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Understanding the Root Causes of Modern Maritime Piracy

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Abstract

This paper examines the trends and determinants of modern-era piracy. To that end, it first applies the extralegal appropriation and production model to contemporary maritime piracy. It, then, utilizes a new dataset of 3,362 maritime piracy incidents that occurred worldwide between 1998 and 2007. To test model predictions, the data cover detailed information on the location, timing, the number of pirates involved, the ship's characteristics and success of each attack, as well as the material damage and violence inflicted upon the crew and the cargo. I combine these data with macroeconomic and aggregate measures on per-capita incomes, rates of economic growth, unemployment rate and institutional quality of countries where piracy incidents occur. I find the results well support the model in that economic and political factors do matter: higher real incomes per capita, lower unemployment rates and more political freedoms influence the number of pirates involved in incidents, the success of attack and property damage inflicted.

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1. Introduction

When mentioning "pirates", most people imagine cruel men with the eye patches and green parrots on their shoulders. But maritime piracy is one of the oldest criminal professions which made a deadly comeback in the early 1990s becoming a serious global threat to sea commerce.

According to the International Maritime Organization (IMO), the total number of incidents of piracy and armed robbery against ships, reported to have occurred or to have been attempted from 1984 to the end of December 2009, is 5,633. Up to date, the number of acts of piracy and armed robbery against ships in 2009 reported was 406, an increase of 106 (24.6%) over the number reported in 2008. Unsurprisingly, 80 percent of international maritime freight travel is largely unguarded and only 1 percent of maritime pirates get arrested (Maggio, 2007).[1] Somalia accounts for more than half of the incidents in 2009, followed by the Far East, in particular the South China Sea, West Africa, South America, the Caribbean and Indian Ocean.

Even though there has been significant improvement in maritime safety in South East Asian and Far East waters, there still remains an underlying potential for piracy incidents. The pressure on the pirates and the robbers has to be maintained by the littoral states and the constant physical presence in the waters. For example, Indonesia is highly praised for their diligent efforts in curbing piracy and armed robberies at sea. There continues to be a year-on-year decline in the number of incidents, with incidents for 2009, the majority opportunistic in nature. On the other hand, this is the second year in a row where incidents in the Singapore straits have increased. Thirteen incidents were reported by ships steaming in the South China Sea. This is the highest number of incidents in the previous five years.

Corresponding with this rise are the crew violence and the material damage from attacks between 1991 and 2009, 382 crew members were killed; 902 crew members were reportedly injured/assaulted; 5,910 crew members were reportedly taken hostage/kidnapped; and 203 crew members went missing. Assaults on crews were typically involved by groups

[1] "Maritime Piracy: Poverty in lawless lands breeds a new era of piracy on the seas" by TakePart, LLC (2010) at http://www.takepart.com/issues/maritime-piracy/16433

of five to ten pirates, some of whom were heavily armed.

Despite these figures, maritime piracy incidents are underreported by as much as 50 percent (Chalk, 2008). Statistical data provides an overall view of the problem but it is by no means an accurate indicator of the actual criminal activity that takes place (Kellerman, 1998). Why are not all piracy cases reported to international organizations? First, port authorities are likely to dock the ship and its crew while they investigate the attack. Thus, if the cost to do so exceeds the sustained loss, the ship owners are unlikely to report. In 1997, investigation costs amounted to $10,000 per day whereas Abhyankar (1999) estimates that the average loss per attack to be approximately $5,000. Also, higher insurance costs and salaries for future crews can be a factor in maritime companies not to report. If local law enforcement is suspected of being in league with the pirates or is turning a blind eye to their activities, then the likelihood of the attack being reported is again very low. Gottschalk et al. (2000) calculate that those losses amounted to $0.32 for every $10,000 of goods shipped in 1997. Overall, the financial incentive for shipping companies to deal with the issue are not too high.

In this paper, I examine the economic and political determinants of modern-day piracy. In order to do so, I first advance a conceptual model of extralegal appropriation and production applied to maritime piracy. The model indicates that piracy's opportunity costs are wage employment and that a lack of enforcement of the law would lower the threshold wage employment below which piracy would become attractive. I then test the empirical implications of the model. In the model, the maritime piracy incidents represent the subversive activity and the resources devoted for extralegal appropriation are the labor inputs used for piracy. Data include 3,362 worldwide modern-day piracy incidents that occurred between 1998 and 2007. I have detailed information on the location, region, timing and success of each attack, as well as the material damage and violence inflicted upon the crew and the cargo. I combine these incident-based data with macroeconomic and aggregate measures on per-capita incomes, rates of economic growth, unemployment rate and institutional quality of countries where the incident took place. I also incorporate the number of pirates involved and the vessels characteristics (the gross registered tonnage, flags, type of vessels) for each incident.

Empirical study reveals the following findings. First, the results fit the theoretical model well in that economic factors play a significant role in the number of pirates, the success of the attack and property damage inflicted. For instance, higher real per-capita incomes and lower unemployment rates tend to reduce the number of pirates. Political institutions are also important explaining this phenomenon. For example, the incidents that occur in a country with higher political freedoms tend to have less number of pirates and the incidents that occur in the territories of more democratic countries tend to reduce the chance of successful attacks. Incidents that take place in more democratic locations also tends to involve fewer cases in which pirates board the ship and ask for ransom demands.

It has already well emphasized that economic conditions and incentives help to explain modern maritime piracy. For instance, many Indonesian pirate attacks are the result of harsh economic conditions. The current spate of attacks in Indonesia can be traced back to the onset of the 1997-98 Asian economic crisis (Wiencek 2001). Also, lack of regional cooperation can explain this subsistence. Smaller developing nations cannot defend against pirate attacks occurring within their jurisdiction. Local authorities in areas such as Malaysia and Indonesia are not equipped with the technology and resources to combat pirates. While Singapore and Malaysia have increased their army forces, Indonesia in particular needs help in reducing pirate activities. This corresponds to Mo (2002)'s suggestion that the most effective way to combat maritime piracy in Southeast Asia is regional cooperation but the lack of cooperation is still a problem.

However, there are not many works in quantitative economics that focus on modern maritime piracy. With the limited amount of work, there are few papers that analyze this phenomenon in several aspects. Maggio (2007) estimates the damage caused by maritime piracy and armed robbery and reveals that piracy and hijackings cost world shipping and industry around \$16-\$25 billion a year. Nevertheless, Murphy (2007) warns against exaggerating the threat posed by maritime pirates. He notes that even \$16 billion in losses is a minimal amount compared to annual global maritime trade value, which is in the trillions of dollars. This also explains why shipping companies do not give a serious attention to this threat. Despite this fact, this terrorism cannot be negligible

since maritime piracy incidents sometimes occurs in international waters beyond the reach of the law in key locations that can affect the global security of nations around the world as well as the world economy.

Moreover, Mejia et al. (2009) focus on the randomness of maritime piracy. They estimate the probability that the cargo ship will be attacked by using a Probit model and the results show that both flags of registry and types of vessel are significant factors explaining maritime piracy. They also inquire whether there is a difference in the probability of being attacked between ships that fly Asian flags and those that fly non-Asian flags. Thus, piracy is clearly non-randomly selected.

Another quantitative analysis on the modern maritime piracy focuses on political institutions and state status. Hastings (2009) explores whether the difference between the geographies of state failure and state weakness matters for piracy. He argues that state failure is associated with less sophisticated attacks whereas state weakness supports more sophisticated attacks since they provide the facilities necessary for pirating. Moreover, pirates from failed states are likely to appropriate more liquid assets, whereas the ones from weak states tend to appropriate assets with less liquidity. Moreover, failed states also face a trade-off. If they improve the political and economic system to escape from state failure, they might be encountered with an increase in high-skilled pirates.

