activity. Criminals, and especially organized criminal groups, benefit from improvements in markets and state and informal governance structures at the bottom end of the governance spectrum. The model and results accord with sociological research on organized criminal groups.

Because the piracy dataset is based on victim reports to the IMB rather than being collected by governments via local police authorities, it allows us to study crime in countries which do not provide sufficient data to be included in previous empirical studies of the economics of crime. Specifically, we are able to show that piracy benefits from improvements in governance at the lower end of the governance spectrum, as access to markets and infrastructure improves and protection of the loot becomes less costly. In weakly governed countries piracy can become endemic, while in collapsed states and well governed countries piracy occurs only very occasionally. Informally governed territories within countries can additionally provide safe havens for criminal activity.

For sophisticated piracy (and by extension other forms of lucrative organized crime) we show that optimal conditions arise when corrupt elites or bureaucracies are able to provide selective access to excellent physical infrastructures and thriving markets in return for bribes. Given that the various aspects of institutional quality tend to be highly correlated, such conditions arise only rarely: for example when a sudden deterioration in economic performance or political stability undermines discipline and commitment in the civil service, as was demonstrated in Indonesia after the Asian crisis.

We believe that our results on the effect of governance on maritime crime can be generalized to other market-dependent crime. Most of the world's main drug producers (e.g. Bolivia, Colombia, Ghana, Mexico, Paraguay, Peru and Thailand) are weak states (Afghanistan and Burma are exceptions). Even terrorist organizations have found substantial obstacles to setting up training camps in collapsed states (Harmony, 2007). Organized criminal groups, such as the Italian Mafia, thrive in environments where government effectiveness and corruption exist alongside one another: precisely the conditions our models suggest are ideal for sophisticated piracy, too.

In summary: the established result of a negative, linear relationship between governance and crime obtained by analyzing (mostly or exclusively) reasonably well governed countries does not necessarily apply to countries at the bottom of the governance spectrum. Criminality might increase as markets create new opportunities and can become endemic unless bureaucrats are incentivized to tackle rather than tolerate or protect criminal organizations. This insight needs to be factored into policy advice to countries emerging from state failure.

References

Ananth Pur, Kripa. 2007. "Rivalry or Synergy? Formal and Informal Local Governance in Rural India." *Development and Change,* 38(3): 401-421.

Azfar, Omar, and Tugrul Gurgur. 2005. "Government Effectiveness, Crime Rates and Crime Reporting." Unpublished.

Azuma, Yoshiaki, and Herschel I. Grossman. 2008. "A Theory of the Informal Sector." *Economics & Politics*, 20(1): 62-79.

Bandiera, Oriana. 2003. "Land Reform, the Market for Protection and the Origins of the Sicilian Mafia: Theory and Evidence." *Journal of Law, Economics and Organization*, 19(1): 218-244.

Baker, Michael L. 2010. "Swapping Pirates for Commerce: An African Maritime Growth Initiative." *Foreign Affairs*. October 4, http://www.foreignaffairs.com/articles/66762/michael-lyon-baker/swapping-pirates-for-commerce

Becker, Gary S. 1968. "Crime and Punishment: An Economic Approach." *Journal of Political Economy, 76*(2): 169-217.

Berger, Helger, and Volker Nitsch. 2008. "Gotcha! A Profile of Smuggling in International Trade." CESifo Working Paper 2475.

Boesen, Nils. 2007. "Governance and Accountability: How do the Formal and Informal Interplay and Change." In *Informal institutions: how social norms help or hinder development*, ed. Johannes Jütting, Denis Drechsler, Sebastian Bartsch and Indra de Soysa, 83-100. Paris: OECD Publishing.

Bureau for International Narcotics and Law Enforcement Affairs. 1997-2010. International Narcotics Control Strategy Report. http://www.state.gov/p/inl/rls/nrcrpt/index.htm.

