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An Economic Impact Assessment of Somali Piracy

By

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Abstract

This thesis estimates the macroeconomic effect of Somali piracy through the measurement and analysis of the costs that the phenomenon imposes on container shipping. Piracy incidents in the wider area of the Gulf of Aden have been intensified over the last years and are creating and levying immense costs that are a heavy burden on Governments, the Shipping Industry and World Trade, which consequently, are also levied onto the markets' consumers – this is especially the case because the area of Somali piracy activity covers the busy sea trade route between Europe and Asia; the Suez Canal.

This research has calculated the cost of Somali piracy per container per year that passes through the High Risk Area (HRA) to be 29 US Dollars – a total cost of 3.4 billion US Dollars per year spread over 116.4 million containers. By treating this cost as a tariff equivalent on container shipping and by using the Global Simulation Model (GSIM) developed by J. Francois and H. K. Hall (2003) we have estimated its effect on welfare, prices, output and bilateral trade of a sample of 10 countries and the Rest of the World (ROW). We find that in terms of welfare countries experience a loss of nearly 77 billion US Dollars. In terms of prices, we find that piracy leads to an average increase of 1.4 percent and in terms of output an average decrease of 0.9 percent. World trade is heavily affected. We estimate that there is a reduction to world trade of roughly 80 billion US Dollars annually. Looking at country-specific effects, we find that in terms of welfare as well as value of trade, China and the European Union are the most affected and Brazil and Australia the least in absolute values. Countries inside or in the wider area affected by piracy, such as the United Arab Emirates, Saudi Arabia and India are fundamentally affected taking their trade sizes into consideration.

Overall we reached the conclusion that Somali Piracy indeed has a significant economic effect on container shipping trade and that it is becoming apparent in different ways. Moreover, we ran a hypothetical scenario of a 30% decrease in the cost of Somali Piracy per TEU to show the benefits that can be derived if the international community engages the phenomenon appropriately. A 30% hypothetical reduction in Somali piracy activities – either by addressing the cause of piracy in Somaliland or by effectively combating piracy at sea – can lead to welfare gains of 25 billion US Dollars and a world trade value increase of 26 billion US Dollars.

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Abbreviations

AFP – Agence France-Presse
BIMCO – Baltic and International Maritime Council
BMP4 – Best Management Practices 4
CGPCS – The Contact Group on Piracy off the Coast of Somalia
CMF – Combined Maritime Forces
CTF – Combined Task Force
DWT – Deadweight Tonnage
EU – European Union
EU NAVFOR – European Union Naval Force
EUR – Euro (EU Currency)
GEM – General Equilibrium Model
GSIM – Global Simulation Model
GTAP – Global Trade Analysis Project
HRA – High Risk Area
IBF – International Bargaining Forum
ICC – International Chamber of Commerce
IMB – International Maritime Bureau
IMO – International Maritime Organization
ITC – International Trade Center
ITF – International Transport Workers' Federation
K&R – Kidnap and Ransom
MIC – Maritime Information Center
NATO – North Atlantic Treaty Organization
OBP – Oceans Beyond Piracy
PAST – Private Armed Security Teams
P&I – Protection and Indemnity
ROW – Rest of the World
TEU – Twenty-Foot Equivalent Unit
UAE – United Arab Emirates
UAV – Unmanned Aerial Vehicles
UKMTO – United Kingdom Marine Trade Operations
UN – United Nations
UNCTAD – United Nations Conference in Trade and Development
UNODC – United Nations Office on Drugs and Crime
UNSD – United Nations Statistical Division
USD – United States Dollars
VLCC – Very Large Crude Carrier
WFP – World Food Programme
WITS – World Integrated Trade Solution
WTO – World Trade Organization

Chapter 1 – Introduction

1.1 Problem Statement and Research Question

Since the early 1990s, Somali piracy has proven to be an enormous burden on companies operating in the wider area of the Gulf of Aden, creating high costs that are difficult to measure. Moreover, besides affecting the private sector, modern piracy is creating heavy costs to the public sector as well since countermeasures are being taken by countries and organizations to battle the increasing attacks. The measurement of the aforementioned parameters would be a great challenge but it would also be assistive in understanding the size of the economic cost that piracy in that area imposes on the world. However, despite the everlasting importance of Somali piracy as a phenomenon, little research has been performed towards measuring its costs[1].

It is within this framework that we attempt to investigate the impact that the additional costs, which are created by the piracy phenomenon on trade performed by container shipping, have on the global economy, trade flows and prices.

Therefore, the core question of this research is: What are the costs of and what is the economic impact of Somali Piracy on trade, output, prices and welfare?

1.2 Relevance

The increase in piracy incidents in the wider area of the Gulf of Aden is characterized by accelerating speed as well as increased intensity and radius (See Figure 1 and Appendix 1).