The basic theoretical model explaining why economic conditions play an important role for modern-day piracy is based on the political economy literature on production and extralegal appropriation. The main objectives are to identify the factors that determine resource allocation among both productive and appropriative activities and the equilibrium distortion of resources and income. This model was originated by Haavelmo (1954) and further developed by follow-up papers such as Hirshleifer (1991), Grossman (1994), Grossman and Kim (1995), Grossman and Iyigun (1995, 1997), Skaperdas (1992, 2005), Bates et al. (2002), and Hafer (2006). In the next section, I apply the production and extralegal appropriation model to contemporary maritime piracy.

2. Theoretical Framework

2.1 Individual Choice

Consider the following model of a representative economy. Assume that the resource endowment of this economy is given, $\overline{\omega}$. The economy uses resources to produce the good for domestic consumption and exports to another economy by water transportation. Let t be the proportion of the resource produced for domestic consumption , $0 < t \leq 1$. Thus, exports are $(1-t)\overline{\omega}$. The population of the economy consists of N identical families. Each family can divide their time between productive and subversive activities. The productive activity (being a farmer) is a wage employment offered by producers.

The income of a family from being a farmer is $w_f f$ where w_f is the wage rate of each unit time of labor and f is the fraction of its time that this family allocates to productive activities. Define p as the fraction of the time that family allocates to subversive activities (being a pirate). That is,

$$f + p = 1 \tag{1}$$

Pirates attack cargo ships containing exported goods. Assume that the exported good is split into R identical cargo ships exporting from this country. The total piracy income is $\beta(1-t)\overline{\omega}$ where β is the fraction of cargo lost due to the attack; $0 \leq \beta < 1$.

The total income from attacking cargo ships are divided among all families proportionately to the time allocated by each family to subversive activity. Therefore, the income of a family from attacking cargo ships is $\beta\left(\frac{(1-t)\overline{\omega}}{N}\frac{p}{P}\right)$ where P is the fraction that of its time that the average family allocates to being a pirate. Thus, the total income of a family, i, is given by

$$i = w_f f + \beta\left(\frac{(1-t)\overline{\omega}}{N}\frac{p}{P}\right) \tag{2}$$

Each family takes w_f and $\beta\left(\frac{(1-t)\overline{\omega}}{NP}\right)$ as given and chooses f and p , subject to

the constraint $f + p = 1$, to maximize i. The Kuhn-Tucker condition for maximizing i implies

$$p^* = \begin{cases} 0 & \text{if } w_f > \beta\left(\frac{(1-t)\overline{\omega}}{NP}\right) \\ [0,1] & \text{if } w_f = \beta\left(\frac{(1-t)\overline{\omega}}{NP}\right) \\ 1 & \text{if } w_f < \beta\left(\frac{(1-t)\overline{\omega}}{NP}\right) \end{cases} \tag{3}$$

and

$$f^* = 1 - p^* \tag{4}$$

Equation (3) indicates that, other things being equal, each family would allocate all of the time to only one activity if the returns to that activity is greater than the return to the other activity. Each family would allocate time to both activities only if the returns to both activities are equal.

2.2 Subversive technology

Recall that β is simply the probability that the cargo ship will get attacked. In the absence of protection, let assume that it is an increasing and concave in $\frac{NP}{R}$ which is the total time that all families allocate to extralegal activity per ship. A simple technology of attacking vessels that incorporates this assumption is

$$\beta = \frac{x}{1+x} \text{ where } x = \phi\frac{NP}{R}, \quad \phi \geq 0 \tag{5}$$

In equation (5), the parameter ϕ determines the effectiveness of time allocated to subversive activity in appropriating the cargo goods.

In equilibrium, since all families are identical, p is equal to P ,which is the fraction of its time that the average family allocates to being a pirate, and f is equal to F. Therefore, the average family would allocate the time according to

$$P^* = \begin{cases} 0 & \text{if} \quad w_f > \frac{\phi(1-t)\overline{\omega}}{R} \\ \frac{\frac{\phi(1-t)\overline{\omega}}{Rw_f}-1}{\phi\frac{N}{R}} & \text{if} \quad \frac{\frac{\phi(1-t)\overline{\omega}}{R}}{1+\frac{\phi N}{R}} < w_f < \frac{\phi(1-t)\overline{\omega}}{R} \\ 1 & \text{if} \quad w_f < \frac{\frac{\phi(1-t)\overline{\omega}}{R}}{1+\frac{\phi N}{R}} \end{cases} \tag{6}$$

and

$$F^* = 1 - P^* \tag{7}$$

Proposition 1 *The time that average family allocates to extralegal activity, P, is increasing in its effectiveness, ϕ, the resource endowment, $\overline{\omega}$, and the proportion of exports, $(1-t)$, but decreasing in the number of families, N, the return of a legal job, w_f, and the number of cargo ships, R.*

Proof.

By comparative static analysis,

Since $P = \frac{\frac{\phi(1-t)\overline{\omega}}{Rw_f}-1}{\phi\frac{N}{R}} = \frac{\phi(1-t)\overline{\omega}-Rw_f}{\phi N w_f}$, I have

$\frac{\partial P}{\partial \phi} = \frac{R}{N\phi^2} > 0$

$\frac{\partial P}{\partial \overline{\omega}} = \frac{(1-t)}{Nw_f} > 0$

$\frac{\partial P}{\partial (1-t)} = \frac{\overline{\omega}}{Nw_f} > 0$

$\frac{\partial P}{\partial N} = -\left(\frac{\phi(1-t)\overline{\omega}-Rw_f}{\phi N^2 w_f}\right) < 0$

$\frac{\partial P}{\partial w_f} = -\left(\frac{(1-t)\overline{\omega}}{N(w_f)^2}\right) < 0$

$\frac{\partial P}{\partial R} = -\frac{1}{N\phi} < 0$ ■

The results from the proposition are straightforward and make economic sense. One may wonder why the time allocation for subversive activities is decreasing in the number of cargo ships. More ships sent with exports on board should be more attractive to the pirates. The reason seems to be different. For a given level of subversive technology, more ships mean fewer resources devoted to piracy attacks per ship. This, however, lowers success probability (or share of resources captured by pirates). In turn, this makes piracy even less attractive.

In equation (5), substituting x into the success contest function, I obtain

$$\beta = \frac{\phi NP}{R + \phi NP} \tag{8}$$

Plugging P^* from the individual optimization in equation (6) into the contest success function in equation (8), I obtain

$$\beta = 1 - \frac{Rw_f}{\phi(1-t)\overline{\omega}} \tag{9}$$

Proposition 2 *The success of attack, β, is increasing in the time that average family allocates to subversive activity, P, the resource endowment, $\overline{\omega}$, the proportion of exports, $(1-t)$, and the effectiveness of time allocated to be a pirate, ϕ, but decreasing in the return of a legal job, w_f, and the number of ships, R.*

Proof.

By comparative static analysis,

From equation (8), since $\beta = \frac{\phi NP}{R+\phi NP}$, I have

$\frac{\partial \beta}{\partial P} = \frac{\phi RN}{(R+\phi NP)^2} > 0$

From equation (9), since $\beta = 1 - \frac{Rw_f}{\phi(1-t)\overline{\omega}}$, I have

$\frac{\partial \beta}{\partial \overline{\omega}} = \frac{Rw_f}{(1-t)\phi(\overline{\omega})^2} > 0$

$\frac{\partial \beta}{\partial (1-t)} = \frac{Rw_f}{\phi\overline{\omega}(1-t)^2} > 0$

$\frac{\partial \beta}{\partial \phi} = \frac{Rw_f}{(1-t)\overline{\omega}(\phi)^2} > 0$

$\frac{\partial \beta}{\partial w_f} = \frac{-R}{\phi(1-t)\overline{\omega}} < 0$

$\frac{\partial \beta}{\partial R} = \frac{-w_f}{\phi(1-t)\overline{\omega}} < 0$

■

Success of attack does not imply that pirates can appropriate properties on board. Pirates can board ship but leave empty handed because of the crew alert. Now I consider the success of appropriation on economic outcomes. In order to model the success of theft, I introduce piracy profits as a proxy since profits come not only from hiring the optimal number of pirates but also from liquidating appropriated goods in the market. In the following section, I analyze the labor market for pirates and derive the determinants of piratical profits.