Chalk, Peter. 2009. "The Evolving Dynamic of Piracy and Armed Robbery in the Modern Era: Scope, Dimensions, Dangers, and Policy Responses." *Maritime Affairs*, 5(1): 5-21.

Coggins, Bridget. 2010a. "Global Patterns of Maritime Piracy and Non-Traditional Threat (2000-2009)." Unpublished.

Coggins, Bridget. 2010b. "Nothing Fails Like Success: Anarchy, Piracy and State-building in Somalia." Unpublished.

de Groot, Olaf J., Matthew D. Rablen, and Anja Shortland. 2011. "Gov-aargh-nance – Even Criminals Need Law and Order." CEDI Working Paper No. 11-01, Brunel University.

Dixit, Avinash. 2003. "On Modes of Economic Governance." *Econometrica*, 7(2): 449-481.

Dixit, Avinash. 2004. *Lawlessness and Economics Alternative Modes of Governance*. Princeton, NJ: Princeton University Press.

Fisman, Raymond, and Shang-Jin Wei. 2009. "The Smuggling of Art, and the Art of Smuggling: Uncovering the Illicit Trade in Cultural Property and Antiques." *American Economic Journal: Applied Economics*, 1(3): 82-89.

Friedman, Eric, Simon Johnson, Daniel Kaufman, and Pablo Zoido-Lobaton. 2000. "Dodging the Grabbing Hand: The Determinants of Unofficial Activity in 69 Countries." *Journal of Public Economics*, 76(3): 459-493.

Gambetta, Diego. 1993. *The Sicilian Mafia: the Business of Private Protection*. Cambridge, MA: Harvard University Press.

Grossman, Herschel I., and Minseong Kim. 1995. "Swords or Plowshares? A Theory of the Security of Claims to Property." *Journal of Political Economy*, 103(6): 1275-88.

Harmony. 2007. *Al Qaida's (Mis)adventures in the Horn of Africa*. West Point, NY: Combating Terrorism Center, United States Military Academy.

Hastings, Justin. 2009. "Geographies of State failure and Sophistication in Maritime Piracy Hijackings." *Political Geography*, 28(4): 213-223.

Heston, Alan, Robert Summers, and Bettina Aten. 2009. *Penn World Table Version 6.3*. Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania.

International Maritime Bureau. 1998-2009. *Piracy and Armed Robbery against Ships. Annual Report.* Barking, Essex: ICC International Maritime Bureau.

Jasparro, Christopher. 2009. "Somalia's Piracy Offer Lessons in Global Governance." YaleGlobal Online. http://yaleglobal.yale.edu (accessed 3 February 2011).

Johnson, Simon, Daniel Kaufmann, and Pablo Zoido-Lobatón. 1998. "Regulatory Discretion and the Unofficial Economy." *American Economic Review*, 88(2): 387-392.

Kaluza, Pablo, Andrea Kölzsch, Michael Gastner and Bernd Blasius. 2010. "The complex network of global cargo ship movements." *Journal of the Royal Society Interface*, 7(48): 1093-1103.

Kaufmann, Daniel. 2004. "Corruption, Governance and Security: Challenges for the Rich Countries and the World." In *The Global Competitiveness Report 2004–2005*, ed. Michael E. Porter, Klaus Schwab, Xavier Sala-i-Martin and Augusto López-Claros, 83-102. New York: Oxford University Press.

Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi. 2009. "Governance Matters VIII: Aggregate and Individual Governance Indicators, 1996-2008." World Bank Policy Research Working Paper 4978.

Lazzarini, Sergio G., Gary J. Miller, and Todd R. Zenger. 2004. "Order with some law: complementarity versus substitution of formal and informal arrangements." *Journal of Law, Economics, and Organization*, 20(2): 261-298.

Leeson, Peter. 2007. "Better Off Stateless: Somalia Before and After Government Collapse." *Journal of Comparative Economics*, 35(4): 689-710.

