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The impact of unsuccessful pirate attacks on financial markets: Evidence in support of Leeson's reputation-building theory☆

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ABSTRACT

This paper examines the effect of unsuccessful Somali pirate attacks on financial-market returns in the Arabian Peninsula. Specifically, it tests Leeson's (2010a) reputation-building theory of pirate signaling behavior postulating that unsuccessful pirate attacks may trigger subsequent future attacks by pirates as pirates attempt to maintain and build their reputation for effective piracy. We test this theory empirically by studying the relationship between pirate attacks and financial-market returns in the Arabian Peninsula. The result of our empirical test supports Leeson's theory: unsuccessful pirate attacks are associated with lower financial-market returns, suggesting that market participants expect unsuccessful pirate attacks to be followed by future pirate attacks.

1. Introduction

Pirates, outlaws, bandits, and highwaymen have preyed upon merchant vessels for millennia. Since the advent of large-scale sea-based shipping in the 16th Century, piracy has played a role in the economies of coastal nations. Some pirates, such as Sir Francis Drake and William Kidd, were sanctioned privateers by monarchs striving to broaden their colonial influence (Risso, 2001). Others, like Blackbeard, the notorious English pirate who plied lawlessly around the West Indies and the Eastern coast of the American colonies were renegades who did not operate under the jurisdiction of any crown. Today, most pirate attacks occur in one of three places: (1) The waters between the West African coastline and the Arabian Peninsula, specifically the Gulf of Aden which is a strategic transit point; (2) the waters around Indonesia; and (3) the open Arabian Sea and Western Indian Ocean. Almost all of the attacks during 2008–2010 were in the calm, target-rich waters of the Gulf of Aden—a passage for 20% of the world's commercial shipping (see Fig. 1). Somalia's 3025-km coastline is the longest in Africa. The *Institute for Economics and Peace*, the *Global Terrorism Index* (GTI), a composite score that ranks countries according to the impact of terrorism from 0 (no impact) to 10 (highest impact), indicates that during the period covered by the current study (2005–2011), the scores for Somalia ranged from 3.75 to 6.97 respectively.[1]

Gambardella (2011) reports that pirate attacks in the target region explored in this study bring in more than $200 million annually – the equivalent of 20–25% of Somali's GDP. Over the last few years, Somali pirates have expanded their efforts and moved all the way eastward to the Western portion of the Indian Ocean. As discussed below, this progression also supports Leeson's (2010a) theories of signaling and reputation building for explaining pirate practices.

The vast majority of the literature is concerned with analyzing the impact of successful pirate attacks on financial-market returns.[2] The current study, however, tests Leeson's (2010a) theories by focusing on unsuccessful pirate attacks, which create the expectation of future pirate attacks, as pirates attempt to maintain and build their reputation for effective piracy. Specifically, we investigate the impact of the rise in Somali pirate attacks from 2005–2011 on the stock markets of the nations of the Arabian Peninsula: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (specifically Dubai and Abu Dhabi).[3] In doing so, we control for daily fluctuations in the price of oil as well as global financial shocks as we examine the impact of piracy on stock returns of those markets from 1995–2012. Our findings support the validity of Leeson's theory, which explains the practices of pirates

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[1] See http://www.tradingeconomics.com/somalia/terrorism-index.
[2] Seehttp://piracy-studies.org/wp-content/uploads/2015/09/Piracy-Studies-Bibliography-September-2015.pdf.
[3] Note that Yemen is excluded because their financial market had not yet been launched during the duration of the data.

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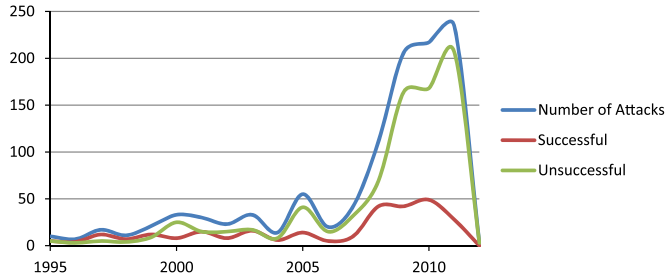

Fig. 1. Annual pirate attacks on oil tankers in the Arabian Sea (1995–2012).

based on signaling and reputation building (Leeson, 2010a, 2010b).

The paper is structured as follows: First, we provide historical and contextual information to examine the impact of pirate attacks on the financial markets of the Arabian Peninsula for the 2005–10, the timeline and focus of our study. Next, we address the notion of pirates as rational economic actors and as notorious public-image savvy drawing on Leeson's examples of pirate media manipulation. We test Leeson's (2010a) theory of pirate signaling and reputation building, hypothesizing an inverse relationship between pirate attacks (both successful and unsuccessful) and stock market returns. We argue that unsuccessful attacks may trigger future attacks aimed at restoring or sustaining pirates' "reputation" as well as causing an increase in "signaling" attempts to capture "expectations" of future pirate attacks. We also included an interaction term to see if shifts in Brent returns on days of pirate attacks have any additional marginal impact. Further, we conducted a series of robustness checks by examining financial market returns from Venezuela, confirming no statistical evidence of pirate attacks impacting the Venezuela financial market. The last section concludes the paper with the findings that pirates tend to increase the number of attempts after failure in support of Leeson's (2010a) reputation building theory. Implications for public policy are also provided.