2.3 Competitive Labor Market of Pirate Firms

Assume that, with the large number of indigenous families, the labor market for pirates is competitive.[2] Output (cargo appropriated) is obtained from using pirates with the technology $\lambda p^{\alpha}, 0 < \alpha < 1$, where p is the unit of labor time of pirating and λ is a parameter reflecting productivity as well as the relative price of the goods produced by the economy. Given this technology, the gross profit obtained from attacking one ship is $\pi = \lambda p^{\alpha} - w_p p$. Recall from individual optimization that $w_p = \beta\left(\frac{(1-t)\overline{\omega}}{NP}\right)$. Substitute $w_p = \beta\left(\frac{1-t)\overline{\omega}}{NP}\right)$ into the profit function, which becomes

[2]I also extend this analysis by assuming a monopsonized labor market for subversive activity and compare the results with the competitive outcome. See Ratisukpimol (2010) for more details.

$$\pi = \lambda p^{\alpha} - \beta \left(\frac{1-t)\overline{\omega}}{NP} \right) p \tag{10}$$

The pirate firms take $\beta \left(\frac{1-t)\overline{\omega}}{NP} \right)$and λ as given and choose p to maximize π. This maximization implies that p satisfies

$$p = \left(\frac{\alpha \lambda NP}{\beta(1-t)\overline{\omega}} \right)^{\frac{1}{1-\alpha}} \tag{11}$$

The market-clearing condition for the labor market is that labor demand (the unit of labor time of pirates times the number of cargo ships) is equal to the labor supply (the fraction of time that the average family allocates to piracy times the number of families). That is,

$$pR = NP \tag{12}$$

Taken together, equations (11) and (12) imply that the market-clearing wage rate equals the marginal product of labor:

$$\left[\frac{NP}{R} \right]^{1-\alpha} = \frac{\alpha \lambda}{\left[\frac{\beta(1-t)\overline{\omega}}{NP} \right]} \tag{13}$$

$$w_p = \left[\frac{\beta(1-t)\overline{\omega}}{NP} \right] = \frac{\alpha \lambda}{\left[\frac{NP}{R} \right]^{1-\alpha}} \tag{14}$$

Substitute the first-order and market-clearing conditions into the profit function.

$$\pi = \lambda \left(\frac{NP}{R} \right)^{\alpha} - \left[\frac{\alpha \lambda}{\left(\frac{NP}{R} \right)^{1-\alpha}} \right] \left(\frac{NP}{R} \right) \tag{15}$$

Therefore, profits from attacking each cargo ship are

$$\pi = \lambda(1-\alpha)\left(\frac{NP}{R}\right)^{\alpha} \tag{16}$$

Plugging P^* from the individual optimization in equation (6) into the profit function above, I obtain

$$\pi^* = \lambda(1-\alpha)\left[\frac{(1-t)\overline{\omega}}{Rw_f} - \frac{1}{\phi}\right]^{\alpha} \tag{17}$$

Proposition 3 *The piracy profits, π, are increasing in the number of pirates, P, price of cargo goods, λ, the resource endowment, $\overline{\omega}$, the proportion of exports, $(1-t)$, and the effectiveness of time allocated to be a pirate, ϕ, but decreasing in the return of a legal job, w_f, and the number of ships, R.*

Proof.

By comparative static analysis,

From equation (16), since $\pi = \lambda(1-\alpha)\left(\frac{NP}{R}\right)^{\alpha}$,

$\frac{\partial \pi}{\partial P} = \lambda(1-\alpha)\alpha\left(\frac{NP}{R}\right)^{\alpha-1}\left(\frac{N}{R}\right) > 0$

From equation (17), since $\pi = \lambda(1-\alpha)\left[\frac{(1-t)\overline{\omega}}{Rw_f} - \frac{1}{\phi}\right]^{\alpha}$,

$\frac{\partial \pi}{\partial \lambda} = (1-\alpha)\left[\frac{(1-t)\overline{\omega}}{Rw_f} - \frac{1}{\phi}\right]^{\alpha} > 0$

$\frac{\partial \pi}{\partial \overline{\omega}} = \lambda(1-\alpha)\alpha\left[\frac{(1-t)\overline{\omega}}{Rw_f} - \frac{1}{\phi}\right]^{\alpha-1}\left[\frac{(1-t)}{Rw_f}\right] > 0$

$\frac{\partial \pi}{\partial (1-t)} = \lambda(1-\alpha)\alpha\left[\frac{(1-t)\overline{\omega}}{Rw_f} - \frac{1}{\phi}\right]^{\alpha-1}\left[\frac{\overline{\omega}}{Rw_f}\right] > 0$

$\frac{\partial \pi}{\partial \phi} = \lambda(1-\alpha)\alpha\left[\frac{(1-t)\overline{\omega}}{Rw_f} - \frac{1}{\phi}\right]^{\alpha-1}\left[\frac{1}{\phi^2}\right] > 0$

$$\frac{\partial \pi}{\partial w_f} = \lambda(1-\alpha)\alpha\left[\frac{(1-t)\overline{\omega}}{Rw_f} - \frac{1}{\phi}\right]^{\alpha-1}\left[-\frac{(1-t)\overline{\omega}}{R(w_f)^2}\right] < 0$$

$$\frac{\partial \pi}{\partial R} = \lambda(1-\alpha)\alpha\left[\frac{(1-t)\overline{\omega}}{Rw_f} - \frac{1}{\phi}\right]^{\alpha-1}\left[-\frac{(1-t)\overline{\omega}}{R^2 w_f}\right] < 0 \ \blacksquare$$

3. The Empirical Analysis

3.1 Data and Descriptive Statistics

I created the data using several specific underlying datasets. For the full description of each piracy incident between 1998 and 2007, the main information sources are the annual reports by the International Maritime Bureau (*IMB*) and the annual and monthly reports from International Maritime Organization (*IMO*). For statistical purposes, the IMB defines Piracy and Armed Robbery as "An act of boarding or attempting to board any ship with the apparent intent to commit theft or any other crime and with the apparent intent or capability to use force in the furtherance of that act". This definition covers actual or attempted attacks whether the ship is berthed, at anchor or at sea. Trivial thefts are excluded unless the thieves are armed. This definition has been adopted by the IMB as the majority attacks against ships take place within the jurisdictions of States and piracy which is defined under United Nations Convention on Law of the Sea (1982) does not address this aspect.

For each incident of piracy and robbery against a seafaring vessel, these allowed me to create data on the exact time of the incident (i.e., year and month); its location by type of waters (port area, territorial water or international waters); the identity of the ship including its flag of registry; its type of goods carried; its gross registered tonnage (*GRT*); the type of violence perpetrated against the crew, ranging from no harm done to deaths; the type of goods stolen or appropriated; and the number of pirates involved in each incident. I also identify whether the attack is actual or attempted.[3]

[3]IMB defines "actual" attack as the incidents where the pirates successfully boarded the target ship regardless of the consequences to the crews and goods. They also define "attempted" attack as the incidents where the pirates failed to board the ship underway and finally gave up the chase. Although the attack is attempted and pirates cannot rob any goods, it can cause injury to the crews by firing upon the target from their ships.

