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Olaf J. de Groot, Matthew D. Rablen, Anja Shortland

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For further information, please contact:

Economics of Security, c/o Department of International Economics, German Institute for Economic Research (DIW Berlin), Mohrenstr. 58, 10117 Berlin, Germany.

Tel: +49 (0)30 89 789-277

Email: eusecon@diw.de

Website: www.economics-of-security.eu

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

Olaf J. de Groot[†]

Matthew D. Rablen[°]

Anja Shortland[‡]

Abstract

We present a theoretical model postulating that the relationship between crime and governance is "hump-shaped" rather than linearly decreasing. State failure, anarchy and a lack of infrastructure are not conducive for the establishment of any business. This includes illegal businesses, as criminals need protection and markets to convert loot into consumables. At the bottom end of the spectrum, therefore, both legal business and criminal gangs benefit from improved governance, especially when this is delivered informally. With significant improvements in formal governance criminal activities decline. We use data from the International Maritime Bureau to create a new dataset on piracy and find strong and consistent support for this non-linear relationship. The occurrence, persistence and intensity of small-scale maritime crime are well approximated by a quadratic relationship with governance quality. Organised crime benefits from corrupt yet effective bureaucrats, and informally governed areas within countries.

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

JEL Classification: K42, P48

[†] German Institute for Economic Research (DIW Berlin), Mohrenstrasse 58, 10117 Berlin, Germany. Email: odegroot@diw.de

[°] Department of Economics and Finance, Brunel University, Uxbridge UB8 3PH, UK. Email: Matthew.Rablen@brunel.ac.uk

[‡] Corresponding Author: Department of Economics and Finance, Brunel University, Uxbridge UB8 3PH, UK and German Institute for Economic Research (DIW Berlin), Mohrenstrasse 58, 10117 Berlin, Germany. E-mail: Anja.Shortland@brunel.ac.uk

1. Introduction

International patterns in piracy present an interesting puzzle. Despite the 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 originate from the anarchic South, but from the relatively 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]

This observation contradicts 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. In this paper we therefore re-examine the relationship between crime and governance, both theoretically and empirically.

We argue that there is a hump-shaped relationship between criminal activities and governance - even criminals need some minimal level of law and order. "Sophisticated" criminal activities involving the production or acquisition of goods that cannot be directly and immediately consumed – for example piracy and drug production – are not viable at the bottom end of the governance spectrum (anarchy). 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 infrastructure and functioning markets to convert loot into consumables. During periods of anarchy (for example during civil conflict) the state cannot provide the security and law enforcement necessary to support market activity.

We begin by developing a simple model of the relationship between governance and crime. Our principal innovation is to distinguish between two different modes of governance: formal governance and informal (non-governmental) governance. By contrast, the existing theoretical literature focuses solely on formal governance. In line with the existing literature, if informal governance is positive and held constant, our model predicts a negative relationship between formal governance and crime. However, we show that the particular interaction between formal and informal modes of 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

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[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.

negative relationship when informal governance is not held constant. Instead, the model predicts a hump-shaped relationship between governance and crime.

We also investigate the relationship between corruption and crime. When corruption is allowed to arise endogenously within the model we also predict a hump-shaped relationship between government control of corruption and crime. Additionally, the model predicts that higher-value crime develops from lower-value forms of crime in a limited set of countries where criminals are able to build up "criminal capital" over time. The more sophisticated the crime, the more sensitive is its incidence to the ease with which government officials can be bribed.

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 rather than by national governments – allows us to include in our sample countries for which no reliable data are collected by the national government. By contrast, the existing empirical literature has relied 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 it 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 the more lucrative forms of piracy. As predicted theoretically, sophisticated piracy occurs mostly in countries with intermediately low levels of governance, specifically countries characterised by relatively effective, yet corruptible bureaucracies and countries where pirates can use informally governed regions for refuge.

Although our findings suggest that crime is decreasing in governance over much of the governance spectrum, the finding that the relationship is more globally characterised as hump-shaped has some important policy implications for combating sophisticated, organised crime. At low levels of governance, aid targeted at improving (informal) governance and infrastructure[3] may be counter-productive, because it may move criminals towards their "sweet spot" on the governance spectrum.

