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A longitudinal analysis of piracy in shipping

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Abstract

Using a dataset of 3,404 acts of maritime piracy from 1996 to 2008, this paper investigates whether piracy is related to the economic development and socio-political status of countries where attacks occur.

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1. Introduction

Over the last years, piracy at sea has gained increased attention from the media and policy makers around the world due to changes that occurred in the nature and location of such acts. Initially concentrated in the Red Sea, Indian Ocean and Malacca and Singapore Straits, attacks off the coast of Somalia, where several vessels were hijacked or fired upon, now represent a threat to international shipping. These attacks have led some ship-owners to avoid sailing through the Gulf of Aden and the Suez Canal as well as an increase in insurance premiums. This represents a cost estimated between 1 to 16 billion US$ per year for the shipping industry (Bone 2008, Bendall 2009, Hanson 2009).

Although piracy affects shipping first, observers often suggest that its root cause is not to be found at sea. The level of poverty, economic hardship and socio-political instability prevailing in countries where pirates live would be the main drivers (Anderson 1995, Eklöf 2006). For instance, Fouché (2009) highlights "political instability and poverty" as being highly relevant particularly in the case of Somalia. Kraska and Wilson (2009, p. 44) assert that "piracy seldom takes place in isolation, frequently occurring in concert with poverty, weak or no governance and economic stagnation" and that the renaissance in piracy can be attributed in part to "the dire situation within Somalia".

Despite an expected role of socio-economic indicators to understand piracy, their relationship with the occurrence of acts of piracy has so far not been subject to much investigation, contrary to other forms of terrorism (Nitsch and Schumacher 2004, Martin et al. 2008). One reason is undoubtedly the difficulty in gathering reliable statistics on piracy, Mejia et al. (2008, 2009) being recent exceptions. This paper fills in the gap in studying the determinants of acts of piracy between 1996 and 2008 from a unique dataset on acts of piracy and economic and political indicators at the country level.

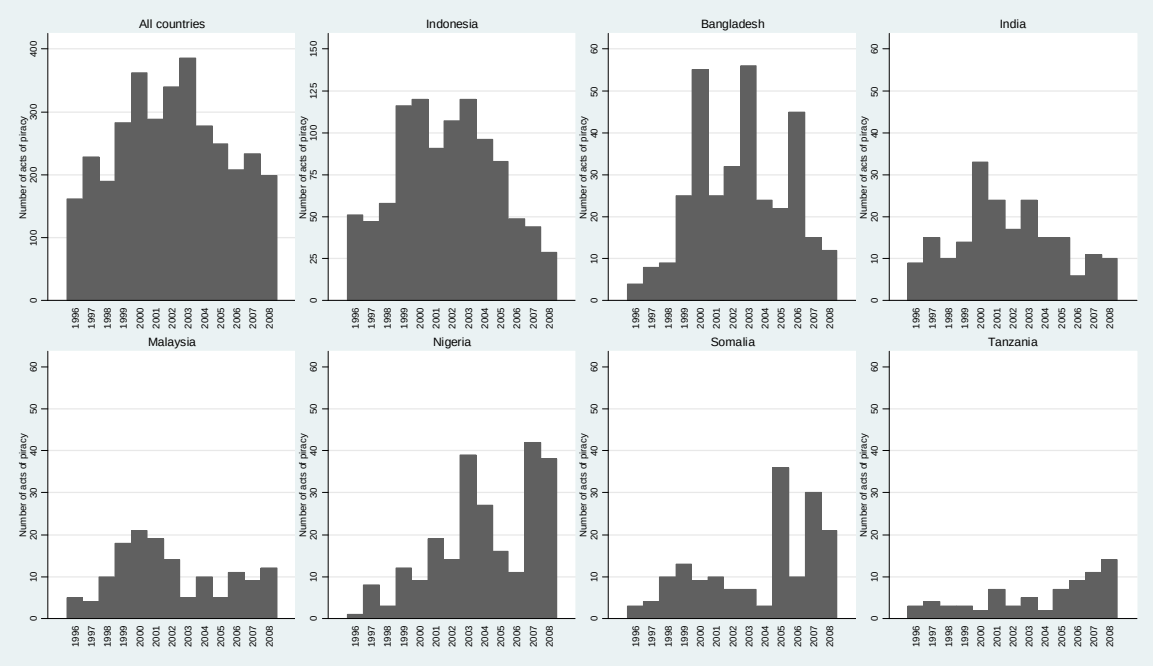
The remainder of this paper is organized as follows. In Section 2, we present our dataset and changes in acts of piracy over the period 1996-2008. Results from random effects Probit regressions are presented in Section 3, with a focus on the impact of country-specific political rights and civil liberties status. Finally, Section 4 provides our conclusions.