Then, based on the location of the attack, I combined the above data with country-level economic and political measures. Data such as real GDP per capita and its 10-year growth rate are sourced from the *Penn World Tables*, Mark 6.3. Annual data on unemployment rates are obtained from the *World Databank.* The data on political and institutional measures primarily come from two different sources: *Freedom House* world political and civil freedom measures, and the *Polity IV* project, "Political Regime Characteristics and Transitions." The Freedom House data provide three measures of political rights, civil liberties and political freedom status. Political rights and civil liberties are measured on a one-to-seven scale, with one representing the highest degree of freedom and seven the lowest.[4] The freedom status is classified into three categories; free, partly free and not free.[5] And the *Polity IV* project provides the institutionalized democracy score, institutionalized autocracy score and the modified polity score.[6]

Finally, the data on total world merchant fleet and maritime trade per capita are obtained through *Shipping Statistics Yearbooks* from the Institute of shipping and Logistics of Bremen (*ISL*). The total merchant fleet cover ships over 100 gt (gross tonnage) and over. They include fishing types and non-trading vessels. The maritime trade per capita is obtained from the loading and unloading cargo traffic volume by selected ports

[4]The ratings process is based on a checklist of 10 political rights questions and 15 civil liberties questions. The political rights questions are grouped into three subcategories: Electoral Process, Political Pluralism and Participation, and Functioning of Government. The civil liberties questions are grouped into four subcategories: Freedom of Expression and Belief, Associational and Organizational Rights, Rule of Law, and Personal Autonomy and Individual Rights.

[5]Until 2003, countries whose combined average ratings for Political Rights and for Civil Liberties fell between 1.0 and 2.5 were designated "Free"; between 3.0 and 5.5 "Partly Free," and between 5.5 and 7.0 "Not Free". Beginning with the ratings for 2003, countries whose combined average ratings fall between 3.0 and 5.0 are "Partly Free" and those between 5.5 and 7.0 are "Not Free".

[6]The institutionalized democracy score is conceived as three essential, interdependent elements. One is the presence of institutions and procedures through which citizens can express effective preferences about alternative policies and leaders. Second is the existence of institutionalized constraints on the exercise of power by the executive. Third is the guarantee of civil liberties to all citizens in their daily lives and in acts of political participation. The operational indicator of democracy and autocracy are derived from the competitiveness of political participation, the openness and competitiveness of executive recruitment, and constraints on the chief executive. They are an additive eleven-point scale (0-10). The Polity score is computed by subtracting the institutionalized autocracy score from the institutionalized democracy score; the resulting unified polity scale ranges from -10 (strongly autocratic) to +10 (strongly democratic). It is a modified version in order to facilitate the use in time-series analysis by converting the standardized authority scores to conventional polity scores.

divided by the total population in the region.

There are five geographic regions covered: Asia, Africa, America, Europe and Oceania. I calculate the cargo traffic volume within each region based only on selected ports, although those data represent 71 percent of the actual world seaborne trade over the ten years for which I have data.

The summary and descriptive statistics of some of the key variables are listed in Table 1. Close to 75 percent of all attacks succeeded over the ten years in the sample. The $YEARS$ variable ranges from one to ten in chronological order. It equals to one if incidents happened in 1998 and ten if happened in 2007. The frequency of incidents over time is slightly backloaded although spread fairly evenly, with the average incident occurring between the 5th and 6th years in the decade-long sample (i.e., between 2002 and 2003). For the 2,300 observations for which I have data on the number of pirates involved in the incident, the average number of pirates employed in each incident is about 6. Most attacks involved one pirate. Of course, these incidents only happened at ports. But close to ten percent of these attacks involved more than ten pirates, and 43 were reported to take more than twenty. There are five incidents in which more than 80 pirates involved with a maximum of 200 pirates. Variable $GOODS$ ranges anywhere from zero to seven on the basis of the economic damage inflicted by the pirates: this variable equals zero if no economic harm was done; $GOODS$ equals one if the pirates left with some cash; it equals two if they stole spare parts; three, four or five if they took storage material, spare parts or equipment, respectively; six if they sought ransom and seven if they commandeered the vessel. For every one hundred incidents recorded in the dataset, there were ten incidents in which cash items were stolen; four in which cargo goods are robbed; three in which the pirates sought ransom; and 5 cases where the vessels were captured.[7]

For countries where the incidents happened, the real per capita incomes is roughly \$7,600 based on 2005 constant U.S. dollars. The 10-year growth rate of real GDP per capita is around 22 percent and the unemployment rate is about 8 percent. The

[7]The definition of variable $CASH$ includes Captains and crews' cash and their personal valuables and belongings.

$STATUS$ dummy variable ranges from zero to two. It equals to zero if countries where the incidents happened have "Not Free" status; one if "Partly Free" status and two if "Free" status. The mean value of the freedom status is about 1 implying that by average the countries where the incident happens has partly free status. The $WATER$ variable ranges from one to three. It equals to one if the incidents happen in the port area; two if happen in territorial water and three if they happen in the international water. It also can be interpreted as the distance from the sea shore. The mean of the variable $WATER$ is around 1.8. The interpretation is that, on average, the incidents happened at ports or local waters. For vessels attacked by pirates, on average, the total internal volume is around 16,800 tons.[8] The mean value of maritime trade per capita is 1.15 metric tons and on average the total world merchant fleet is around 89,360.

[Table 1 about here.]

Examining the correlation matrix shown in Table 2 a, the success of attack have increased over time but the number of pirates has declined over time. Note that the success of attacks and the number of pirates decline slightly with increases in per-capita income and the unemployment rate but they are positively correlated with the growth rate of real GDP per capita. Also, the number of pirates declines when citizens have more freedom and political rights and when countries are more democratic. With the smaller number of pirates, the probability of all types of property appropriation declines.

Turning to Table 2 b, we see that it is harder to successfully attack when the ships are sailing farther from the land and when the ships are larger. But the success of attack is positively correlated with the maritime trade per capita and the number of vessels. It is interesting to observe that the farther the distance from port, the higher chance of robbing cash, vessel and ransom but not for cargo goods. The reason is that it is easier to successfully operate when the ships are at the port for loading and unloading the cargo. The number of robberies is decreasing in the size of vessel. This could be because larger ships imply higher protection level. Note that the number of fleet is increasing

[8]Some carriers attacked by pirates are fishing boats and other small ships which have very low tonnages and their values were not recorded by IMO and IMB. Thus, I assume the minimum value of variable $TONNAGE$ is zero.

in the ransom demand and vessel hijacking but decreasing in the cash and cargo goods robberies.

In Table 2 c, incidents with cash and cargo goods robberies have declined slightly over time, whereas incidents involving vessel hijacking and ransom demanding rose. The number of pirates is increasing with all four types of robberies.

[Table 2 about here.]

3.2 Main Results

Now, to validate the extralegal appropriation model as an application to modern maritime piracy, I utilize dataset described above to estimate the number of pirates, success of attack and piracy profits on economic and political explanatory variables. The time that average family allocates to subversive activity is represented by the data on number of maritime pirates involved in each incident. The success of attack is a proxy for subversive technology of attacking vessels and piratical profits are represented by the success of the economic outcomes.