The paper is structured as follows. In section 2 we review the literature on crime and governance, focusing on the differing roles of formal and informal modes of governance. Section 3 builds on this literature to develop a theoretical model. Section 4 sets out our empirical modelling strategy; section 5 introduces a new dataset on global patterns of piracy; and section 6 presents the results. Section 7 concludes.

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

2. Governance and Crime

In this section we review the literature – spanning both economics and sociology – on the relationship between governance and crime. We distinguish between formal modes of governance (provided by the state), and other "informal" modes of governance. Such informal modes of governance include village councils, Islamic courts, traditional tribal caste or clan-based structures, social norms, and patron-client relationships, but also organised criminal groups (e.g. the Mafia).

The term anarchy denotes the complete absence of governance - neither property nor human rights are protected. All transactions are governed by coercion – the classic "jungle economy" (Piccione and Rubinstein 2006). In countries with the lowest levels of governance, formal governance has collapsed or is very weak. Markets only exist where they are underpinned by (coercive forms of) informal governance. Where there is a pool of young men trained in the use of violence and easy access to weapons, informal governance tends to be provided in the form of organised private protection.[4] However, unless these groups are well entrenched, they behave as "roving bandits" - maximising 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. Second, criminals need the institutions which underpin the functioning of markets: the proceeds from crime and illicit activity usually need to be traded. Even a mugger needs to sell a stolen watch or mobile phone.

Countries with intermediate levels of governance are characterised 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 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. Organised criminal groups can provide private protection and enforcement of property rights, allowing people (including other 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

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

or corruptible formal governance is therefore likely to be ideal for criminals needing to trade the proceeds from crime.

The countries in which we observe the highest levels of governance are characterised by a predominance of formal governance over informal. Informal institutions are unsuited to delivering the highest levels of governance as they typically apply the law selectively and only within their geographical sphere of influence. Informal structures also often provide incumbent firms with protection against new entrants (Varese, 2001), which means that they are economically less efficient than state-provided "rule of law for all" (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 fall as illicit activities are discouraged by the effective operation of the police and the courts. Empirical studies that exclude countries with the lowest levels of development 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, the literature we review points to a hump-shaped relationship between governance and sophisticated forms of crime.

3. Theoretical Model

A country is characterised by a level of governance, $g \in [0,1]$, where $g = 0$ denotes a perfectly anarchic 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. The previous section documented a three-fold relationship between formal and informal governance: dominance of informal governance at the lowest governance levels, complementarity and co-existence of modes at intermediate levels of governance, and dominance of formal governance at high levels of governance. We formalise this relationship in the following way. Total governance, g, comprises both a formal (f) and an informal (i) component, and we assume that the relative share of formal versus informal governance varies as a function of the total level of governance:

$$g \equiv f[g] + i[g] \tag{1}$$

For $g = 0$, it follows from (1) that $f[0] = i[0] = 0$. Based on the evidence presented in section 2, we assume that in a perfectly governed state all governance is formal ($f[1] = 1$), which, from (1), implies $i[1] = 0$. To capture the idea that informal governance dominates at the lowest levels of governance we assume that the first increment of governance above $g = 0$

is purely informal governance, $f_g[0]=0$ (so $i_g[0]=1$). Last we assume that formal governance is an increasing and convex function of total governance ($f_g \geq 0$, $f_{gg} > 0$), which implies $i_{gg} < 0$. For instance, a simple specification of the model that satisfies these assumptions is given by setting $f[g] = g^2$ and $i[g] = g(1-g)$. Note that this specification implies that 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 $\phi[x]$ 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 before x can be safely consumed. 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 police authorities is $d \in [0,1]$. We suppose this probability is a function of the strength of formal governance. We therefore write $d \equiv d[f[g]]$, where $d[0]=0$, $d[1]=1$ and $d_f > 0$.