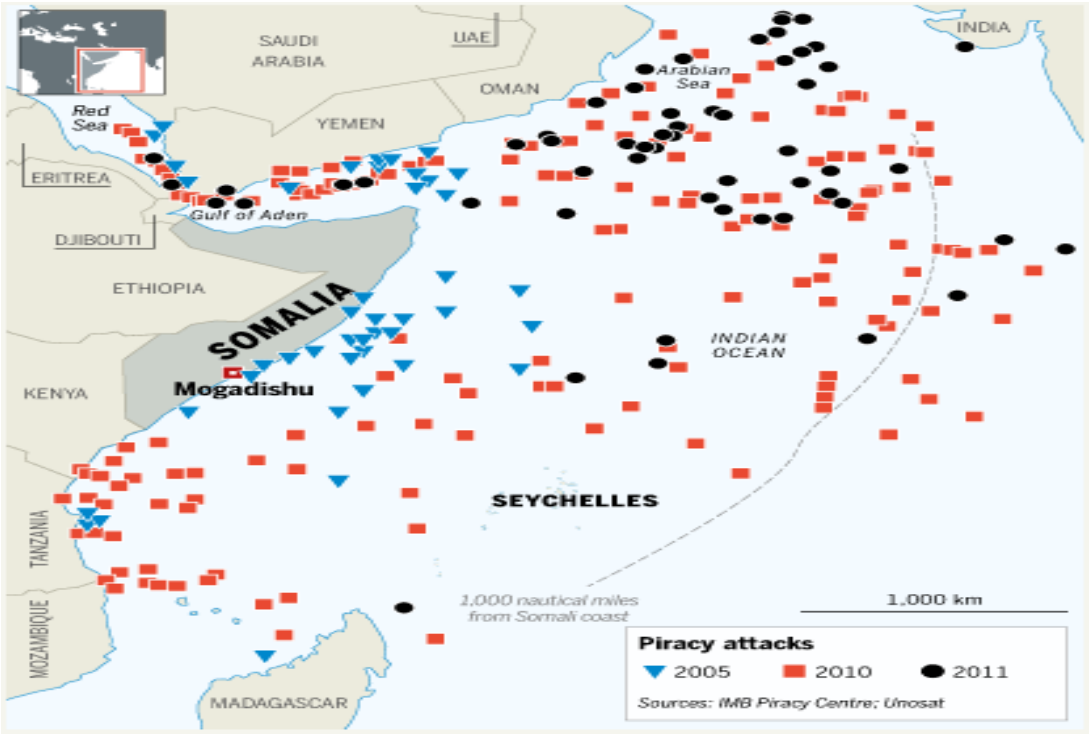
Thus far, the countermeasures that have been taken by the International Community have been proven ineffective in vanquishing the piracy phenomenon and the shipping industry continues to be affected. Before 2008 there was an average of 1.7 attacks per month. After 2008 this number was increased to 11 (Besley, et al., 2012). Sea Trade that passes through the high-risk area suffers additional costs, which are inevitably transferred to the markets' consumers. Therefore, measuring the magnitude of the impact that piracy has on the world economy and trade would most likely be of great importance in understanding and combating it.

Over 80 percent of international maritime trade passing through the Gulf of Aden is with Europe (US Department of Transportation, 2008). Nevertheless, piracy poses direct and substantial burdens on governments and the maritime industry; therefore countermeasures are being taken to repel piracy attacks. These countermeasures include, among others, private onboard armed security and deterrent equipment, higher vessel speeds and rerouting. These measures though (alongside increased insurance premiums and crew expenses), translate to extra costs for shipping

[1] The One Earth Foundation has performed the most analytical and thorough measurement and it is cited extensively through this research.

companies. On top of that, governments and taxpayers have to pay large amounts yearly for military operations and for the prosecution and imprisonment of the suspected pirates.

Figure 1 – Radius of Piracy Attacks



Source: IMB Piracy Reporting Center

Moreover, apart from the economic cost, the human cost of piracy is a great one but difficult to measure due to the absence of reliable information. In the course of 2010, 2753 seafarers were attacked and 1090 were held as hostages (Hulburt, 2011). The physical and psychological impact on these people and their families is enormous and it can also eventually be translated in increased labor costs that can affect consumer prices as well. Also, almost no research has been targeted in the direction of the welfare loss that Somali piracy imposes on the world economy but rather on the direct economic cost that the phenomenon creates. This research though, aims at providing further information and thus assistance in the battle against the piracy phenomenon by indicating the size of the economic impact it has on world economic welfare and global trade; it does not include or focus on the human cost of piracy.