Leeson, Peter. 2009a. "The Laws of Lawlessness." *Journal of Legal Studies*, 38(2): 471-503.

Leeson, Peter. 2009b. *The Invisible Hook.* Princeton: Princeton University Press.

Leeson, Peter, and Claudia Williamson. 2009c. "Anarchy and Development: An Application of the Theory of Second Best" *Law and Development Review*, 2(1): 77-96.

Loayza, Norman V. 1996. “The Economics of the Informal Sector: A Simple Model and Some Empirical Evidence from Latin America.” *Carnegie-Rochester Conference Series on Public Policy*, 45(1): 129-162.

Marshall, Monty G., and Benjamin R. Cole. 2009. *Global Report 2009: Conflict, Governance and State Fragility*. Washington, DC: Center for Systemic Peace and Center for Global Policy.

Marshall, Monty G., Ted R. Gurr, and Keith Jaggers. 2010. “Polity IV Project: Political Regime Characteristics and Transitions, 1800-2009.” Center for Systemic Peace.

Murphy, Martin. 2007. “Contemporary Piracy and Maritime Terrorism: The Threat to International Security”, International Institute for Strategic Studies Adelphi Series Working Paper 388.

Murphy, Martin. 2010. *"Somalia: The New Barbary? Piracy and Islam in the Horn of Africa.*” London: C. Hurst & Co.

Olson, Mancur. 1993. “Democracy, dictatorship, and development.” *American Political Science Review*, 87: 567-576.

Percy, Sarah, and Anja Shortland. 2010. “The Business of Piracy in Somalia.” DIW Discussion Paper 1033.

Piccione, Michele, and Ariel Rubinstein. 2007. “Equilibrium in the Jungle.” *Economic Journal*, 117 (522): 883-896.

Rodrigue, Jean-Paul. 2004. “Straits, Passages and Chokepoints: A Maritime Geostrategy of Petroleum Distribution.” *Cahiers de Géographie du Québec*, 48(135): 357-374.

Shortland, Anja, and Marc Vothknecht. (2010). “Combating "Maritime Terrorism" off the Coast of Somalia.” Forthcoming in *European Journal of Political Economy.*

Soares, Rodrigo R. 2004. “Crime Reporting as a Measure of Institutional Development.” *Economic Development and Cultural Change*, 52(4): 851-871.

Sörenson, Karl. 2008. “State Failure on the High Seas – Reviewing Somali Piracy.” Swedish Defence Academy OFI Report 2610-SE.

Tharoor, Ishaan. 2009. “*How Somalia's Fishermen Became Pirates.*” Time Inc. http://www.time.com/ (accessed 3 February 2011)

Varese, Federico. 2001. *The Russian Mafia: Private Protection in a New Market Economy*. New York: Oxford University Press.

Volkov, Vadim. 2002. *Violent Entrepreneurs: The Use of Force in the Making of Russian Capitalism*. Ithaca, NY: Cornell University Press.

World Sea Ports. 2010. World Shipping Register. http://www.e-ships.net (accessed 16 September 2010).

Appendix

Proof of Proposition

(i) Setting $g = 0$ in (1) we have that $\frac{\phi_x[x]}{k} = 0$, which implies $x[0] = 0$. Since $b \le x$ it must also hold that $b[g] = 0$. Hence $x[0] = b[0] = 0$ is an equilibrium. Setting $g = 1$ in (1) we again have that $\frac{\phi_x[x]}{k} = 0$, so also $x[1] = b[1] = 0$ is an equilibrium.