If a criminal evades the authorities the implied transaction cost incurred in trading loot for consumables depends on the extent to which there is a functioning market mechanism, a prerequisite for which is the enforcement of a minimum level of property rights, and the provision of a minimum level of infrastructure to get goods to market. While both infrastructural development and the enforcement of property rights are associated with formal governance, informal methods of governance can also enable criminals to enforce their property rights in addition to any protection offered through formal governance. We therefore assume that the share of x that is lost in trading the loot for consumables is a (decreasing) function of total governance, $m[g] \in [0,1]$, where $m[0]=1$, $m[1]=0$ and $m_g < 0$. 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 $b \geq 0$. We assume that the probability of the bribe being accepted depends on the ability of the state to control corruption – which we suppose to be an increasing function of formal governance ($c[f[g]]$) – and on the size of the bribe. We can then write the probability that a bribe b is accepted as $a[b,c[f[g]]]$, where $a_b > 0$ and $a_c < 0$.

We assume $a[\cdot]$ further satisfies the following conditions. First, for all $(f_0,f_1) \in [0,1]$ with $f_0 > f_1$, $a[b,c[f_1]]$ stochastically dominates $a[b,c[f_0]]$, so a given bribe is more likely to be accepted in a state with lower formal governance. Second, $a[0,c]=a[b,1]=0$, so a zero bribe

is always rejected, and a bribe of any size is always rejected in a state with perfect governance. Last, in order to ensure the existence of an optimum, $a_{bb} < 0$. For example, a simple specification that satisfies these properties is given by $a[b, c[f]] = 1 - c[f]^b$ and $c[f] = e^{-(1-f)}$.

If the authorities reject the bribe, the loot is confiscated by the authorities, and the criminal is punished (fined) in proportion to the size of the loot, at a rate $p > 0$. If the authorities accept the bribe, the criminal escapes punishment, and the authorities agree to assist the criminal in trading the loot for consumables. We suppose that the extent to which police assistance improves the enforcement of a criminal's property rights is related to the capability of the authorities to enforce property rights more generally, as measured by the level of formal governance $f[g]$. Therefore, having successfully bribed the police, a criminal is able to consume a proportion $\{1 - (1 - f[g])m[g]\}$ of the loot.

The resulting structure of the model is illustrated in Figure 2, where the payoffs (Z_A, Z_R, Z_N) are given by

$$Z_A = w - \frac{\phi[x]}{k} + \{1 - (1 - f[g])m[g]\}x - b;$$

$$Z_R = w - \frac{\phi[x]}{k} - px;$$

$$Z_N = w - \frac{\phi[x]}{k} + (1 - m[g])x.$$

Along the lines of Becker (1968), individuals choose (b, x) to maximise their expected utility, given by

$$EU = d[f]\{(1 - a[b,c])U[Z_R] + a[b,c]U[Z_A]\} + (1 - d[f])U[Z_N] . \qquad (2)$$

For simplicity, we assume individuals are risk neutral, so (2) becomes

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

The marginal benefit from an increase in x is given by

$$B[g] = d[f]\{-p(1 - a[b,c]) + a[b,c](1 - (1 - f)m[g])\} + (1 - d[f])(1 - m[g]),$$

so the first order conditions for (b, x) are therefore

$$x : B[g] = \frac{\phi_x[x]}{k}; \qquad (3)$$

$$b : d[f]\{a_b[b,c](x(1+p-(1-f)m[g])-b)-a[b,c]\}=0. \qquad (4)$$

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 (3) and (4) are sufficient for an interior maximum.

We can now state the following proposition:

Proposition 1. *At a stable equilibrium, the following hold:*

i) $x[0]=0;$

ii) $x_g[0]>0;$

iii) For all k there exists a value $\bar{g}[k]\in(0,1)$ *such that* $x[g]=0$ *for all* $g\in[\bar{g}[k],1];$

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

v) 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 sophisticated crime under anarchy ($g=0$).[5] Although there is no probability of being detained by the police, criminals are unable to consume the loot, because of the absence of a functioning market. 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. Part (iii) establishes that crime returns to a zero level for a sufficiently high level of governance. In conjunction with (ii), this implies that, at some level of governance, crime must begin to fall as a function of governance.