2. Data and descriptive statistics

We study the pattern of acts of piracy in shipping using a dataset collected by the International Maritime Bureau (IMB) from 1996 to 2008. The dataset contains information for each actual or attempted act of piracy and armed robbery against ships on the status of the ship when attacked (steaming, anchored…), the type of attack (boarded, fired upon, hijacked…), the ship name and flag, where and when the attack took place along with a narration on circumstances. Since we know when and where each attack took place, we are then able to calculate the number of attacks or attempted attacks PIR_{it} in the territorial waters of each country i in year t. The total number $\Sigma_i\Sigma_t PIR_{it}$ is equal to 3,404 over the period under consideration.

Figure 1 shows a general inverted U-shaped profile for acts of piracy over time. The "worst" years are 2000 (N=362) and 2003 (N=385), while the number of attacks was 208 in 2006, 233 in 2007 and 199 in 2008. The surge in the number of acts of piracy highlighted by media illustrates the situation for the last two years only, with respectively 406 and 445 attacks in 2009 and 2010.

Figure 1. Acts of piracy and armed robbery against ships (1996-2008)



Source: authors' calculations from IMB (1996-2008)

Piracy concerns only a limited number of countries[1]. From our sample of 1,976 observations for 152 countries over 13 years, 75.6% of the country-year observations are not subject to acts of piracy, 17.3% between 1 and 5 acts, and 7.1% more than 5 acts. Indonesia is the first place of attacks with 1,011 acts (29.7%), but this country has experienced a strong decrease since 2003. It is followed by Bangladesh (332 acts, 9.8%), Nigeria (239 acts, 7.0%), India (203 acts, 6%) and Somalia (163 acts, 4.8%). The recent surge in number of acts is mainly attributed to African countries and in particular two countries, Nigeria and Somalia.

Table 1 presents some descriptive statistics on various economic and socio-political indicators of countries where attacks are taking place[2]. The three socio-political indicators are those reported by the independent organization Freedom House. Political rights and civil liberties range from 1 (best situation) to 7 (worst), while freedom status is a synthetic indicator based on previous ratings. In 'free' countries, political competition is open, civil liberties are respected and there are independent civic life and media. In 'partly free' countries, weak rule of law prevails and some restrictions on civil liberties and political rights exist. In 'not free' countries, political rights and civil liberties are denied.

Descriptive statistics suggest that economic development and political indicators have an influence on the likelihood of finding acts of piracy in a country (see Table 1). The GDP per capita is nearly three times lower in countries subject to piracy (3,677 instead of 10,886 US$) as well as the GDP growth rate (2.491% versus 2.878%). Acts of piracy are also more likely for countries with weak political rights and civil liberties indicators. For the synthetic indicator, free countries account for 53.9% of the annual observations with no piracy attacks, but only 27.7% of the annual observations with attacks.

[1] Some attacks could not be allocated to any specific country and had to be disregarded. The 91 attacks in the Gulf of Aden in 2008 are the most representative.

[2] All these statistics were retrieved from the Global Development Network Growth database, Development Research Institute at New York University (http://dri.as.nyu.edu/object/dri.resources.growthdatabase)

Table 1. Descriptive statistics of the sample

Variables		No piracy	Piracy	All
Economic indicators				
GDP PPP per capita (/1000)		10.886	3.677	9.078
GDP growth (annual %)		2.878	2.491	2.782
Political indicators				
Political rights		3.012	3.941	3.238
Civil liberties		3.027	4.033	3.272
Status	Free	0.539	0.277	0.475
	Partially free	0.253	0.420	0.294
	Not free	0.202	0.292	0.224
Number of observations		1493	483	1976

Source: authors' calculations from IMB (1996-2008)