2. Piracy in the Gulf of Aden

Pirate attacks are still common on the high seas and can play a disruptive economic role (Besley et al., 2015). It is estimated that the global cost of piracy in 2011 was between $6.6 and $6.9 billion.[4] Somalia, in particular, became a major source for maritime piracy after 2005. Following decades of political and economic strife, impoverished subsistence farmers and fishermen turned to piracy as a means to increase their income.[5] As the success rate of pirate incursions increased, they attracted the attention of local militants who joined in. In Somalia, as the monsoon season subsides and the seas calm, attacks typically resume in frequency and intensity and the number of hijackings of ships and hostages taken off the coast of Somalia continue to climb (Cook and Garrett, 2013).

This expansion of pirate attacks took many by surprise. For example, Blair and Lieberthal (2007) focus on pirate attacks in the Persian Gulf and the Strait of Hormuz in particular. While they posit that oil tankers are not very susceptible to risk, they did not anticipate the surge in pirate attacks as increasing numbers of Somalis took to the seas. Within the subsequent years, with the number of pirate attacks on the rise – including attacks on oil tankers – the world began to take notice. Schuman (2009) reports that piracy in the Strait of Malacca had been wiped out by 2009 because of three factors: (1) Military force; (2) Political resolution; and (3) Economic growth. Schuman points out, however, that the same resolution would not be possible in Somalia due to the presence of a weak central government and inconsequential law enforcement. Onuoha (2009) examined the Somali piracy surge and concluded that "pirate attacks have increased both horizontally and vertically. Horizontally, pirates have acquired the weaponry and high-tech gadgetry … automatic weapons, rocket-propelled grenades, faster attack craft with longer ranges, satellite phones, and global positioning systems (GPS) in their attacks" (p35). Onuoha (2009) explains that the vertical increase relates to attacks on all types of vessels, a stark contrast to the early part of the last decade. Among the Somali pirates' successful attacks was the November 18, 2008 hijacking of the Saudi oil tanker *Sirius Star* which carried over $100 million worth of oil. The ship was ransomed for $25 million.[6] This brazen success led to even more attempted hijackings of oil tankers; and while few attacks were successful, the attempts alone have led to regional economic disruptions.

Treves (2009) points out that the global responses to the rise in Somali pirate attacks had been insufficient because of limitations in the Law of the Sea. For instance, Gettleman (2008) notes that Jama Ali, a notorious Somali pirate, was not worried about international law at all. The punishments were relatively toothless, with little more than fines and seizures of pirate vessels. This prompted the UN Security Council to pass Resolution 1816 in 2008 on acts of piracy and armed robbery against vessels in territorial waters and the high seas off the coast of Somalia.

Following this resolution, France conducted a military mission in Somali waters to free the captured passengers of the cruise ship *Le Ponant*. The successful action by France triggered the passage of Resolution 1851 which authorized "all necessary measures that are appropriate in Somalia for the purpose of suppressing acts of piracy and armed robbery at sea" (Treves, 2009: p.401). This expanded upon Resolution 1816 by further allowing for military attacks against pirates on Somali soil. According to Kontorovich (2010), this passage also led to the formation of a joint naval force under US command that included contributions from thirteen nations, which set forth to arrest and capture Somali pirates under international law. Though very few pirates were prosecuted, the successes of their missions greatly reduced the number of pirate attacks over the course of a few months, and by 2012, the number of attacks had reverted to pre-escalation levels. Fig. 1 illustrates the 2005–10 upswings in pirate attacks on oil tankers, the timeline and focus of our study[7].

Historically, the economic impact of pirate attacks on private financial markets has been relatively limited in terms of temporary or unexpected oil supply disruptions in the Middle East. A good example is the Tanker War in the Persian Gulf in the 1980s where even during times when oil tankers were attacked daily, the price of oil continued to fall because oil supplies surpassed demand for oil (Report European Union, 2009). Kilian (2009) finds that exogenous political events in the Middle East played a role in the oil markets in the early 1990s through 2007. It appears as though that as the number of attacks decreased, the financial impact became negligible.[8]

3. The rationality of pirate behavior

Following Milgrom and Roberts (1982), Kreps and Wilson (1982), and Kreps et al. (1982), Leeson (2007, 2009a, 2009b, 2010a, 2010b) have laid out the economic principles that explain the behavior of pirates based on the theories of signaling and reputation building. The theory of reputation building predicts that if the number of pirate victims was high enough and their high cost of resistance visible, pirates could raise the benefits of surrender and maximize their long-term payoff by building a reputation for mercilessness toward resistors

[4] See http://oceansbeyondpiracy.org/sites/default/files/economic_cost_of_piracy_2011.pdf.