(ii) Totally differentiating in (1) we have

$$x_g[g] = -\frac{\left\{f_g d_f \{a(1-m)\} + d\left\{\left(\frac{\partial b}{\partial g} a_b + c_f f_g a_c\right)(1-m) - a\, m_g\right\} - f_g d_f (1-m) - (1-d) m_g\right\}}{d\,\frac{\partial b}{\partial x} a_b (1-m) - \frac{\phi_{xx}}{k}} \quad \text{(A.1)}$$

where $\frac{\partial b}{\partial g} = -\frac{EU_{bg}}{EU_{bb}}$ and $\frac{\partial b}{\partial x} = -\frac{EU_{bx}}{EU_{bb}}$. At $g = 0$ we have $x[0] = b[0] = f_g[0] = a = d = 0$ and $m = 1$, so (A.1) becomes

$$x_g[0] = -\frac{k m_g[0]}{\phi_{xx}} > 0.$$

(iv) Totally differentiating using (1) and (2) gives

$$x_k[g] = -\frac{\phi_x}{k\left(dk\,\frac{\partial b}{\partial x} a_b (1-m) - \phi_{xx}\right)}; \quad \text{(A.2)}$$

$$b_k[g] = -\frac{a_b \frac{\partial x}{\partial k}(1-m)}{a_{bb}\left(x(1-m) - b\right) - 2a_b + (1-m)\frac{\partial x}{\partial b}}; \quad \text{(A.3)}$$

where

$$\frac{\partial x}{\partial k} = -\frac{EU_{xk}}{EU_{xx}} \ge 0; \quad \frac{\partial x}{\partial b} = -\frac{EU_{xb}}{EU_{xx}} \ge 0;$$
$$\frac{\partial b}{\partial k} = -\frac{EU_{bk}}{EU_{bb}} = 0; \quad \frac{\partial b}{\partial x} = -\frac{EU_{bx}}{EU_{bb}} \ge 0.$$

Local stability of the equilibrium requires that $\frac{\partial x}{\partial b}\frac{\partial b}{\partial x} < 1$, which implies that the denominators of (A.2) and (A.3) are negative. Since the numerators of (A.2) and (A.3) are positive we therefore have