3.2.1 Reduced-Form Estimates

I derive the baseline empirical results by estimating the following reduced-form equation:

$$\begin{aligned} OUTCOME_{it} &= \alpha + \Gamma_{it}\boldsymbol{\beta} + \Omega_{it}\boldsymbol{\gamma} + \sum_{j=1998}^{2007} \psi_j \times I_j \\ &\quad + \sum_{k=1}^{22} \lambda_k \times I_k + \sum_{m=1}^{5} \lambda_m \times I_m + \varepsilon_{it} \ , \end{aligned} \tag{18}$$

where $OUTCOME_{it}$ is an outcome of the piracy act that took place in location i at time t; it is based on the number of pirates, the success of the attack or the nature of the appropriation involved. In (18), α is a constant and Γ_{it} represents incident-specific

explanatory variables related to the vessel or geographic location where the incident occurred. And Ω_{it} represents economic or political variables associated location i at time t. Finally, the I_j , I_k and I_m represent controls for time fixed effects, location fixed effects and region fixed effects, with the second being based on the 22 locations and the latter being based on the 5 regions in my database where piracy incidents were reported.

In alternative specifications, my dependent variable $OUTCOME_{it}$ is the number of pirates involved in each incident, $PIRATES$. Another specification uses $ATTACK_{it}$ as a dependent variable. It is a dummy variable that takes on the value of one if pirates succeeded in boarding the vessel and zero is the attack is attempted which means the pirates could not successfully board the vessel. Alternatively, my dependent variable $OUTCOME_{it}$ is also one of four measures of economic outcomes: whether or not the pirates stole cash from the crew or the vessel, $CASH_{it}$; they used the crew for ransom demands, $RANSOM_{it}$; they succeeded in capturing the vessel, $VESSEL_{it}$; or they stole cargo goods for sale; $CARGOGOODS_{it}$. All of dependent variables are dummies except $PIRATES$.

In terms of the incident-specific economic or political explanatory variables in the matrix Ω_{it}, there are per-capita real GDP, its growth rate and unemployment levels at time t in location i, $RGDPCAP_{it}$, $GROWTH_{it}$ and $UNEMP_{it}$, respectively. This matrix also includes measures on political rights, political freedom status and the polity score, labeled as $PRIGHTS_{it}$, $STATUS_{it}$ and $POLITY_{it}$, respectively.[9] The matrix of incident-specific vessel and geographic explanatory variables, Γ_{it}, includes the month and year of the incident, its geographic location, the type of water where the incident happens ($WATER$) as well as the gross registered tonnage ($TONNAGE$), flag, type of vessel, the total world fleet in that year ($SHIPS$) and the maritime trade volume per capita in the region where the incident occurs ($MTRADECAP$).[10]

[9]To facilitate interpreting the results in the empirical analysis, I generated a new variable representing the inverse of the index value such that the higher score implies the higher degree of political rights freedom.

[10]I have dummies for the flags of 20 countries under which the vessels attacked sailed. The incidents invloving ships under these country flags account for more than 75 percent of the data. The countries for which I have flag dummies include: Antigua and Barbuda, Bahamas, Cyprus, Denmark, Greece, Hong Kong, Indonesia, India, Liberia, Malaysia, Malta, Marshall Islands, Netherlands, Norway, Panama, Saint Vincent, Singapore, Thailand, United Kingdom, and the United States. I also have eight carrier-type

In Tables 3 through 8, I report the baseline, reduced-form estimates. Table 3 includes the economic and political factors and outcome related to the number of pirates and the next table turn to the success of attack. Table 5 through 8 then turn to an assessment of more economic-based outcomes. From Table 3 to Table 8, the regressions in column (1) are the simplest specification, with only key economic and politico-institutional measures employed with the fixed effects on attack locations and years. The second regression then adds fixed effects based on the attack regions.[11] The third column adds $WATER$ as a basic right-hand side control. The next regression then adds $TONNAGE$ of the vessels, $MTRADECAP$ and $SHIPS$ as additional controls. And the final column in table 4 through 8 includes the number of pirates, $PIRATES$, as an additional control variable.

In terms of the incident-related or geographic variables that are controlled for in all regressions in Table 3, I include the $TONNAGE$ of the vessels because the number of pirates required for an attack might be associated with the size of the vessel. Since the variable $WATER$ could be interpreted as the distance from the sea shore, the position of the attack could affect the amount of pirates employed when attacking the vessel. Hence, I include $WATER$ as a basic right-hand side control. I include a measure of the volume of maritime trade per capita of the region where the attack occurred, $MTRADECAP$, on the idea that maritime trade volumes could, independently, affect the number of pirates necessary for attacking in a particular region. $MTRADECAP$ can also be interpreted as the sum of the demand and supply for goods and services transported by sea in the region. Lastly, I also include $SHIPS$ because the number of target ships in each year could affect the number of pirates hired.

The set of our basic economic variables as well as those for political stability and institutional controls are self-explanatory. In any case, the main economic variables are

dummies: Liquid gas tankers, Chemical tankers, Oil tankers, Container ships, Bulk carriers, General cargo ships, Fishing boats and Others (Passenger ferries, Tugs, Barges, Yachts and Supply ships).

[11] On this basis, I end up with ten year fixed effects for 1998 through 2007; five regional fixed effects for Asia, Africa, Oceania, Europe, the Americas and others; and 22 location fixed effects that cover Bangladesh, Brazil, Cameroon, Colombia, Dominican Republic, Ecuador, Ghana, Guinea, Guyana, India, Indonesia, Ivory Coast, Malaysia, Nigeria, Peru, Philippines, Somalia, Tanzania, Thailand, Venezuela, Vietnam and finally, "others" for locations that are not covered by these 21 countries.

real income per capita, $RGDPCAP$, economic growth, $GROWTH$, and the unemployment rate, $UNEMP$. And the main controls for political stability and institutional quality are the political rights index, $PRIGHTS$, the freedom status, $STATUS$, and the polity score, $POLITY$.

In the first column of Table 3, I regress the number of pirates, $PIRATES$, on the simplest set of only economic and political variables and fixed effects for location and year. As shown, the number of pirates depends negatively on per-capita income, positively on unemployment rates and negatively on the freedom status of the country where the incident took place. Adding fixed effects for the region of attacks reveals that GDP per capita, unemployment rate and freedom status are still statistically significant determinants of the number of pirates. In column (3), I add $WATER$ as an additional control which is significant. This implies that more pirates were needed when they attacked ships farther ashore. In the final column, I present the estimate with the full set of controls and fixed effects plus the gross registered tonnage, $TONNAGE$, maritime trade per capita, $MTRADECAP$, and number of ships, $SHIPS$, as additional controls. The earlier set of results remain the same while $TONNAGE$ and $SHIPS$ are statistically significant, implying that less pirates were needed when they attacked larger ships and the number of world fleet is higher. As stated in Proposition 1, for a given level of piracy effort, more ships and larger ships mean fewer resources devoted to piracy attacks.

The results of the estimates in Table 3 support Proposition 1. The results of the comparative static analysis correspond to the sign of the coefficient in the estimation in which $PIRATES$ is represented the time fraction that average family allocates to subversive activity (P). The proxy for wage income from the production sector (w_f) is $RGDPCAP$. The proxy for the proportion of export, $(1-t)$, is the maritime trade per capita, $MTRADECAP$. The number of ships, R, is represented by $SHIPS$.

[Table 3 about here.]