[5] See Hassani-Mahmooei and Parris (2013) for more on the impact of resource shortages on personal decisions.

[6] See http://www.digitaljournal.com/article/262509.

[7] Fig. 1 is constructed based on data collected from the International Criminal Court and the International Maritime Bureau. For details, see the section on data description.

[8] Note that Kilian's (2009) data only run through 2007 – before the majority of the upturn in piracy occurred between 2005 and 2010.

that would in turn deter future merchantmen from refusing to give in without a fight. In fact, pirates have a strong incentive not to kill victims that surrender to increase their chances of taking future prizes. If merchantmen expected to be murdered by the pirates, they would have an incentive to *always* resist pirate attacks, undermining the pirates' primary purpose. In such an instance, resisting would be no costlier than surrendering but would present a greater benefit since there would be at least a chance that resistance might succeed.

Leeson's theory of reputation building predicts that pirates would fulfill their promise of mercy if merchantmen fully comply. Actors act rationally under perfect conditions of Nash equilibrium in which each actor is assumed to know the strategies of the other side, and no actor has anything to gain by changing only their own strategy. Consequently, merchantmen surrender to their pirate attackers and, in return, the pirates spare merchant crew members' lives. Thus, the pirates' "surrender-or-die" taboo is what helps maximize their desired outcomes.

To increase visibility and credibility, pirates utilize "PR" methods (through testimonials of captives who were let go unharmed), "Jolly Roger" customized flags, symbols, non-verbal cues and rituals to shape their identity and public image and signal their goals to maximize revenues without any costly conflict. Reputation is the reflection of how well the pirate groups are perceived by potential target merchantmen. Torture-for-information or torture-for-reputation (Leeson, 2010a) are enacted by pirates to send a strong signal that uncooperative behavior will not be tolerated or remain unchallenged.

To dissuade future captives from revenue-eroding behaviors, establish their reputation, and enhance their personal-maximizing values, pirates must cruelly punish all uncooperative captive behaviors relating to loot, including those that destroyed booty. However, rather than brutalizing prisoners indiscriminately, pirates typically reserve torture for resistant captives as the theory of reputation building predicts. Much like organized crime, pirates manipulate their image by sending strong messages that they fear neither death nor the law (Varese, 2006). The high discount rates that they place on themselves reduce the likelihood of being pushed to the limits by their victims or the authorities, for that matter.

Behavioral theory of the firm postulates that economic events can also impact a firm's reputation. Goodhart (2008), for example, explains that the recent global financial crisis harmed the reputation of many banks – and yet, as long as they remained solvent, most consumers were less concerned about the lost reputation. On the other hand, Kane and Klingebiel (2004) show that following a crisis, firms will act rapidly to rebuild brand reputation to reduce significant reputation risk (Lee, 2010; Starnawska, 2016). Post-crisis communications are also used to repair the reputation (Belasen, 2008). One can theorize that the relative demand elasticities of the industries are likely to play a role in the speed of corporate responses. Likewise, pirates who face potential loss of economic rent when their reputation is tarnished would likely take rapid measures to restore their lost reputation. Thus, we can say that a pirate derives utility from economic rents collected from successful attacks (Y_t) as well as from building reputation (R) which will lead to additional future revenue (Y_τ):

$$U=U\left(Y_t,\ \sum_{i=t}^{\tau} R_i\right) \tag{1}$$

$$Y_\tau=f(R) \tag{2}$$

We can use a game theoretic approach to explain the expected generation of utility in Eq. (1). A pirate has two strategies: attack or not attack an incoming ship. Likewise, the target of the attack, whether corporate or national, has a choice whether or not paying the ransom. In this sequential game, if the pirates launch an attack that is successful, one would suspect that the dominant strategy for the target is to pay out the ransom to avoid casualties. However, this will only be the case if the target views the pirates' threats as credible. Thus, we know that this must also be a repeated game plan such that reputation can be brought in. By continuing to attack ships, particularly after failed attacks, the pirate can ensure that their threats are viewed to be legitimate, hence ensuring positive payoffs when future attacks are successful. More failures must be met with even more attacks to avoid possible erosion of reputation. Thus, the Nash equilibrium is for pirates to continue attacking ships and for the targets to continue paying out ransoms, making this a zero-sum game.

As noted by Luft and Korin (2004), the motives behind pirate practices may go beyond profit maximization, the rise in pirate attacks in the Middle East may also be directly related to the rise of some religious extremists or ideology-based terrorist groups. Such groups create social structures that help facilitate their ways of thinking and behaving through social order and pattern of interactions. The social order is then reinforced through strong identity and is sustained through ideological systems, shared beliefs, and espoused values (Hechter and Horne, 2003). The goal is to create public awareness for the group as well as legitimize its financial status and business performance. Furthermore, it drives the social identity of the group through actions, symbols, rituals, and results. This strong identity acts as a powerful medium through which external agents interpret and evaluate information and the efficacy of the group performance as well as its reputation (Belasen, 2008).