$$x_k[g] \ge 0; \quad b_k[g] \ge 0.$$

List of Figures and tables

Figure 1: *Distribution of intensity of (all acts of) piracy*

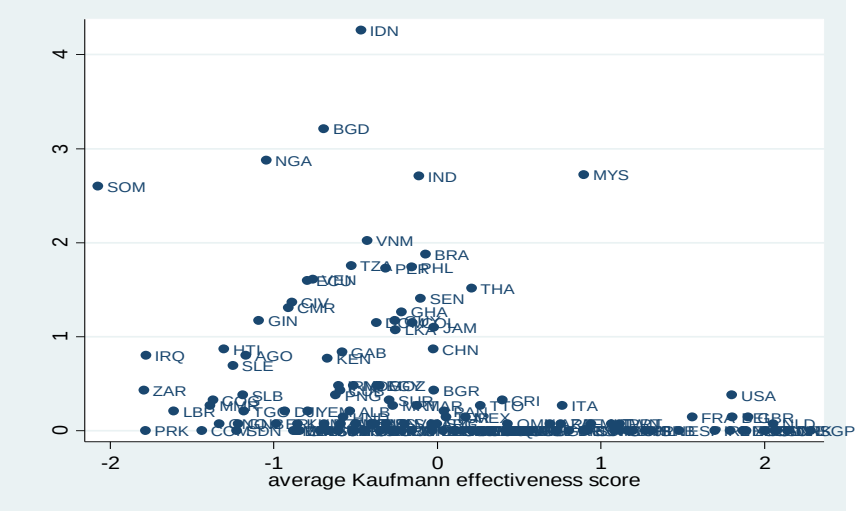

Figure 2. *Decision tree of a prospective criminal*

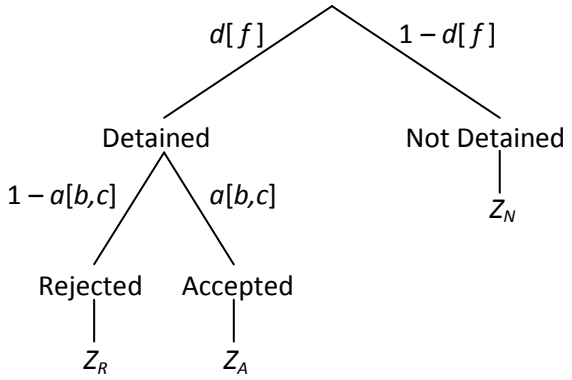

Figure 3. *Hypothesised Relationship between Piracy and Governance*

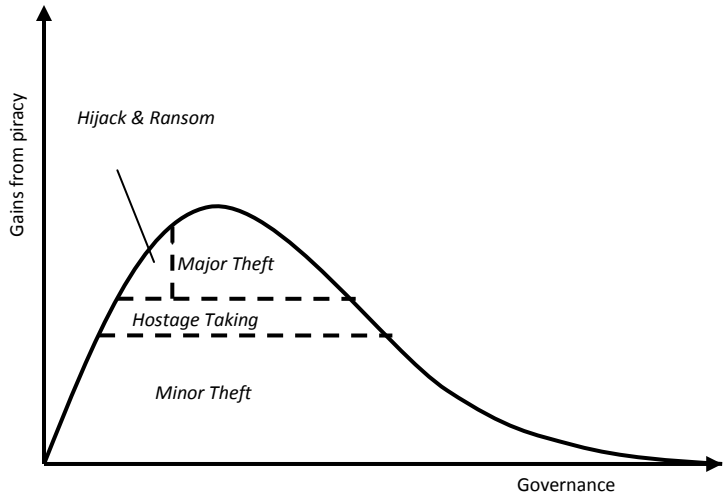

Table 1. *Descriptive Statistics of all variables used*

Variable	Control type	N	Mean	St.Dev.	Min.	Max.
Dummy variables						
Successful minor theft		1976	0.177	0.381	0	1
Successful boarding		1976	0.199	0.400	0	1
Minor theft + attacks on stationary ships		1976	0.209	0.406	0	1
Large vessel and major cargo theft		1976	0.020	0.141	0	1
Any vessel and major cargo theft		1976	0.031	0.173	0	1
Hostage-taking		1976	0.008	0.087	0	1
Hijack and Ransom		1976	0.023	0.149	0	1
Intensity variables						
Successful boarding		1976	1.282	6.334	0	124
Minor theft + Attack on stationary ships		1976	1.469	7.251	0	140
Explanatory variables						
Log(gdp per capita)	motive	1787	8.920	1.144	5.733	11.388
State failure	means	1976	0.016	0.126	0	1
Civil (2)	means	1972	0.010	0.100	0	1
Low conflict	means + motive	1976	0.081	0.273	0	1
Deep ports	opportunity	1976	1.822	3.477	0	28
Choke	opportunity	1976	0.085	0.279	0	1
Drug exports	means	1976	0.124	0.330	0	1
Corruption (WB cce+4)	opportunity/means	1728	4.022	1.000	1.984	6.625
Government effectiveness (WB gee+4)	means	1756	4.023	0.996	1.489	6.531
Rule of Law (WB rol+4)	opportunity/means	1742	3.988	0.987	1.314	6.116
Log(Kuala Lumpur)	report bias	1963	9.053	0.659	5.759	9.861