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 (iv) of the Proposition is a simple corollary of parts (i) – (iii). It follows from the observation that, as crime is hump-shaped in total governance, any increasing function of

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[5] Under anarchy people will commit crimes from which they gain direct utility with impunity.

total governance (of which formal governance and corruption control are two) will also have a hump-shaped relationship with crime.

Last, part (v) of the Proposition summarises the role of criminal capital. Experienced (high-k) criminals incur less cost to steal a given value of loot, and will therefore optimally steal more. Although ours is a static model, in practice criminal capital is accumulates 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.

Part (v) also 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. High-value crime – the type performed by experienced criminals – should therefore be especially sensitive to the ease with which government officials can be bribed. Empirically, therefore, in countries near the sweet spot – where we expect to observe high-value crime – we should see a decreasing relationship between government control of corruption and the incidence of high-value crime.

4. Empirical Modelling

Piracy is an ideal case study of the relationship between sophisticated 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 not armed. 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 hypothesised 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.[6] At the sweet spot lucrative forms of piracy (such as hijack and ransom) become feasible and occur alongside minor theft, according to individuals' criminal capital.

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[6] In a single country study, Percy and Shortland (2010) show that piracy in Somalia was significantly reduced in times of instability, uncertainty and violent conflict. Within Somalia most pirate incidents appear to be

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 modelling we therefore split the dependent variable into petty maritime crime and lucrative 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 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

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emanating from Puntland: an area of the country in which there is informal governance and some degree of stability rather than the anarchy of Southern and Central Somalia (Coggins, 2010b). This suggests that the effects of governance on piracy are indeed non-linear: conditions of complete anarchy are bad for pirates.

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.[7]

4.1.2 Sample Selection

We suspect that the non-linear interactions between governance and piracy only become evident when countries at the bottom end of the governance spectrum are included in the sample. However, countries at the very bottom of the governance spectrum have been systematically excluded from existing studies of governance and crime. State failure results in the complete breakdown of data collection.[8] 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 negatively correlated with institutional quality and 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

Although we have some reservations about whether all acts of piracy accurately reported (as discussed below) we also investigate the factors determining the intensity of piracy. As for the probability of piracy, our model 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 favourable for carrying out acts of maritime crime, a large 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:

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[7] 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.
[8] For example the IMF's assessment of Somalia (IMF, 2009, p. 3) simply stated that the Somali government "has not been able to restore order" and that the "absence of an internationally recognized government and official information about economic and financial developments precludes a full assessment…".

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

where $y_{it}^* = \beta_0 + \beta X_{it} + \upsilon_i + w_t + \varepsilon_{it}$. We are only able to find stable coefficients for small-scale maritime crime.[9] 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 in which 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 anarchic 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 with quality of governance.

5. Data

5.1. Piracy dataset

We construct a new dataset from the Annual Piracy Report compiled by the 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.[10]

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[9] Sophisticated piracy is extremely rare and the results are therefore dominated by Somalia and Indonesia.
[10] 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.

The IMB defines piracy as any "armed maritime crime", which includes attacks on ships at anchor and against steaming ships in territorial waters.[11] 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.[12] Second, we code "successful" attacks according to their severity into petty maritime crime and sophisticated forms of piracy.[13] 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 are 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 organisation and criminal capital – but also access to markets and an infrastructure or at least protection for the pirates' 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 harbour (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 expenses arising from pirate attacks themselves.[14] However, we assume that if piracy regularly occurs in a country, at least one captain will report it. 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. However, 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. We therefore de-emphasise 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. The "rule of law" index captures the

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[11] 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).
[12] 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.
[13] The IMB considers attacks "successful" if the pirates board the ship. We consider attacks successful if the pirates derive at least some profit from the operation. We count as unsuccessful those attacks where pirates were chased off a ship without loot.
[14] (http://www.usatoday.com/news/world/2010-07-03-nigeria-privacy_N.htm)

phenomenon we seek to cover most closely.[15] 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. 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.[16]

Kaufmann *et al.* (2009) report estimates for these variables for each country from 1996 to 2008,[17] and Kaufmann (2004) shows that it is feasible to treat these estimates as panel data. Although the Kaufmann Index largely fails to capture many informal aspects of governance, this does not affect the nature of our empirical test: our model predicts that crime is hump-shaped in both formal and total governance.