Most analysts and researchers also point to the potential economic gains brought on by socioeconomic failures in Somalia as the main driver of piracy (Lennox, 2008). For example, Gambardella (2011) points out that Somali pirate attacks were the biggest threat to shipping in the Gulf of Aden by the start of this decade. According to the International Maritime Bureau (IMB), the 219 attacks by Somali pirates in 2010 made up 49 percent of the total piracy attacks worldwide. In that same year, Somali pirates hijacked 49 ships, while taking 1016 seafarers hostage.[9] The *One Earth Future Foundation* (OEF) approximates that the total ransom paid to Somali pirates reached $238 million in just 2010 alone (Rengelink, 2012), a remarkable amount given that the Gross Domestic Product (GDP) in Somalia was worth just 1.07 billion US dollars in that same year.[10] A new study estimates that Somali pirates reaped as much as $413 million in ransom payments from 154 hijackings from 2005 – 2012.[11]

4. Material and methods

In this study, we set out to examine the impact of pirate attacks on the financial markets of the Arabian Peninsula.[12] In all, our model analyzes seven stock market indices across an eighteen-year period. To do this, we employ a fixed effects model in an attempt to control for market-specific effects thereby yielding estimates for the impact of a pirate attack on the average stock market index.[13] Furthermore, due to variability in the levels of each of the markets, we choose to focus on returns and control for changes in the Brent Oil price as well as controlling for two major events: the Global Financial Crisis and the War in Iraq. Hence our model takes the following form:

$$\%\Delta M_{it}=\beta_0 t+\beta_1 P_{it}+\beta_2\,\%\Delta B_{it}+\beta_3(P^*\%\Delta B)_{it}+\beta_4\,\%\Delta M_{it-1}+\beta_5 F+\beta_6 I+\varepsilon_{it} \tag{3}$$

[9] See http://psm.du.edu/media/documents/industry_initiatives/industry_reports/maritime_imb_annual-report-2011.pdf.

[10] See http://www.tradingeconomics.com/somalia/gdp.

[11] See http://siteresources.worldbank.org/EXTFINANCIALSECTOR/Resources/Pirate_Trails_World_Bank_UNODC_Interpol_report.pdf.

[12] For recent studies on the stock markets in the Arabian Peninsula and their behavior, see, among others, Aloui and Hkiri (2014), Abu-Ghunmi et al. (2015), Alotaibi and Mishra (2015), Bley and Saad (2015), Boubaker and Sghaierm (2015), Maghyere et al. (2015), Mensi et al. (2015), and Öztürk and Volkan (2015).

[13] Note that the Hausman test revealed that a fixed effects model would indeed be preferable to a random effects model.

Eq. (3) serves to fuse the theoretical connections between Leeson's (2010a) theory to a standard financial market model which would assess the relations between commodity returns and financial returns (see, for example, Nikkinen at al., 2014, Atilgan et al., 2015, and Belasen and Demirer, 2016). The empirical model regresses the daily return of each of the stock market indices (M) on the instances of a pirate attack[14] (P), the daily returns of the Brent Crude Oil price (B), an interaction between the two, a lag of the market return, and two dummy variables: one that accounts for the Global Financial Crisis[15] (F) and another that identifies major events in the Iraq War (I). The Global Financial Crisis dummy serves to identify whether there is a structural break in the data from the point that subprime mortgages were recognized as toxic assets, thus triggering the shock to the global economy. It takes a value of 1 between March 2007 (when Freddie Mac announced it would no longer buy subprime mortgages) and the end of our data set (October 2012), and a value of 0 otherwise.[16] The Iraq War dummy takes a value of 1 during major events of the war and a 0 value otherwise.[17]

Specifically, we address: (a) the notion of pirates as rational economic actors generally, as found in Leeson (2007, 2009a, 2009b, 2010a, 2010b); (b) the idea of pirates as public-image savvy drawing on Leeson's examples of pirate media manipulation (2010a); and, (c) test Leeson's (2010a) theory of pirate signaling and reputation building. We hypothesize an inverse relationship between pirate attacks (both successful and unsuccessful) and stock market returns. The literature has shown that pirate attacks play a statistically significant, albeit short term, role in the economies of coastal countries. We suspect that this impact will be picked up by the financial markets as well. In particular, we believe that while successful attacks should have a greater impact, even unsuccessful attacks could impact the market. As we stated earlier in the study, according to reputation theory (Leeson, 2010a), unsuccessful attacks may trigger subsequent future attacks by pirates with the purpose of restoring or sustaining their "reputation" as well as causing an increase in "signaling" attempts to capture "expectations" of future pirate attacks.