Table 2. *Data Definitions and Sources*

Variable	Source	Definition
Dummy variables		
Successful minor theft	International Maritime Bureau (IMB)	Actual theft of few goods, defined (approximately) as the amount the pirate(s) are able to carry
Successful boarding	IMB	Actual and attempted theft of few goods
Minor theft & attacks on stationary ships	IMB	Actual and attempted theft of few goods + attacks on ships that are stationary (berthed or anchored)
Large vessel and major cargo theft	IMB	Theft of large ships (trawler or greater) + theft of large amount of goods
Any vessel and major cargo theft	IMB	Theft of large ships + theft of small ships + theft of large amount of goods
Hostage-taking	IMB	Piracy cases where only crew are held for ransom
Hijack and Ransom	IMB	Cases where ship and crew are held for ransom
Intensity variables		
Successful Boarding	IMB	Actual and attempted theft of few of goods
Minor theft & attacks on stationary ships	IMB	Actual and attempted theft of few goods + attacks on ships that are stationary (berthed or anchored)
Controls		
Log(gdp per capita)	Penn World Tables	Log of GDP per capita (in 2006$)
State failure	Polity IV Project	Dummy that takes value 1 if Polity IV reports -77
Civil (2)	Marshall and Cole (2009) (MEPV)	Country-years where a civil conflict of intensity 2 takes place
Low conflict	MEPV	Dummy for low-level (<4) domestic conflict
Deep ports	World Shipping Register	Number of ports with a draft equal to the New Panamax standard (15.2 meters)
Choke	Kaluza *et al.* (2010)	Choke points for tanker and container traffic
Drug exports	International Narcotics Control Strategy	Dummy for countries mentioned as significant non-synthetic drug producers
Corruption	Kaufman (2009) (K09)	Extent to which power is exercised for private gain
Government effectiveness	(K09)	Quality of civil service
Rule of Law	(K09)	Subjective estimate regarding quality of Rule of Law
Log(Kuala Lumpur)	self-collected	Log of the distance between country capital and KL

Table 3. *Small-scale maritime crime: Logit regressions*

Model	**1a**	**1b**	**1c**	**2a**	**2b**	**2c**	**3a**	**3b**	**3c**
Dependent:	Successful minor theft			Successful boarding			Minor theft & attacks on stationary ships		
Constant	-6.914*	0.070	-0.171	-6.376**	2.025	0.506	-6.494**	2.062	0.453
	(3.602)	(4.188)	(3.672)	(2.822)	(3.577)	(3.577)	(2.834)	(3.598)	(3.602)
Corruption Control	3.126*	3.223*							
	(1.869)	(1.906)							
(Corruption Control)^2	-0.602**	-0.541**							
	(0.243)	(0.247)							
Govt effectiveness				2.855*	2.917**		2.972**	3.114**	
				(1.467)	(1.487)		(1.475)	(1.502)	
(Govt Effectiveness)^2				-0.549***	-0.460**		-0.567***	-0.483**	
				(0.193)	(0.194)		(0.195)	(0.196)	
Rule of Law			3.328**			3.025*			3.316**
			(1.638)			(1.593)			(1.606)
(Rule of Law)^2			-0.582***			-0.572***			-0.609***
			(0.222)			(0.216)			(0.218)
Log(GDP per capita)		-0.975***	-0.924***		-1.168***	-0.841***		-1.215***	-0.895***
		(0.319)	(0.330)		(0.335)	(0.320)		(0.336)	(0.321)
Civil Conflict (2)	2.302**	2.108**	2.170**	3.181**	2.780**	2.771**	3.126**	2.726**	2.733**
	(1.079)	(1.041)	(1.040)	(1.406)	(1.294)	(1.268)	(1.406)	(1.293)	(1.272)
Drug exports	1.057*	0.952	0.947	0.867	0.728	0.734	1.242**	1.070*	1.040*
	(0.566)	(0.599)	(0.594)	(0.606)	(0.630)	(0.599)	(0.620)	(0.641)	(0.613)
Deep Ports	0.757***	0.961***	0.961***	0.790***	1.005***	0.919***	0.799***	1.041***	0.960***
	(0.227)	(0.309)	(0.310)	(0.259)	(0.311)	(0.290)	(0.272)	(0.316)	(0.306)
(Deep Ports)^2	-0.031*	-0.044	-0.043	-0.035	-0.049*	-0.039	-0.036	-0.053*	-0.042
	(0.019)	(0.029)	(0.028)	(0.023)	(0.029)	(0.026)	(0.024)	(0.029)	(0.279)
Log-likelihood	-469.672	-458.891	-458.802	-509.542	-495.069	-488.583	-517.462	-499.992	-493.424
N	1728	1694	1708	1756	1722	1708	1756	1722	1708