3. Econometric analysis

We turn to a multivariate analysis to investigate the determinants of acts of piracy at the country level. As many countries are not concerned with attacks, we focus on the probability of observing at least one act of piracy per year. Let A_{it} be a dummy variable such that $A_{it} = 1$ when piracy in country i $(i = 1, \dots, I)$ at date $(t = 1, \dots, T)$ is observed, and 0 otherwise. We suppose that a latent variable A_{it}^* measures the propensity of piracy such that:

$$A_{it}^* = X_{it}\beta + \theta_i + \varepsilon_{it} \quad (1)$$

with X_{it} a set of explanatory variables, β a vector of coefficients to estimate, and θ_i and ε_{it} two residuals. In (1), θ_i is a country-specific effect such that $\theta_i \sim N(0; \sigma_\theta^2)$ and ε_{it} is a pure error term such that $\varepsilon_{it} \sim N(0; 1)$. The error terms θ_i and ε_{it} are supposed to be independent of both each other and of the explanatory variables X_{it}. We have $A_{it} = 1$ when $A_{it}^* \geq 0$ and $A_{it} = 0$ otherwise. Let $a_{it} = -\infty$ and $b_{it} = -X_{it}\beta$ if $A_{it} = 0$, and $a_{it} = -X_{it}\beta$ and $b_{it} = +\infty$ if $A_{it} = 1$. Then, the log likelihood of the model is $L = \sum_i \ln \Pr(A_{i1}, \dots, A_{iT})$ with:

$$\Pr(A_{i1}, \dots, A_{iT}) = \int_{-\infty}^{+\infty} \Pi_{i=1}^{I} [\Phi(b_{it} - \theta_i) - \Phi(a_{it} - \theta_i)] \, \phi(\theta_i) d\theta_i \quad (2)$$

with $\phi(.)$ and Φ respectively the density function and distribution function of the univariate normal distribution. The corresponding specification is hence a random effect Probit model which is estimated using quadrature techniques[3]. Our estimates are presented in Table 2.

In a preliminary step (column 1 of table 2), we only account for economic variables and introduce year-specific dummies as additional covariates. These time coefficients will pick up the changing pattern of piracy over the whole period under consideration. For instance, the trend in piracy is likely to be affected by the fact that civil defence and military efforts against piracy changed from 1996 to 2008[4]. We observe a negative correlation between the

[3] The assumption behind the random effect specification is that the country specific effects are uncorrelated with the selected explanatory variables. We further assess the relevance of this exogeneity assumption by estimating conditional Logit models. When performing Hausman tests, our results indicate that the difference between the random effect and the fixed effect coefficients is never systematic, and therefore, that the random effect specification is appropriate.

[4] For instance, the Combined Task Force 150 was engaged in anti-piracy operations off the coast of Somalia from 2006 to 2008. Ideally, one would like to allocate international anti-piracy efforts to individual countries, but so far, such information on national efforts is not available for the large sample of countries under consideration.

probability that piracy occurs and the GDP per capita, which is significant at the 1 percent level. As expected, developed countries are less likely to experience acts of piracy in their territorial waters. The opposite pattern is found between piracy and a country's GDP growth rate, but the relationship is not significant at conventional level.

Table 2. Random effect Probit estimates of piracy

Variables		(1)	(2)	(3)	(4)	(5)
Constant		-1.169***	-1.413***	-1.869***	-1.491***	-9.354***
		(-4.54)	(-4.19)	(-4.70)	(-5.02)	(-7.54)
GDP PPP per capita/1000		-0.062***	-0.057***	-0.050***	-0.053***	-0.058***
		(-4.10)	(-3.67)	(-3.20)	(-3.48)	(-4.27)
GDP growth (annual %)		-0.012	-0.012	-0.011	-0.012	-0.015**
		(-1.60)	(-1.58)	(-1.50)	(-1.53)	(-1.96)
Political rights (1: Best to 7: worst)			0.065			
			(1.12)			
Civil liberties (1: Best to 7: worst)				0.170**		
				(2.33)		
Status	Partially free				0.392*	0.199
(ref: Free)					(1.92)	(1.00)
	Not free				0.543**	0.158
					(2.02)	(0.61)
Year dummies		YES	YES	YES	YES	YES
Additional controls		NO	NO	NO	NO	YES
Observations		1863	1863	1863	1863	1863
Countries		144	144	144	144	144
Log likelihood		-618.4	-617.8	-615.8	-616.1	-587.29

Source: authors' calculations from IMB (1996-2008)

Note: estimates from random effect Probit models, with t-statistics in parentheses. Significance levels are respectively 1% (***), 5% (**) and 10% (*). Additional controls are log of population size, growth rate of population and log of surface in km².