On the other hand, there should be a direct relationship between Brent prices and the financial markets in question (due to the heavy dependence on oil and oil-related industry revenues in the region). Of course, since the financial markets are so closely related to the Brent market, we include an interaction term to see if shifts in Brent returns on days of pirate attacks have any additional marginal impact [18]. We hypothesize that on days of attacks, movements in Brent returns will be even more important to the stability of the financial markets. Furthermore, we anticipate that the lagged market returns will be significantly positively related if there is any persistence in market returns. Finally, we hypothesize that the two coefficients for the event dummies will be negative if they are significant at all.

Daily data for Brent Oil along with the market index values were obtained from Global Financial Data (GFD). In all, we examine seven individual Middle Eastern stock market indices from 1995 to 2012: Abu Dhabi, Bahrain, Dubai, Kuwait, Oman, Qatar, and Saudi Arabia. The sample period runs from January 1, 2005 through October 19, 2012 and consists of daily market returns. These countries have significant stock market capitalization and represent a good share of important Middle East stock markets.[19] The various differences in observation counts relates to the data availability for each of those markets within GFD. Data for pirate attacks were obtained from the International Criminal Court (ICC) and the International Maritime Bureau (IMB). The IMB publishes three quarterly and one annual report each year. Our data are obtained from the annual reports and were manually collected. Each report lists all of the pirate attacks across the world with specifics on the date, the specific vessel that was attacked, whether or not the attack was successful, as well as whether there were any casualties in the attack. For the region we examined, there were very few casualties over the eighteen-year time period of our study. Instead, we collected data on the occurrence of attacks on oil transport vessels (1085 in total) as well as the successes (283) and failures (805) of these attacks. Summary statistics for these data are found in Table 1.

Stock returns in Table 1 indicate that, except Abu Dhabi, all markets had positive returns during the sample period. Note that the mean returns for the Dubai market is significantly higher than others, but this is mostly due to the specific start date for the Dubai market data which began after the global financial collapse had ended. In terms of the standard deviation of the returns, the stock markets of Bahrain and Kuwait have lower values of the other markets, suggesting that these two markets had experienced a relatively lower market risk, measured by the standard deviation or returns, during the sample period. Note that the standard deviation of oil returns in Table 1 has been two or three times higher than the stock returns in the sample, suggesting that the oil market has been much more volatile than the individual stock markets during the sample period. This also informed by the relatively much larger minimum and maximum values of oil returns relative to those of the stock markets.[20]

5. Results and discussion

Our initial specification features two separate regressions utilizing different measures for the P term, i.e., the nature of the pirate attack. The first examines the impact of any pirate attack on an oil transport vessel, successful or otherwise; and the second differentiates between successes and failures. Furthermore, we use robust standard errors to correct for potential heteroscedasticity. Results of these two regressions can be seen in Table 2 under Model 1 and Model 2, respectively.

The theoretical expectations held up well in the first model. In general, a pirate attack will lower the average daily return by roughly 0.16%. As we expected, the Brent returns played a positive role on the markets, yielding a 1.98% average increase in the average return for each 1% increase it displays. And on days of pirate attacks, as we

[14] Note that we opted to use levels for pirate attacks rather than changes since the non-augmented Dickey-Fuller test for stationarity revealed that the pirate attack data is in fact stationary, as the MacKinnon p-value is 0.000. On the other hand, the market data was transformed into returns to preserve the model stationarity.

[15] One may argue that the global crisis dummy is too long, however the following sources show an endpoint in 2011: https://www.stlouisfed.org/financial-crisis/full-timeline and http://lauder.wharton.upenn.edu/wp-content/uploads/2015/06/Chronology_Economic_Financial_Crisis.pdf.

[16] Many observers use June 2007 as the beginning of the global financial crisis. We selected a more conservative data, March 2007, as our start date because that was the moment in which there were signs of financial troubles. For example, in its crisis timeline, the Federal Reserve Bank reported that even in April 2007, a leading subprime mortgage lender, New Century Financial Corporation, filed for Chapter 11 bankruptcy protection, see, https://www.stlouisfed.org/Financial-Crisis. Shortly after this, the price of oil began to rocket upwards and most national economies entered into recessions. Alternative specifications, such as those identified in Maghyera et al. (2015) were not statistically different when the entire period was taken into account.

[17] Since a good deal of the duration of the current Iraq War covers the same time span as the Global Financial Crisis, we instead opted to target major events in Iraq. A few examples include: The March 20, 2003 invasion; The fall of Baghdad in April 10, 2003; The removal of the Baathist regime in May 1, 15, and 23, 2003; The start of Operation Desert Scorpion in June 15, 2003; The formation of the Iraqi Governing Council in July 13, 2003; Abu Ghraib abuse scandal in April 18, 2004; and the June 8, 2004, UN resolution 1546. Event data was obtained from an ABC News report: http://abcnews.go.com/WNT/IraqWhereThingsStand/story?id=2961278 & page=1 (ABC News, 2007).