Table 4. *Sample Selection Example: logit regressions*

	4a	**4b**	**4c**
Dependent variable	Minor theft & attacks on stationary ships		
Sample	Excluding government effectiveness score <-0.7	Excluding government effectiveness score <-0.6	
Constant	-20.238**	-7.510	4.252**
	(9.918)	(10.120)	(1.835)
Govt effectiveness	8.909**	3.332	-2.071***
	(4.539)	(4.595)	(0.449)
(Govt Effectiveness) ^{2}	-1.207**	-0.606	
	(0.517)	(0.516)	
Civil Conflict (2)	25.909	22.011	23.083
	(4169.424)	(1189.676)	(2539.158)
Drugs	1.280*	1.835**	1.874**
	(0.700)	(0.748)	(0.737)
Deep Ports	0.857***	0.863***	0.881***
	(0.298)	(0.331)	(0.326)
(Deep Ports) ^{2}	-0.038	-0.041	-0.047
	(0.025)	(0.030)	(0.030)
Log-likelihood	-343.859	-326.022	-326.761
N	1355	1277	1277

NOTE: Countries missing at least partly from both restricted samples: Albania, Angola, Bangladesh, Bosnia and Herzegovina, Cambodia, Cameroon, Comoros, Congo, Dem. Rep., Congo, Rep. Cote d'Ivoire, Cuba, Djibouti, Dominica, Dominican Republic, Ecuador, Equatorial Guinea, Eritrea, Fiji, Gabon, The Gambia, , Guinea, Guinea-Bissau, Haiti, Honduras, Indonesia, Iran, Islamic Rep., Iraq, Kenya, Korea, Dem. Rep., Liberia, Liberia, Libya, Marshall Islands, Mauritania, Myanmar, Nicaragua, Nigeria, Pakistan, Palau, Papua New Guinea, Sao Tome and Principe, Serbia, Sierra Leone, Solomon Islands, Somalia, Sudan, Suriname, Syrian Arab Republic, Tanzania, Togo, Ukraine, Vanuatu, Venezuela, Yemen.

Additional countries missing from second sample: Algeria, Bulgaria, Georgia, Guatemala, Kiribati, Lebanon, Madagascar, Micronesia, Peru, Romania, Tonga, Vietnam.

Table 5. *Regression results for the intensity of piracy: xttobit regressions*

	5a	**5b**	**5c**	**6a**	**6b**	**6c**	**7a**	**7b**	**7c**
	Countries with at least one act of piracy						All countries		
Dependent:	Successful boarding			Minor theft & attacks on stationary ships			Successful boarding	Minor theft & attacks on stationary ships	
Constant	-1.305	-1.155	-0.987	-1.812	-1.142	-1.006	0.259	0.438	-0.002
	(1.910)	(1.745)	(1.713)	(1.901)	(1.735)	(1.701)	(2.071)	(1.892)	(1.849)
Corruption Control	1.951**			2.303***			1.753**		
	(0.864)			(0.863)			(0.892)		
(Corruption Control)^2	-0.319***			-0.369***			-0.307***		
	(0.115)			(0.115)			(0.118)		
Govt effectiveness		1.972***			2.040***			1.850**	
		(0.745)			(0.743)			(0.768)	
(Govt Effectiveness)^2		-0.290***			-0.302***			-0.287***	
		(0.099)			(0.099)			(0.102)	
Rule of Law			1.892**			1.987***			1.931**
			(0.759)			(0.755)			(0.790)
Rule of Law-Sq			-0.308***			-0.324***			-0.347***
			(0.105)			(0.105)			(0.109)
Deep Ports	0.200***	0.180***	0.193***	0.208***	0.184***	0.197***	0.190***	0.182***	0.200***
	(0.054)	(0.055)	(0.054)	(0.054)	(0.055)	(0.054)	(0.048)	(0.049)	(0..048)
Log(GDP per capita)	-0.241*	-0.307**	-0.269*	-0.244*	-0.310**	-0.274*	-0.465***	-0.558***	-0.439***
	(0.140)	(0.153)	(0.146)	(0.138)	(0.152)	(0.144)	(0.155)	(0.166)	(0.158)
Civil Conflict (2)								0.585*	0.559*
								(0.338)	(0.339)
Log-likelihood	-808.371	-812.911	-810.461	-835.736	-841.681	-839.064	-858.097	-894.744	-887.925
N	966	972	970	966	972	970	1694	1722	1708