There are, as yet, no comprehensive global indices of informal governance. We do, however, have two variables that provide 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 organised 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

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[15] *Rule of Law* – measuring the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence.

[16]*Control of Corruption* – measuring the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.
Government Effectiveness – measuring 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

[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 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.

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 favourable geography, busy harbours and / or proximity to trade routes. Second, would-be pirates need access to the "means" of piracy, such as boats, capable sea-men, weapons and men trained in their use ("maritime tradition"). Third, the emergence of piracy might be aided by a "motive" such as poverty or economic crises. Fourth, the ability and willingness of a government to intervene to stop piracy is deemed a crucial factor in determining the emergence and the amount of piracy in a location. State failure is argued to be positively associated with piracy – a view also commonly expressed in the popular press.

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).[21] 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]

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[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.

[21] Benítez (2009) defines the New Panamax standard as a draft of maximum 15.2 meters (the size of ship which will be able to use the Panama Canal after its expansion is completed in 2014).

[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.

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 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. In addition, we currently employ an

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[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.

[25] This control is only significant in one model. Therefore it is otherwise excluded from the reported results.

[26] All reported results are calculated in 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.

assumption that α = 2 in *governance$^{\alpha}$*. We test the validity of that assumption by varying α between 1.5 and 2.5. The results (not reported) do not change significantly.

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 organised in the country. However, the drug dummy is not robustly significant across regression specifications.

As hypothesised, 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 factor of relevance is the opportunity arising from ships berthed in harbours. 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 now test how our result relates to the previous literature on governance and crime, by artificially raising 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 are discarding an obvious outlier - Somalia - which produces persistent and intense piracy despite its low governance score. However, the governance score for Somalia as a whole is based on anarchic conditions in Southern and Central Somalia: the governance score of the pirate province, Puntland, would be considerably 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

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[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.

to high governance range seem not to hold for countries at the bottom of the governance spectrum.

6.2. Intensity of Piracy

Table 5 summarises the results on the intensity of (small-scale) maritime crime. We get 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 begin to fall. This main result does not depend on the sample or the definition of governance (we see very little difference between the three proxies in models a, b and c). Once again we confirm the importance of opportunity (major ports give easy access to targets) and 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).

6.4. Sophisticated Piracy

For the more lucrative forms of piracy we look at the different types of attacks separately. The results are presented in Tables 7 and 8. The most ambitious 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 Figure 3, and while the quadratic effect in governance is preserved in the coefficients, it is (as would be 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.

Last, the existence of petty forms of maritime crime increases the likelihood of more ambitious forms of piracy occurring. This provides evidence for part (v) of Proposition 1 (high-k criminals take advantage of favourable conditions to steal more) and fits in well with explanations of Somali piracy which focus on Somali fishermen initially beginning stealing from ships, and eventually moving on to extortion and large-scale hijack and ransom (Jasparro, 2009; Tharoor, 2009).[29]

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 of this is that sophisticated piracy is organised crime and not driven by extreme poverty.

Model 11b in Table 8 shows that similar results for the effects of governance are obtained for the hostage taking form of piracy: 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: when we control for possible reporting bias the government effectiveness variable loses significance and distance from Kuala Lumpur takes on significance instead. Therefore this governance result should be interpreted with caution. However, the low-level ethnic conflict dummy is robustly significant; indicating that pirates take advantage of areas where government control is compromised. Busy anchorages also provide opportunities for hostage taking. As for 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 the existence 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). 11 of the 45 positive observations of this variable are generated by Somalia and the Somalia dummy is highly significant. As for 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

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[29] 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.

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 we may well see them developing a piracy branch 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 capture these pockets of lawlessness within countries adequately.