[18] Note that a regression of Brent returns against our measure of pirate attacks yielded an insignificant F-score of 1.95. The specific t-statistic for the beta coefficient of the pirate attacks was −1.40 with a p-value of 0.163. Hence, it is unlikely that we have multicollinearity in our model. The joint impact captured by the interaction should, therefore, be clear of bias.

[19] For a recent data on stock market capitalization in the region, see https://www.quandl.com/collections/economics/stock-market-capitalization-by-country.

[20] For recent studies on the link between oil and stock markets, see Mollick and Assefa (2013), Narayan and Sharma (2014), Louis and Balli (2014), and Nikkinen et al. (2014).

Table 1
Descriptive statistics.

	t	Mean	Std Dev	Min	Max
Stock Indices (Returns)					
Abu Dhabi	1622	−0.014%	1.213%	−6.831%	7.928%
Bahrain	3400	0.014%	0.585%	−4.801%	3.679%
Dubai	921	0.128%	1.118%	−7.795%	9.554%
Kuwait	2795	0.013%	0.788%	−4.114%	4.064%
Oman	3456	0.019%	1.071%	−10.896%	16.442%
Qatar	2397	0.054%	1.362%	−8.750%	9.880%
Saudi Arabia	3147	0.055%	1.178%	−9.669%	8.658%
Control markets (Returns)					
Brent price	3604	0.078%	2.258%	−15.388%	13.716%
Pirate attacks					
Total attempts=1088					
Successes=283					
Failures=805					

Table 2
Fixed effects regression results for the impact of pirate attacks on financial markets (1995–2012).

Coefficient:	Model 1	Model 2
Pirate Attacks		
Coefficient:	−0.1594***	
SE:	(0.0576)	
Successful Attacks		
Coefficient:		0.0379
SE:		(0.0893)
Unsuccessful Attacks		
Coefficient:		−0.2875***
SE:		(0.0755)
Brent Price Returns		
Coefficient:	1.9758***	1.9720***
SE:	(0.4225)	(0.4224)
Attacks*Brent Returns		
Coefficient:	8.2633***	
SE:	(2.2765)	
Successful*Brent Returns		
Coefficient:		3.1097
SE:		(4.2379)
Unsuccessful*Brent Returns		
Coefficient:		9.3900***
SE:		(2.6918)
Lagged Daily Returns		
Coefficient:	0.1709***	0.1703***
SE:	(0.0088)	(0.0088)
Global Financial Crisis		
Coefficient:	-0.0720**	-0.0674***
SE:	(0.0213)	(0.0214)
Major Events in the Iraq Crisis		
Coefficient:	0.0149	0.0204
SE:	(0.1196)	(0.1196)
R^2	.0404	.0412
F	75.47	57.78
n (groups)	10,906 (7)	10,906 (7)

Note:
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

suspected, the financial markets become much more dependent on variations in Brent prices. A 1% increase in the Brent return on a day of a pirate attack will yield approximately an 8.26% return on the financial market. We also found that the lagged market returns are indeed significantly positively related to the daily returns which is consistent with past research such as in Kar et al. (2011). Finally, the variation in the global financial crisis displayed significantly negative coefficients; however, the Iraq War coefficient was insignificant.

The expectations fell flat in the second model. Consistent with Leeson's (2010a) reputation theory, unsuccessful attacks capturing expectations of future attacks did affect daily returns negatively at the one percent level. On the other hand, successful attacks were completely insignificant in relation to daily returns; thus we fail to reject the hypothesis that the value is statistically different from zero. *Note that the economic significance of unsuccessful attacks is nearly twice that of an attack in general: an additional unsuccessful pirate attack lowers stock returns by 0.29% that day, while attacks in general lower the returns by just 0.16% (similarly, shifts in Brent prices will drive the market more on days featuring unsuccessful attacks than on successful ones).* This finding appears to confirm Leeson's (2010a) theory, which explains that pirates endeavor to sustain their image, and hence would need to follow up unsuccessful attacks with even more attempts to ensure an eventual successful result as well as to restore their credibility. Otherwise their reputation would slip which, in turn, could potentially diminish their capacity for future economic gains. Thus the market responds in anticipation of further attacks. Amongst the other independent factors, we found little variation compared to the results of Model 1.

Next we isolated the period of peak pirate attacks (2005–2011) to see if the impact of a pirate attack was different when more international attention was being placed on pirates. Models 3 and 4 in Table 3 are identical to Models 1 and 2 with the exception that the sample was truncated to just include the six-year peak of pirate attacks. While the magnitude for the coefficient on pirate attacks increased slightly, it was not a statistically significant difference, such that one may conclude that if there is a pirate attack on an oil transport vessel, financial markets in the Middle East will fall by roughly 0.2%, ceteris paribus.