Table 6. *Piracy Dynamics: logit regressions*

	8a	**8b**
Dependent:	Successful boarding	
Constant	8.124***	5.829
	(2.151)	(3.491)
Lag s/a minor theft	-9.888***	-10.340***
	(2.965)	(3.100)
Govt effectiveness		-0.196
		(1.564)
(Govt effectiveness)^2		-0.085
		(0.196)
Interaction laggedminor* effectiveness	5.393***	5.547***
	(1.606)	(1.672)
Interaction laggedminor * (effectiveness)^2	-0.644***	-0.648***
	(0.215)	(0.222)
Deep Ports	0.221***	0.249***
	(0.078)	(0.078)
Drug dummy	1.772***	1.676***
	(0.607)	(0.586)
Civil conflict (level2)	2.586*	2.503*
	(1.498)	(1.466)
Log(GDP per capita)	-1.339***	-0.832***
	(0.257)	(0.312)
Log-likelihood	-453.461	-450.530
N	1583	1583

Table 7. *Sophisticated Piracy: Logit regressions*

Model	**9**	**10**
Dependent:	Large vessel and major cargo theft	Any vessel and major cargo theft
Constant	-1.396	-3.012***
	(1.119)	(1.025)
Corruption Control	-2.441***	-1.937***
	(0.766)	(0.652)
Govt effectiveness	1.307**	1.348**
	(0.635)	(0.603)
Choke Point	1.792***	2.079***
	(0.431)	(0.470)
Deep Ports	0.126**	0.113**
	(0.050)	(0.051)
Petty Piracy	1.722***	1.492***
	(0.448)	(0.425)
Log-likelihood	-132.041	-178.668
N	1728	1728

Table 8. *Hostages and Hijack and Ransom: Logit regressions*

Model	**11a**	**11b**	**12**	**13**	**14**
Dependent:	Hostage-taking		Hijack and ransom		
Constant	5.835**	-0.965	-3.299**	-2.978*	-4.508***
	(2.874)	(1.877)	(1.399)	(1.556)	(1.435)
Corruption	-2.966***	-3.404***	-0.647*	-0.895**	-0.360
	(1.041)	(1.059)	(0.364)	(0.400)	(0.358)
Govt effectiveness	0.970	1.761*			
	(0.949)	(0.977)			
Ethnic Conf (1)	1.539**	1.613**			
	(0.715)	(0.757)			
Low Conflict			2.049***	1.523***	1.874***
			(0.524)	(0.537)	(0.520)
Somalia dummy			5.604***		7.320***
			(1.934)		(1.781)
Choke Point			1.858***	2.673***	
			0.700	(0.686)	
Deep Ports	0.242***	0.231**			
	(0.081)	(0.092)			
Petty Piracy				1.387***	1.522***
				(0.509)	(0.513)
Log(Kuala)	-1.589***				
	(0.207)				
Log-likelihood	-94.510	-98.410	-117.029	-117.658	-115.939
N	1849	1849	1728	1728	1728