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. Institution-building measures in Indonesia are reflected in the considerable improvements in Indonesia's 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 criminal activity. Criminals and especially organised crime benefit from improvements in market and state structures at the bottom end of the governance spectrum. The model and results are intuitive and accord with sociological research on organised 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 are too dysfunctional to 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 opportunities for theft and enjoying the fruits of crime improve. In weakly governed countries piracy can become endemic, while in ungoverned, failed 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 organised 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 cannot be sure that our results on the effect of governance on maritime crime can be generalised to other forms of crime. However, the current problems of rich European countries with organised criminal gangs from Eastern Europe and Asia suggests that well developed markets and infrastructures are more attractive to these criminals than the conditions in their poor and unstable home countries. Organised 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 perfect for sophisticated piracy, too. What our result does show clearly, is that the established result of a negative, linear relationship obtained by analysing (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 incentivised to tackle rather than tolerate or protect criminal organisations. This insight needs to be factored into policy advice to countries emerging from state failure.

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Appendix

Proof of Proposition 1

(i) Setting $g = 0$ in (3) we have that $B[0] = \frac{\phi_x[0]}{k} = 0$, so $x[0] = 0$ is an equilibrium.

(ii) Totally differentiating in (3) we have

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

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

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

(iii) Setting $g = 1$ in (3) we have that $B[1] = -p < 0$, so $EU_x < 0$. Therefore, since $x_g[0] > 0$, continuity guarantees that for each k there exists a value $\bar{g}[k] \in (0,1)$ such that $B[\bar{g}[k]] = 0$. It follows that at $g = \bar{g}[k]$ we have $B[\bar{g}[k]] = \frac{\phi_x[0]}{k} = 0$, so $x[\bar{g}[k]] = 0$ is an equilibrium. For $g \in (\bar{g}[k], 1]$ we have $B[g] < 0$ so the first order condition (3) does not hold, and the equilibrium is a corner solution at $x[g] = 0$.

(v) Totally differentiating using (3) and (4) gives

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

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

where

$$\frac{\partial x}{\partial k} = -\frac{EU_{xk}}{EU_{xx}} \geq 0; \quad \frac{\partial x}{\partial b} = -\frac{EU_{xb}}{EU_{xx}} \geq 0;$$

$$\frac{\partial b}{\partial k} = -\frac{EU_{bk}}{EU_{bb}} = 0; \quad \frac{\partial b}{\partial x} = -\frac{EU_{bx}}{EU_{bb}} \geq 0.$$