In an attempt to gain further clarity on the results, we suspected that perhaps there might be lingering effects in the market due to timing issues. For instance, while a repelled attack might be reported within minutes by the impacted vessel, communication after a successful hijacking might be delayed.[21] Thus it is possible that while successful attacks played an insignificant role in impacting daily returns, it may be significant at some point over the next few days. Alternatively, it could be that unsuccessful attacks and hijackings could lead to market uncertainty, while paying ransoms following successful attacks might lead to feelings of relief, and subsequently cause a lesser impact on the market. We therefore examined the five days after each attack by adding lags to each of the above models. Table 4 summarizes the results.

Based on these results, we believe that our second alternative (i.e., unsuccessful attacks could lead to market uncertainty) is more likely to be true. It appears as though the markets respond positively within a few days of a pirate attack indicating some sort of bounce-back once the fear of uncertainty goes away. However, by the end of the week following an attack, we see the impact of that relief dissipate. Again, we find that unsuccessful attacks have richer, short-run dynamics capturing expectations of potential upcoming future attacks.

Further, we conducted a series of robustness checks, including: (1) adding in various lags of the S & P 500 to gauge global markets; (2) an event dummy to capture the duration of the European Sovereign Debt Crisis; (3) a simple time measure to act as an intercept coefficient in the

[21] See http://www.hellenicshippingnews.com/wp-content/uploads/2015/01/2014-Annual-IMB-Piracy-Report-ABRIDGED.pdf.

Table 3
Fixed effects regression results for the impact of pirate attacks on financial markets (2005–2011).

Coefficient:	Model 3	Model 4
Pirate Attacks		
Coefficient:	−0.2197***	
SE:	(0.0938)	
Successful Attacks		
Coefficient:		0.0118
SE:		(0.0772)
Unsuccessful Attacks		
Coefficient:		−0.2354***
SE:		(0.0653)
Brent Price Returns		
Coefficient:	3.6199***	1.4063***
SE:	(0.8704)	(0.3652)
Attacks*Brent Returns		
Coefficient:	13.4430***	
SE:	(3.7102)	
Successful*Brent Returns		
Coefficient:		3.4179
SE:		(3.6647)
Unsuccessful*Brent Returns		
Coefficient:		12.4372***
SE:		(2.32775)
Lagged Daily Returns		
Coefficient:	0.1938***	0.1347***
SE:	(0.0139)	(0.0076)
Global Financial Crisis		
Coefficient:	−0.0793*	−0.0717**
SE:	(0.0410)	(0.0314)
Major Events in the Iraq Crisis		
Coefficient:	−0.0149	−0.0113
SE:	(0.2020)	(0.1847)
R^2	.0530	.0356
F	42.14	50.06
n (groups)	4550 (7)	4550 (7)

Note:
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

Table 4
Summary of selected coefficients for pirate attacks over time.

	Overall	Successful	Unsuccessful
Initial Day	−0.1426***	0.0441	−0.2683***
Day 2	0.0702*	0.1128	0.0368
Day 3	0.0212	−0.0726	0.1111*
Day 4	−0.0977**	−0.1042	−0.0747
Day 5	0.0001	0.0202	−0.0189
Day 6	−0.1867***	−0.0021	−0.3365***

Note:
* Significant at the 10% level;
** Significant at the 5% level;
*** Significant at the 1% level.

fixed effects model; and (4) an increase in the number of lags for the pirate attacks out additional days. In each case, there was little or no statistical change in our results.[22]

While these results show clearly significant impacts of pirate attacks

[22] Regression outputs for each of these robustness checks are available upon request.

Table 5
OLS regression results for the impact of pirate attacks on caracas exchange returns (1995–2012).