We respectively added the socio-political indicators in columns 2, 3 and 4 of table 2. We choose to introduce the three indicators separately as these covariates are positively correlated. For instance, the R^2 of an estimated OLS on political rights as a function of civil liberties is equal to 0.85. While the coefficient associated with political rights is not statistically significant (column 2), the probability at the 5 percent level for a country to be subject to piracy increases when civil liberties are restricted (column 3). A negative correlation exists between piracy and freedom status (column 4). Piracy is more likely to occur in partially free or not free countries. At the mean of the sample, the probability increases respectively by 5.8 points of percentage for partially free countries and 9.1 points for not free countries.

We then introduced three additional controls (column 5): log of population size, growth rate and log of surface. Our results are twofold. Firstly, the probability of piracy is positively correlated with population's size (at the 1 percent level)[5]. Secondly, the relationship between piracy and the freedom status is no longer significant. We get very similar results when introducing the ordered indicators of either political rights or civil liberties. As piracy is likely to be influenced by its lagged value, we then estimate a random effect dynamic Probit model with the following specification:

$$A_{it}^{*} = \gamma A_{it-1} + X_{it}\beta + \theta_i + \varepsilon_{it} \quad (3)$$

[5] Conversely, the correlation between piracy and both population growth and surface area is not significant at conventional level.

with $t > 1$. Note that the lagged coefficient of piracy is assumed to be the same for all countries. The error terms ε_{it} are assumed serially independent, but the composite error term $\theta_i + \varepsilon_{it}$ is correlated over time due to the country-specific θ_i terms. The solution proposed by Heckman (1981) consists in estimating jointly a linearized reduced form for the latent variable and for the first period of observation. Conditional on the country effects θ_i and assuming that the error terms ε_{it} are serially independent, the joint probability $\Pr(A_{i1}, \ldots, A_{iT})$ may be expressed as the product of the first-period probability of observing A_{i1} and the product of the other specific-period probabilities which depend on the lagged term A_{it-1} and on the selected covariates X_{it} (Stewart, 2006)[6].

Table 3. Random effects dynamic Probit estimates of piracy

Variables		(1)	(2)	(3)	(4)	(5)
Constant		-1.042***	-1.078***	-1.427***	-1.160***	-9.123***
		(-4.51)	(-3.82)	(-4.25)	(-4.56)	(-8.09)
Lagged piracy		0.533***	0.539***	0.517***	0.560***	0.500***
		(4.19)	(4.43)	(4.33)	(4.68)	(4.18)
GDP PPP per capita/1000		-0.033***	-0.035***	-0.028**	-0.036***	-0.041***
		(-4.92)	(-3.67)	(-2.25)	(-3.56)	(-4.93)
GDP growth (annual %)		-0.006	-0.005	-0.002	-0.004	-0.010
		(-0.75)	(-0.64)	(-0.30)	(-0.54)	(-1.31)
Political rights (1: Best to 7: worst)			0.152***			
			(2.78)			
Civil liberties (1: Best to 7: worst)				0.251***		
				(5.09)		
Status	Partially free				0.404**	0.115
(ref: Free)					(2.46)	(0.71)
	Not free				0.845***	0.059
					(3.61)	(0.30)
Year dummies		YES	YES	YES	YES	YES
Additional controls		NO	NO	NO	NO	YES
Observations		1863	1863	1863	1863	1863
Countries		144	144	144	144	144
Log likelihood		-617.3	-615.0	-610.0	-613.7	-579.1

Source: authors' calculations from IMB (1996-2008)

Note: estimates from random effects dynamic Probit models, with t-statistics in parentheses. Significance levels are respectively 1% (***), 5% (**) and 10% (*). Additional controls are log of population size, growth rate of population and log of surface in km².

The results reported in Table 3 show a strong state dependence in acts of piracy over time. The probability for a country to be concerned with piracy is much higher when there were some acts of piracy in that country the previous year. Furthermore, we still get a positive correlation between the freedom indicators and piracy and the relationship is now significant for both political rights, civil liberties and the freedom status (columns 2-4). However, this does not hold anymore when population size, population growth and surface are taken into account (column 5). Piracy is then more likely in countries with large and fast-growing population, while socio-political indicators are not significant.