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

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

24

Figure 1: *Distribution of intensity of (all acts of) piracy*
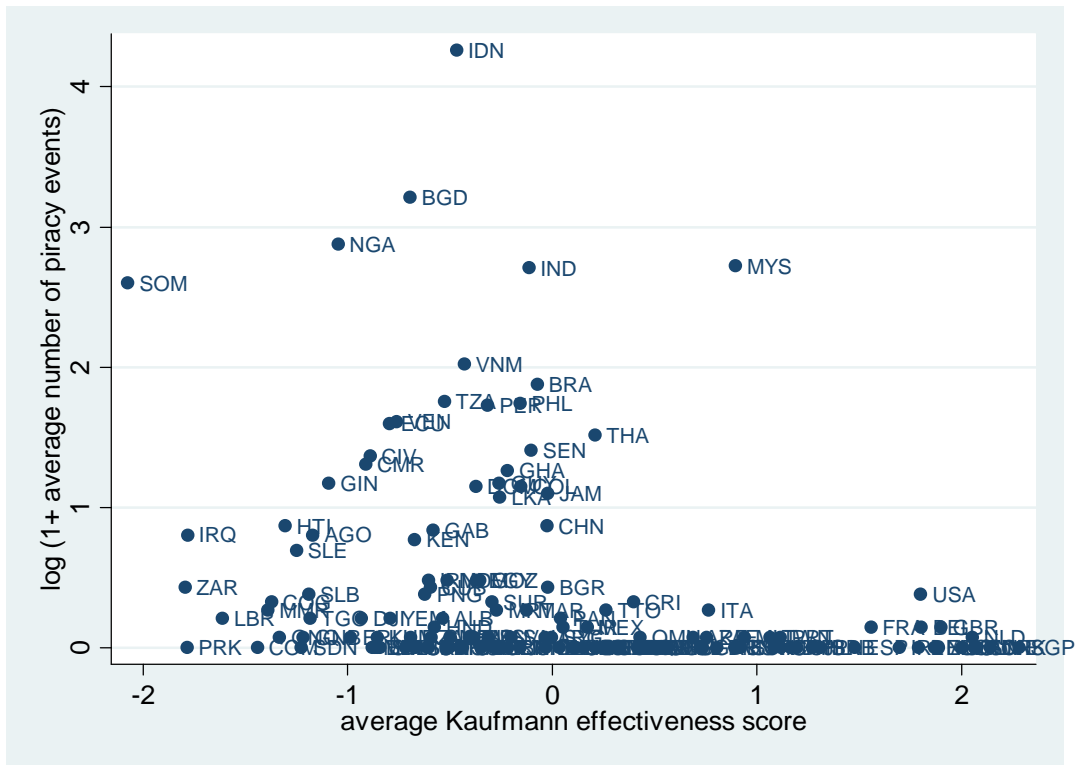
Figure 2. *Decision tree of a prospective criminal*
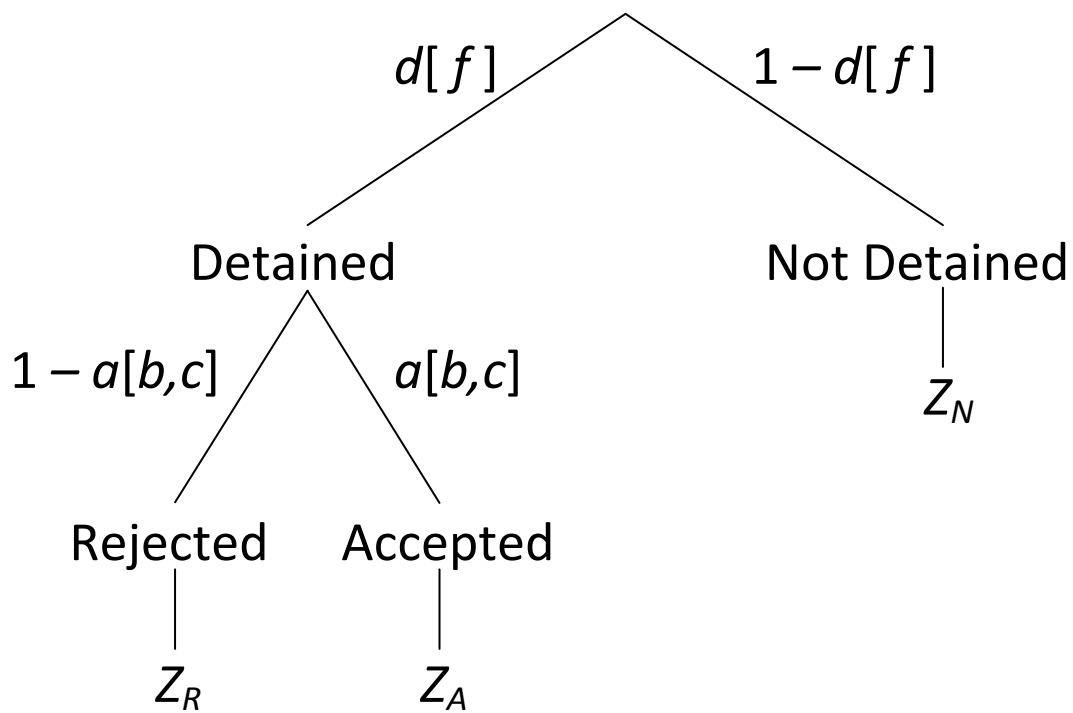
Figure 3. *Hypothesised Relationship between Piracy and Governance*
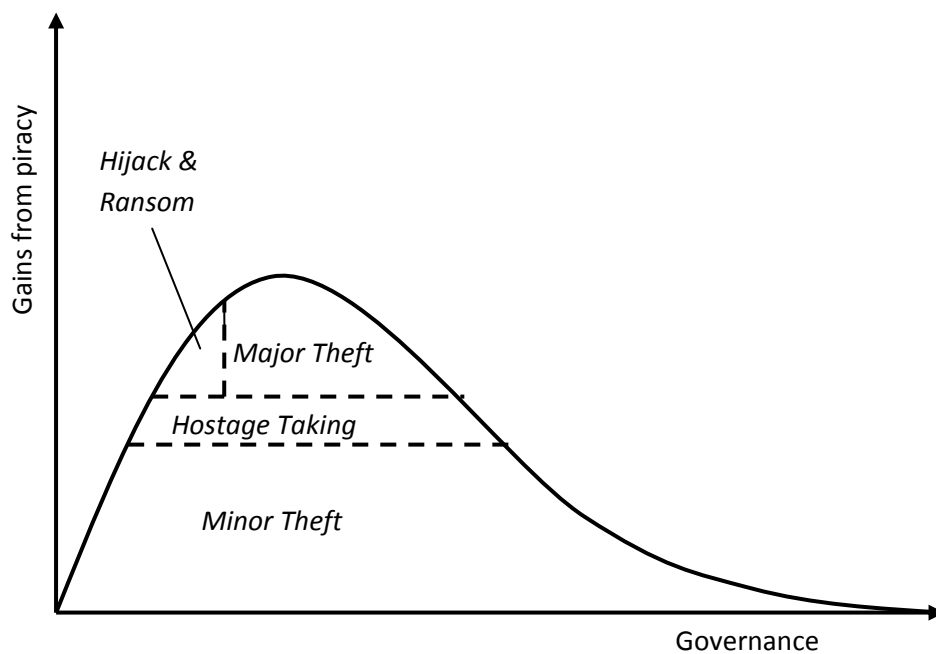
Table 1. *Descriptive Statistics of all variables used*