In Table 4, the dependent variable is the success of attack by pirates. Note that the success of attack produces binary outcomes. Thereby, it would be more appropriate to estimate by using Probit technique. With the most parsimonious regression in column

(1), only real income per capita, unemployment rate and political rights matter. Real income per capita produces the expected sign whereas the unemployment rate and political rights come with the unexpected signs meaning that higher unemployment rate and the lower political right freedom reduce the chance of success in attack. The results remain the same in column (2) when I add the fixed effect for regions except $PRIGHTS$ which is no longer significant. When the $WATER$ is added to column (3), it becomes statistically significant with the negative sign. Probability that pirates successfully attack is higher when they target the ships closer to land. As the dataset suggest, the probability of successful attacks at the port is about 88% while the probability of success in international waters is around 46%. In column (4), when $TONNAGE$, $MTRADECAP$ and $SHIPS$ are added, all of them are significant with the expected sign. $TONNAGE$ produces a negative sign; the larger the ship, the lower probability of successful attack. $MTRADECAP$ produces a positive sign; if the region has more flows of cargo traffic by water, the likelihood that the pirates successfully attack improves. $SHIPS$ produces a negative sign; if the number of world fleet rises, the success of attack drops. In the last column, the number of pirates can also explain the success of attack. More pirates improve the success of attack. $POLITY$ becomes significant with the negative sign. The more democratic country, the lower probability of successful attack. In contradiction, I also find that $PRIGHTS$ becomes significant again; more political rights freedom was associated with higher success rates.

Compare this table with Proposition 2 and recall that β is the success of attack which is a dependent variable in this table. Similar to proposition 1, I also find that the estimates support this proposition. Coefficient of the number of pirates, $PIRATES$, real income, $RGDPCAP$, maritime trade volume per capita, $MTRADECAP$, and number of ships, $SHIPS$, produce the same sign as in Proposition 2 when performing comparative static analysis of β on P, w_f, $(1-t)$ and R, respectively.

[Tables 4 about here.]

Since success of attack solely does not imply success of appropriation, I, then, consider economic outcomes as dependent variables. Because the level of piratical profits

comes from the number of appropriation incidents, I test Proposition 3 by using economic outcomes as a proxy of profits. Table 5 through 8 present four measures of common economic outcomes pirates appropriated: whether or not the pirates stole cash, cargo goods, hijack vessel and demand ransom. Again, since the types of properties taken by pirates produce binary outcomes. I run the baseline, reduced-form regressions with Probit approach.

In Table 5, I turn to cash robberies as outcomes and find that $RGDPCAP$ and $UNEMP$ are statistically significant in all columns. When levels of income per capita and the vessels' total volume were higher, cash robberies did decline significantly. $WATER$ and $PIRATES$ are positively significant. Paradoxically, however, I also find that higher unemployment was also associated with fewer piracy incidents with cash robberies. This might be because they shift toward other targets. And none of the politico-institutional measures carry explanatory power here, with neither $POLITY$, $PRIGHTS$, nor $STATUS$ providing an explanation in the way of piracy incidents involving cash robbery except $PRIGHTS$ in the first column with the positive sign.

In Table 6, I use the cargo goods robbery as dependent variable. In the last column, when adding the number of pirates into the equation, I find that the growth rate of income per capita and number of pirates are significant with the expected signs. Illogically, cargo goods robbery is increasing with more freedom countries. It is also interesting to observe that, unlike other types of burglary, the farther from the sea shore, the less likelihood of cargo goods robbery. As I explained before in Table 2, it is more vulnerable for cargo ships to get attacked when at the port for loading and unloading the goods.

I explore the determinants of vessel capture by pirates in Table 7. Growth rate of real income is significant in the first column only. All political factors are significant, at least one specification in which $STATUS$ and $POLITY$ produce negative coefficients. In the last column, only $RGDPCAP$, $PRIGHTS$, $TONNAGE$ and $PIRATES$ are significant. The number of vessel hijacking is increasing in the countries with more political rights. Interestingly, the sign of $MTRADECAP$ coefficient is positive although it is not significant which is different from other types of robbery. The region with the

higher volume of goods carried by water faces a higher chance of the vessel capture. Moreover, unlike other types of appropriation, the coefficient of the growth rate of real GDP per capita, $GROWTH$, is positive in vessel hijackings only. With the higher growth rate of income per capita, the number of vessel hijackings is increasing. Pirates have more opportunities to select the target goods because of the accumulation of capital and technology. Definitely, pirates decide to hijack vessel which yields higher return to them.

Finally, Table 8 presents the impact of my explanatory variables on the extent to which pirates seek ransom. As seen, the income level is significant except the last column while the growth rate of income level is significant in the last column only. They produce the predicted negative sign while illogically $STATUS$ is also significant with the positive sign in all columns. The distance from the land, the size of the vessel and the volume of maritime trade per capita also matter for ransom demanding. Note that ransom demand is the only economic outcome that the number of pirates, $PIRATES$, is no longer significant.

Comparing these results with Proposition 3, I find that all four estimates support this proposition as the number of pirates and real income produces the same sign as proposed in model. However, maritime trade volume per capita supports the theory only in vessel hijacking and the signs of coefficient $SHIPS$ in all four regressions are not consistent with the number of ships, R, in the model.

[Tables 5, 6, 7 and 8 about here.]

3.2.2 **Alternative Specifications & Robustness**

Although I show the reduced-form estimates with the Probit regression when the dependent variables are dummies, I performed the reduced-form linear regressions to test the robustness of qualitative results. I perform the analogs of the regressions shown in the final columns of Tables 4 through 8. The results show that qualitative results are very similar to the ones reported in Table 4 through 8.[12] The only difference is the

[12] All results discussed but not shown are available upon request.

vessel hijacking estimate in table 7 where the coefficient of $SHIPS$ is negative in linear regression which now corresponds to Proposition 3.

Since the data on the total world fleet is collected annually, variable $SHIPS$ takes only ten values. This might cause a problem when I control for year fixed effects. Then I perform the regression shown in the final columns of Table 3 through 8 without year fixed effects. They produce the same results as reported in tables.

Next, one problem with estimating the incidents of appropriation by using the reduced-form approach comes from the fact that some explanatory variables are endogenous; $TONNAGE$, $WATER$, $PIRATES$. They are choice variables that the pirates have full control over because they can decide on how many pirates hired, which ships and where to attack them. Thus, I did two-stage least square estimates (*2SLS*) in which I instrument for these endogenous variables. My instrument choice is a set of (twelve) dummies for month of attack. The idea is that because weather conditions are not only highly seasonal but also significant influence whether or not attacks in the open seas or harbors would succeed with higher likelihood. The baseline *2SLS* empirical results were estimated and they did not alter in any qualitative manner.

Although I report a subset of the analyses conducted, I experimented with a variety of alternative specifications to test the robustness of my qualitative results. For example, besides the three institutional and polity measures I have included in the tables above, I also have other three related measures such as the civil liberty index, the democracy and autocracy indexes of countries in which attacks occurred. Utilizing these variables in conjunction with or in lieu of $PRIGHTS$, $STATUS$ and $POLITY$ in a variety of alternative regressions, the key results did not alter in any meaningful way, although the measures I reported on above generally produced to most significant effects on outcomes and the signs of their coefficients were not always consistent with predictions.

4. Conclusion

This paper attempts to test the validity of the extralegal appropriation and production model as an application to modern maritime piracy. Based on the theoretical

framework, the extralegal activities are affected by economic incentives. Accordingly, the rise of modern-era maritime piracy is inversely related to the economic conditions of regions from which modern pirates emerge.

In order to test the empirical relevance of economic factors for piracy, I rely on a dataset that includes worldwide 3,362 modern-day piracy incidents that occurred from 1998 to 2007. The data provide detailed information on the location, timing and the type of each attack, whether it is actual or attempted, the characteristics of the target vessel as well as the material damage and violence inflicted upon the crew and the properties. Based on the country where the incident take place, data on macroeconomic and aggregate measures of per-capita incomes, rates of economic growth, unemployment and political quality are included.