Coefficient:	Model 1	Model 2
Pirate Attacks		
Coefficient:	−0.0803	
SE:	(0.3067)	
Successful Attacks		
Coefficient:		−0.1717
SE:		(0.5071)
Unsuccessful Attacks		
Coefficient:		−0.0615
SE:		(0.3843)
Brent Price Returns		
Coefficient:	−0.6574	−0.6602
SE:	(1.8134)	(1.8134)
Attacks*Brent Returns		
Coefficient:	−2.2491	
SE:	(11.8861)	
Successful*Brent Returns		
Coefficient:		23.7383
SE:		(21.7879)
Unsuccessful*Brent Returns		
Coefficient:		−12.9989
SE:		(14.0811)
Lagged Daily Returns		
Coefficient:	0.1206***	0.1204***
SE:	(0.0182)	(0.0182)
Global Financial Crisis		
Coefficient:	−0.0797	−0.0754
SE:	(0.0886)	(0.0891)
Major Events in the Iraq Crisis		
Coefficient:	1.2751**	1.2752**
SE:	(0.5016)	(0.5052)
R^2	.0260	.0270
F	8.52	6.65
N	1926	1926
Coefficient:	Model 3	Model 4
Pirate Attacks		
Coefficient:	0.2382	
SE:	(0.3093)	
Successful Attacks		
Coefficient:		0.4945
SE:		(0.6646)
Unsuccessful Attacks		
Coefficient:		0.1962
SE:		(0.3496)
Brent Price Returns		
Coefficient:	−0.4162	-0.4165
SE:	(2.3116)	(2.3128)
Attacks*Brent Returns		
Coefficient:	−4.9388	
SE:	(12.9453)	
Successful*Brent Returns		
Coefficient:		22.4135
SE:		(29.3284)
Unsuccessful*Brent Returns		
Coefficient:		−10.8982
SE:		(14.4089)
Lagged Daily Returns		
Coefficient:	0.0331	−0.0363
SE:	(0.0335)	(0.0337)
Global Financial Crisis		
Coefficient:	−0.0106	0.0016
SE:	(0.1113)	(0.1122)
Major Events in the Iraq Crisis		
Coefficient:	1.3506***	1.3509***
SE:	(0.4955)	(0.4958)
R^2	.0118	.0134
F	1.56	1.32
N	789	789

Note:
* Significant at the 10% level;
** Significant at the 5% level;
*** Significant at the 1% level.

on regional financial markets, it is still possible that the results are spurious. Hence, we conducted an additional robustness check by examining financial market returns from Venezuela, the largest non-Middle Eastern oil producer in OPEC, in the context of our model. Since the pirate attacks in the Arabian Sea should not theoretically impact Venezuelan oil supply, and since according to the ICC International Maritime Bureau (2014) no serious acts of piracy have threatened Venezuelan waters over our sample period, we should not see an impact on the Venezuelan financial market. The Venezuela market data was also obtained through the GFD as described in the data section. We specifically chose to use the daily returns for the Caracas Exchange. The Caracas Exchange had 4307 observations over our time period (1995–2012) with an average daily return of 0.058% and a standard deviation of 2.648%. Since this regression only contains a singular market, we were able to run it as a pooled cross-sectional OLS regression instead of as a Fixed Effects regression. In examining both the whole as well as restricted (2005–2011) samples, our results show that there is no statistical evidence of pirate attacks impacting the Venezuela financial market. Thus we once again show that the results are unlikely to be spurious. These results appear in Table 5.

6. Conclusions

Economic theory suggests that pirates' practices may be explained by sound economic decisions. Pirates act as organized criminals and try to maximize their profits by signaling their reputation through various means such as horror, torture, kidnapping, and attacks. While the direct economic results of pirate attacks are clearly discernible, there has been little examination of the spillover effects of pirate attacks on private financial markets. In this paper, we tested the reputation theory as applied to piracy. By showing that unsuccessful attacks decrease stock market indices, this study concludes that pirates tend to increase the number of attempts after failure in order to restore their reputation. It is argued that stock markets expect future increases in attacks and thus are negatively affected by the failures. As shown in this study, the effects on financial markets during 2005–2011 on the six Arab countries located on the western shores of the Arabian Peninsula was used to find indirect empirical confirmation of the reputation building theory.

The results suggest that pirate attacks have significant wealth effects. In particular, unsuccessful attacks have a larger impact on stock market returns than successful attacks. This finding is consistent with the overall expectation about the impact of reputation on return of investment (Carroll, 2013) and more particularly with Leeson's (2010a) reputation building theory, which postulates that pirates aim at establishing reputation by capturing influential figures or attacking ships as these events are frequently highlighted freely in the popular media, allowing them to sustain their reputation, critical for achieving their profit maximization motives. In case of unsuccessful attacks, investors anticipate further attacks as pirates are believed to want to maintain their reputation by increasing the frequency of future attacks to result in more successful ones. Hence, our findings have important implications about pirate behavior and are also consistent with Leeson's (2010a) theory of reputation.

These findings also present an interesting perspective to public policy. How far should a government go to combat piracy on the high seas? The United Nations Convention on the Law of the Sea (UNCLOS) of 1982 permits countries to act independently and set up their own maritime security operations.[23] However, if countries know that piracy is not just affecting vacationers and commercial vessels but also their financial markets, then they should cooperate strategically and devote additional resources to dealing with the pirates. From an economic point of view, that approach is desirable. But many governments may lack the political capital and wherewithal to deal with such a threat. And while UN Resolutions 1816 and 1851, mentioned earlier, dealt with the Somali threat in short order, future attacks may be of a less direct measure, for example, hacking into an oil transport's GPS navigation and taking it off route, as opposed to directly attempting to seize the ship. This form of technological piracy, in turn, may introduce even more uncertainty into the financial markets requiring governments to cooperate in assessing the long-term and short-term policy implications of the oil disruptions.

[23] See http://www.un.org/Depts/los/convention_agreements/convention_historical_perspective.htm.

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