We finally estimated the relationship between the number of acts of piracy and economic/political indicators[7]. Given the high proportion of zero values for acts of piracy, we

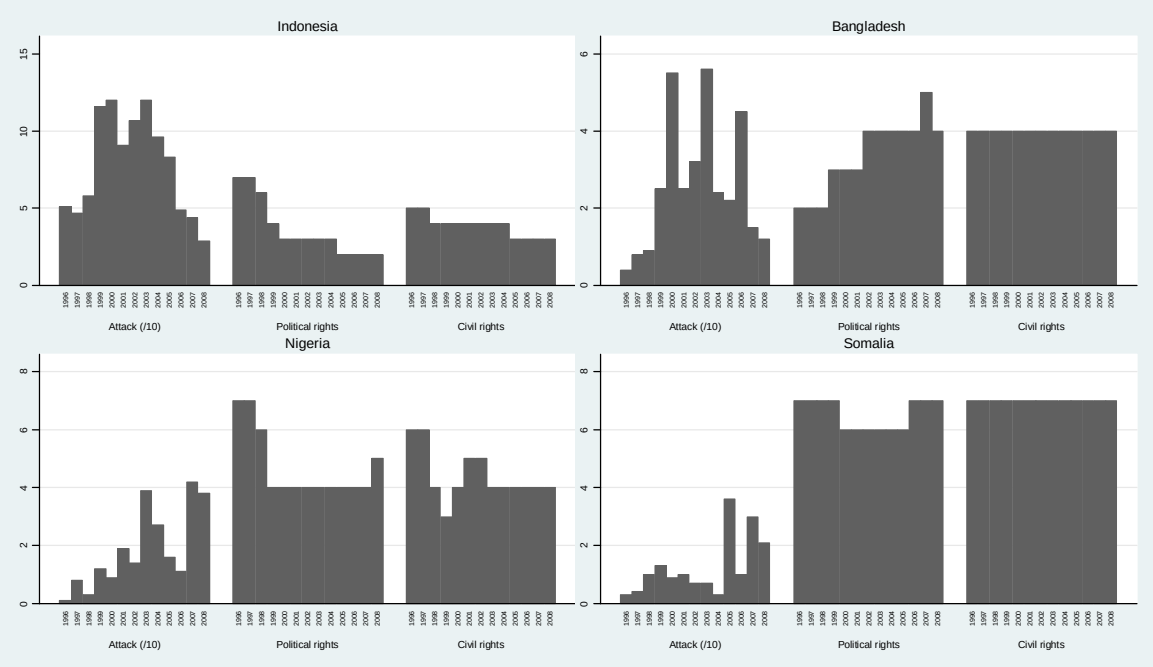
[6] The selected covariates to explain the first-period probability have to include the explanatory variables considered for the other periods and 'instruments'. We included a measure of trade defined as the sum of imports and exports as percentage of GDP in the first-period equation.

[7] These additional results are available upon request.

rely on random effects Tobit models with the log of acts of piracy as a dependent variable. Again, the number of acts of piracy is higher in countries with low GDP per capita. The GDP growth is negatively correlated with piracy at the 10 percent level and even at the 5 percent level once population size, population growth and surface are controlled for. We obtain positive coefficients for the various political indicators, but not significant at conventional levels.

So, our results suggest that the economic situation of a country is more important when explaining piracy than its political situation. These results should however be taken with caution due to the limited changes observed in socio-political indicators over the selected period. Figure 2 illustrates this element for few cases. As shown in Figure 2, both freedom indicators remain poor in Somalia and to a less extent in Nigeria between 1996 and 2008. So, this can clearly not explain the recent surge of piracy in both countries. Indonesia and Bangladesh, which are very similar at first glance, offer two contrasting patterns. In both cases, the trend in acts of piracy is decreasing. However, while political rights have improved in the former country, they have strongly deteriorated in the latter (and civil rights have remained constant).

Figure 2. Changes in political rights, civil liberties and acts of piracy



Source: authors' calculations from IMB (1996-2008)

4. Conclusion

This article deals with the shifting pattern and location of acts of piracy and armed robbery against ships. The observed shift from South-East Asia to Africa is confirmed by the recent surge in attacks in 2009 and 2010, with growing demands for ransoms amounting to millions of dollars. The root causes for such shift are however more difficult to identify. Our results show that acts of piracy are negatively related to the current level of GDP per capita. Poor situations related to political rights, civil liberties and freedom status tend to increase the likelihood of piracy, but the correlation remains weak and it is no longer significant once population and surface are taken into account. Finally, a strong state dependence in maritime piracy exists around the world.

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