I have emphasized three main findings: First, the empirical results support the proposed theoretical model well as economic factors play a significant role in explaining the modern maritime piracy behavior. For instance, higher real per-capita incomes and lower unemployment rates are likely to reduce the number of pirates. Seaborne trade volume is increasing in the number of pirates and the success of attack. Second, political institutions are also important explaining this phenomenon although they are not as much nor consistent as economic factors. For example, the incidents that occur in the country with higher freedom tend to have less number of pirates and the incident that occurs in the territory of more democratic country tends to well protect the sea defense which reduces the chance of being successful in attacking. It also tends to involve fewer cases in which pirates board the ship and ask for ransom demands. Finally, I found that there are also other factors that explain maritime piracy incidents such as the ships' size, the distance between the incident position and the shore, the total merchant fleet in each year and the cargo traffic volume by marine transportation. For example, attacking larger ships involves pirates more for the attack to succeed. Pirates tend to successfully kidnap the crews and ask for ransoms in the region with the higher maritime trade volume.

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Table 1: Descriptive Statistics

Variables	*Observations*	*Mean*	*St. Dev.*	*Min*	*Max*
$YEARS$	$3,371$	5.45	2.62	1	10
$PIRATES$	$2,300$	5.95	7.57	1	200
$ATTACK$	$3,371$	0.744	0.436	0	1
$GOODS$	$3,371$	1.559	1.981	0	7
$CASH$	$3,371$	0.096	0.295	0	1
$CARGOGOODS$	$3,371$	0.036	0.187	0	1
$VESSEL$	$3,371$	0.045	0.208	0	1
$RANSOM$	$3,371$	0.028	0.165	0	1
$RGDPCAP$	$3,362$	$7,595$	$39,804$	345.517	$653,046$
$GROWTH$	$3,371$	22.04	21.73	-65.5087	130.991
$UNEMP$	$3,371$	8.01	4.35	0.691563	50
$PRIGHTS$	$3,371$	4.26	1.50	1	7
$STATUS$	$3,371$	1.08	0.603	0	2
$POLITY$	$3,371$	4.26	4.35	-10	10
$WATER$	$3,371$	1.80	0.780	1	3
$TONNAGE$	$3,371$	$16,768.04$	$21,602.44$	0	$218,593$
$MTRADECAP$	$3,371$	1.152	1.121	0.367487	21.1
$SHIPS$	$3,371$	$89,359.09$	$2,269.98$	$86,817$	$94,936$

Table 2: Correlation Matrices

Table 2 a:

The Correlation Matrix									
	$ATTK$	$YEAR$	$PRTS$	$GOOD$	$RGDP$	GRW	$UNEM$	$PRGT$	$STAT$
$ATTK$	1	...	...	...	...	...	...	...	...
$YEAR$	.0305	1	...	...	...	...	...	...	...
$PRTS$	.0302	-.019	1	...	...	...	...	...	...
$GOOD$	.4851	.0345	.1723	1	...	...	...	...	...
$RGDP$	-.061	-.059	-.02	-.024	1	...	...	...	...
GRW	.0792	.1286	.0107	-.032	.188	1	...	...	...
$UNEM$	-.063	.0979	-.045	-.012	-.055	-.327	1	...	...
$PRGT$	.1496	.0298	-.023	.0225	-.111	.0004	.1297	1	...
$STAT$	.1488	.0892	-.037	.0038	-.078	.0974	.0892	.8894	1
$POLT$	.1229	.0176	-.024	.0276	-.148	-.027	.0248	.888	.768

Table 2 b:

The Correlation Matrix									
	$ATTK$	$PRTS$	$CASH$	$CRGO$	$RNSM$	$VESL$	$TONN$	$MTRD$	WTR
$ATTK$	1	...	...	...	...	...	...	...	...
$PRTS$	.0318	1	...	...	...	...	...	...	...
$CASH$	.2227	.0473	1	...	...	...	...	...	...
$CRGO$	.1223	.1287	-.057	1	...	...	...	...	...
$RNSM$	.0964	.0979	-.045	-.0247	1	...	...	...	...
$VESL$	.1120	.0975	-.052	-.0287	-.0227	1	...	...	...
$TONN$	-.141	-.084	-.098	-.0524	-.1010	-.1204	1	...	...
$MTRD$	.0495	-.02	.0679	-.0149	-.0248	.0048	-.0074	1	...
WTR	-.405	.0622	.1338	-.0576	.1341	.0605	.0055	-.0125	1
$SHIPS$	.0302	-.003	-.0067	-.0054	.0564	.0234	.0039	.0514	.0602

Table 2 c:

The Correlation Matrix					
	$YEAR$	$PRTS$	$CASH$	$CRGO$	$VESL$
$YEAR$	1	...	...	...	...
$PRTS$	-0.0178	1	...	...	...
$CASH$	-0.0146	0.0473	1	...	...
$CRGO$	-0.0283	0.1287	-0.0572	1	...
$VESL$	0.0200	0.0975	-0.0524	-0.0287	1
$RNSM$	0.0630	0.0979	-0.0451	-0.0247	-0.0227

Table 3: Reduced-Form Estimates with The Number of Pirates as Dependent Variable

VARIABLES	(1)	(2)	(3)	(4)
RGDPCAP	-4.04e-06***	-3.51e-06***	-3.97e-06***	-4.71e-06***
	(1.27e-06)	(1.16e-06)	(1.36e-06)	(1.25e-06)
GROWTH	0.000763	0.000555	-0.000947	0.00833
	(0.00624)	(0.00627)	(0.00694)	(0.00713)
UNEMP	0.0791***	0.0945***	0.0960***	0.0921***
	(0.0239)	(0.0256)	(0.0285)	(0.0256)
PRIGHTS	0.556	0.679	0.627	0.753
	(0.513)	(0.520)	(0.474)	(0.532)
STATUS	-1.871**	-1.830**	-1.675**	-1.902**
	(0.718)	(0.698)	(0.617)	(0.729)
POLITY	-0.0671	-0.0613	-0.0889	-0.0982
	(0.0574)	(0.0614)	(0.0578)	(0.0571)
WATER			0.922*	0.903*
			(0.501)	(0.481)
TONNAGE				-2.48e-05**
				(9.67e-06)
MTRADECAP				3.058
				(2.088)
SHIPS				-0.000274*
				(0.000156)
LOCATION FE	Y	Y	Y	Y
YEAR FE	Y	Y	Y	Y
REGION FE	N	Y	Y	Y
Observations	2,293	2,293	2,293	2,293
R-squared	0.037	0.039	0.043	0.050

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Reduced-Form Estimates with Probit Regressions with The Success of Attack as Dependent Variable

VARIABLES	(1)	(2)	(3)	(4)	(5)
RGDPCAP	-9.14e-07***	-1.14e-06***	-8.34e-07***	-1.05e-06***	-4.97e-07
	(1.59e-07)	(3.18e-07)	(2.37e-07)	(2.63e-07)	(3.48e-07)
GROWTH	-0.00114	0.000200	0.000273	0.00201	0.00175
	(0.000738)	(0.000947)	(0.000796)	(0.00149)	(0.00184)
UNEMP	-0.00649*	-0.0180**	-0.0205***	-0.0206***	-0.0260***
	(0.00337)	(0.00811)	(0.00706)	(0.00703)	(0.00630)
PRIGHTS	0.157**	0.0393	0.0412	0.0698	0.153**
	(0.0771)	(0.0424)	(0.0484)	(0.0480)	(0.0746)
STATUS	-0.0275	-0.0268	-0.0100	-0.0166	-0.117
	(0.0950)	(0.0836)	(0.112)	(0.138)	(0.154)
POLITY	-0.0312	-0.0249	-0.0129	-0.0198	-0.0230*
	(0.0202)	(0.0170)	(0.0124)	(0.0146)	(0.0138)
WATER			-0.461***	-0.481***	-0.544***
			(0.0611)	(0.0641)	(0.0596)
TONNAGE				-8.81e-06***	-9.78e-06***
				(2.99e-06)	(3.28e-06)
MTRADECAP				0.487*	0.707**
				(0.273)	(0.330)
SHIPS				-4.47e-05**	-1.25e-05
				(2.16e-05)	(3.93e-05)
PIRATES					0.0131*
					(0.00746)
LOCATION FE	Y	Y	Y	Y	Y
YEAR FE	Y	Y	Y	Y	Y
REGION FE	N	Y	Y	Y	Y
Observations	3,362	3,362	3,362	3,362	2,293