Variable	Control type	N	Mean	St.Dev.	Minimum	Maximum
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 Annual Report	Actual theft of small amount of goods, defined (approximately) as the amount the pirate(s) are able to carry by themselves
Successful boarding	International Maritime Bureau Annual Report	Actual and attempted theft of small amount of goods
Minor theft & attacks on stationary ships	International Maritime Bureau Annual Report	Actual and attempted theft of small amount of goods + attacks on ships that are stationary (berthed or anchored)
Large vessel and major cargo theft	International Maritime Bureau Annual Report	Theft of large ships (trawler or greater) + theft of large amount of goods
Any vessel and major cargo theft	International Maritime Bureau Annual Report	Theft of large ships + theft of small ships + theft of large amount of goods
Hostage-taking	International Maritime Bureau Annual Report	Piracy cases where individuals are held for ransom, but the ship is not
Hijack and Ransom	International Maritime Bureau Annual Report	Piracy cases where both ship and crew are held for ransom
Intensity variables		
Successful Boarding	International Maritime Bureau Annual Report	Actual and attempted theft of small amount of goods
Minor theft & attacks on stationary ships	International Maritime Bureau Annual Report	Actual and attempted theft of small amount of 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 variable that takes value 1 if Polity IV reports -77
Civil (2)	Major Episodes of Political Violence	Country-years where a civil conflict of intensity 2 takes place
Low conflict	Major Episodes of Political Violence	Low level civil or ethnic conflict dummy: 0< MEPV score<4
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) and Rodrigue (2004)	Choke points for tanker and container traffic
Drug exports	International Narcotics Control Strategy	Dummy for countries mentioned as significant non-synthetic drug producers
Corruption (WB cce+4)	Kaufmann *et al.* (2009)	Extent to which power is exercised for private gain
Government effectiveness (WB gee+4)	Kaufmann *et al.* (2009)	Quality of civil service
Rule of Law (WB rol+4)	Kaufmann *et al.* (2009)	Subjective estimate regarding the quality of the Rule of Law
Log(Kuala Lumpur)	self-collected	Log of the distance between a country's capital and Kuala Lumpur

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

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. *Top end 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