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Reduced-Form Estimates with Probit Regressions with Cash Robbery as Dependent Variable

VARIABLES	(1)	(2)	(3)	(4)	(5)
RGDPCAP	-1.59e-06***	-2.28e-06***	-2.54e-06***	-2.72e-06***	-2.60e-06***
	(2.63e-07)	(3.42e-07)	(3.63e-07)	(3.08e-07)	(3.26e-07)
GROWTH	0.000238	-0.00309	-0.00292	-0.00189	-0.00503
	(0.00344)	(0.00546)	(0.00521)	(0.00511)	(0.00491)
UNEMP	-0.0399***	-0.0425***	-0.0380***	-0.0375***	-0.0377***
	(0.00718)	(0.00950)	(0.00901)	(0.0108)	(0.00961)
PRIGHTS	0.223**	0.0606	0.0648	0.0972	-0.0252
	(0.0899)	(0.150)	(0.144)	(0.141)	(0.168)
STATUS	-0.325	-0.327	-0.329	-0.339	-0.258
	(0.224)	(0.263)	(0.242)	(0.244)	(0.274)
POLITY	-0.0145	0.0114	-0.00382	-0.0119	0.0141
	(0.0131)	(0.0212)	(0.0212)	(0.0203)	(0.0230)
WATER			0.390**	0.381**	0.387*
			(0.167)	(0.167)	(0.217)
TONNAGE				-7.98e-06***	-1.14e-05**
				(2.23e-06)	(5.03e-06)
MTRADECAP				0.199	-0.259
				(0.157)	(0.493)
SHIPS				-3.62e-05	9.12e-06
				(2.98e-05)	(5.99e-05)
PIRATES					0.0201***
					(0.00605)
LOCATION FE	Y	Y	Y	Y	Y
YEAR FE	Y	Y	Y	Y	Y
REGION FE	N	Y	Y	Y	Y
Observations	3,010	3,010	3,010	3,010	2,029

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Reduced-Form Estimates with Probit Regressions with Cargo Goods Robbery as Dependent Variable

VARIABLES	(1)	(2)	(3)	(4)	(5)
RGDPCAP	-7.70e-06	-3.18e-06	-2.75e-06	-3.09e-06	-5.98e-07
	(5.54e-06)	(4.80e-06)	(3.56e-06)	(3.89e-06)	(5.24e-07)
GROWTH	-0.00666**	-0.00416	-0.00434	-0.00511	-0.00956**
	(0.00334)	(0.00279)	(0.00304)	(0.00324)	(0.00449)
UNEMP	-0.00219	-0.00429	-0.00269	-0.00164	0.0157
	(0.0116)	(0.0139)	(0.0150)	(0.0138)	(0.0114)
PRIGHTS	0.00337	0.00578	-0.0245	-0.00818	-0.118
	(0.170)	(0.185)	(0.146)	(0.145)	(0.103)
STATUS	0.332*	0.289	0.333**	0.371***	0.399*
	(0.182)	(0.198)	(0.143)	(0.141)	(0.222)
POLITY	-0.0215	-0.0209	-0.0109	-0.0170	0.0170
	(0.0370)	(0.0410)	(0.0336)	(0.0338)	(0.0181)
WATER			-0.204	-0.224	-0.164
			(0.230)	(0.224)	(0.179)
TONNAGE				-1.03e-05**	-1.19e-05
				(4.59e-06)	(8.25e-06)
MTRADECAP				-0.424	-0.502
				(0.590)	(0.654)
SHIPS				4.63e-05	5.52e-05
				(3.89e-05)	(4.49e-05)
PIRATES					0.0157***
					(0.00366)
LOCATION FE	Y	Y	Y	Y	Y
YEAR FE	Y	Y	Y	Y	Y
REGION FE	N	Y	Y	Y	Y
Observations	3,026	2,909	2,909	2,909	1,856

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Reduced-Form Estimates with Probit Regressions with Vessel Hijacking as Dependent Variable

VARIABLES	(1)	(2)	(3)	(4)
RGDPCAP	2.03e-08	-9.93e-08	-2.91e-07**	-3.47e-06**
	(1.13e-07)	(1.34e-07)	(1.43e-07)	(1.38e-06)
GROWTH	0.00395**	0.00170	0.00176	0.00700
	(0.00188)	(0.00281)	(0.00240)	(0.00767)
UNEMP	-0.0228	-0.0167	-0.0151	-0.00806
	(0.0180)	(0.0235)	(0.0246)	(0.0279)
PRIGHTS	0.203***	0.171**	0.183*	0.237*
	(0.0685)	(0.0850)	(0.0940)	(0.133)
STATUS	-0.234**	-0.308**	-0.344***	-0.607
	(0.117)	(0.122)	(0.123)	(0.390)
POLITY	-0.0272**	-0.0242	-0.0331**	-0.0136
	(0.0128)	(0.0149)	(0.0166)	(0.0206)
WATER			0.245***	0.0445
			(0.0647)	(0.108)
TONNAGE				-0.000143**
				(6.50e-05)
MTRADECAP				0.104
				(0.617)
SHIPS				2.36e-05
				(8.52e-05)
PIRATES				0.0142***
				(0.00380)
LOCATION FE	Y	Y	Y	Y
YEAR FE	Y	Y	Y	Y
REGION FE	N	Y	Y	Y
Observations	2,893	2,880	2,880	1,833

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Reduced-Form Estimates with Probit Regressions with Ransom Demand as Dependent Variable

VARIABLES	(1)	(2)	(3)	(4)	(5)
RGDPCAP	-1.82e-06***	-1.96e-06***	-2.16e-06***	-1.80e-06***	-4.22e-07
	(2.93e-07)	(4.52e-07)	(5.03e-07)	(3.72e-07)	(8.05e-07)
GROWTH	0.00232	-2.38e-05	-0.000997	-0.00294	-0.0154***
	(0.00271)	(0.00589)	(0.00553)	(0.00484)	(0.00489)
UNEMP	-0.0201*	0.0198	0.0218*	0.0473***	0.0317
	(0.0121)	(0.0122)	(0.0116)	(0.0124)	(0.0319)
PRIGHTS	-0.129	-0.123	-0.148	-0.0161	0.0229
	(0.0798)	(0.0884)	(0.109)	(0.0981)	(0.255)
STATUS	0.502***	0.805***	0.899***	1.248***	3.148***
	(0.146)	(0.165)	(0.194)	(0.234)	(0.333)
POLITY	0.0133	0.00289	-0.0168	-0.0836***	-0.178***
	(0.0140)	(0.0189)	(0.0302)	(0.0302)	(0.0562)
WATER			0.465***	0.484***	0.575***
			(0.157)	(0.126)	(0.162)
TONNAGE				-9.21e-05***	-0.000127***
				(2.09e-05)	(3.42e-05)
MTRADECAP				-0.938*	-2.647***
				(0.509)	(0.575)
SHIPS				4.13e-05	0.000112
				(3.61e-05)	(7.56e-05)
PIRATES					0.0154
					(0.00961)
LOCATION FE	Y	Y	Y	Y	Y
YEAR FE	Y	Y	Y	Y	Y
REGION FE	N	Y	Y	Y	Y
Observations	2,746	2,717	2,717	2,717	1,836

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1