1.3 Why Container Shipping

General Cargo accounts for approximately 60% of the value of goods distributed by sea and the majority of this cargo is carried by containerized liner services that provide a fast, frequent and efficient way of transport for numerous destinations around the globe. Additionally, the container market is a fast growing one. Between 1975 and 2007 the number of containers handled was increased from 14.1 million TEU to 466 million TEU with a yearly growth rate of 10.4% (Stopford , 2009). It facilitated door-to-door business and pushed shipping companies and terminals to introduce advanced logistics in their operations and manage both the sea and land

fragment of transport while at the same time massively reducing port time. Before containers, transportation of goods was slow and unreliable. Containerization led to the minimization of the distance between manufacturers and markets and therefore played an important role in the expansion of globalization.

1.4 Structure of the thesis

This research will be divided into six Chapters. Chapter two presents the background of the situation in Somalia and gives an overview of relevant studies that have been performed and also examine the existing body of knowledge around the matter. Additionally, an overview of recent developments and the current situation concerning piracy incidents will be provided. In Chapter three, the cost factors that exist as a result of the piracy phenomenon are analyzed and quantified and the total cost of piracy is estimated. This will be achieved mainly through the analysis of multiple sources such as reports, articles and previous relative studies, after categorizing the costs into different components. In chapter four we demonstrate the framework and methodology behind the research but also the limitations and issues that have surfaced during the research process. In order to assess how the aforementioned costs affect trade between countries, the Global Simulation Model (GSIM) will be employed. Furthermore, the GSIM will be presented and the input data and variables are modified, explained and analyzed. Finally, in Chapter five the results of the research will be presented and Chapter 6 concludes.

Chapter 2 – Piracy in the Horn of Africa

2.1 Background

Piracy off the coast of Somalia has been threatening International Shipping since the collapse of the Siad Barre regime in the early 1990s and the commencement of the Somali Civil War (Sana Aftab, 2007). By the end of 1990, the capital Mogadishu experienced heavy violence and intra-city combat. Siad Barre was eventually overthrown from his position and the state collapsed. No military fraction managed to provide stability and as a result the Northwestern region of the country, namely Somaliland, declared itself independent (BBC News , 2012). In 1998 authorities of the Northeastern region declared the semi-autonomy of the Puntland State of Somalia. Finally, in 2002, the leaders of Baidoa announced the formation of a Southwestern state of Somalia (UN Workshop, 2008). The piracy attacks are clearly linked to the increased insecurity and absence of a functional central government in Somalia, which creates instability and provides fertile grounds for unlawful actions. This setting acts as a safe haven for Somali pirates who are close to one of the world's busiest trade arteries and who hold hostages in captivity in the country until their ransom demands are met.

For the Somali fishermen, piracy has hugely negative effects for their livelihoods. First of all, pirates take the best boats from fishermen – their own country men – to use for piracy purposes (Somalia Report, 2011). On top of that, foreign fishing vessels from Europe, China, Thailand, Yemen and other countries, have exploited the situation by entering Somali waters illegally for fishing purposes and depriving local fishermen of their catch. Additionally, Somali waters had become the dumping ground for radioactive material such as uranium, lead, mercury but also industrial waste (Sakhuja, 2010).

It is for these aforementioned reasons that the local population declares they have taken upon illegal actions: Somali pirates claim they are "only patrolling their seas" and consider themselves "coastguards" (Gettleman, 2008). The names of certain pirate groups such as the "National Volunteer Coastguard of Somalia" are a testimony to this belief. However, as the earnings from ransoms have increased substantially, piracy as a profession has become a lucrative and attractive choice for many Somalis (Ishaan, 2009). Moreover, according to reports, there are suspicions of possible forms of cooperation between pirates and Somali government officials (Charbonneau, 2009).

The international Community has engaged, alarmed by the increasing number of piracy incidents, (mainly) in the form of military countermeasures. At this moment several Task Forces are effective in the area, such as Combined Task Force 150, Combined Task Force 151 and the EU Task Force (Operation Atalanta). The main objectives of these operations are to reduce disruption of the endangered shipping routes, to provide protection to the commercial vessels passing through the danger

area and to prosecute pirates and provide humanitarian aid by protecting the vessels of the World Food Program (EU NAVFOR, 2010).

A 2010 report by the One Earth foundation estimated that Somali piracy costs the International Economy between 7 and 12 Billion US Dollars (Bowden , 2010). The 2011 report by the same foundation estimated the total economic cost of Somali piracy to vary between 6.6 and 6.9 Billion US Dollars. (Bowden , 2011) Increased insurance rates alone can add roughly 20000 US Dollars per voyage per ship, a cost that inevitably is partly passed on to shippers. (Frump, 2009) Another research estimates the direct and indirect costs of Somali piracy to range from 1 Billion to 16 Billion US Dollars (Chalk, 2008). On the other hand, some analysts believe that while these figures seem large, they are relatively inconsequential since they represent less than 0.1 percent of world trade and only 0.6 percent of the total number of vessels passing through the Gulf of Aden and argue that little of these costs are passed to the consumers (Gilpin , 2009).

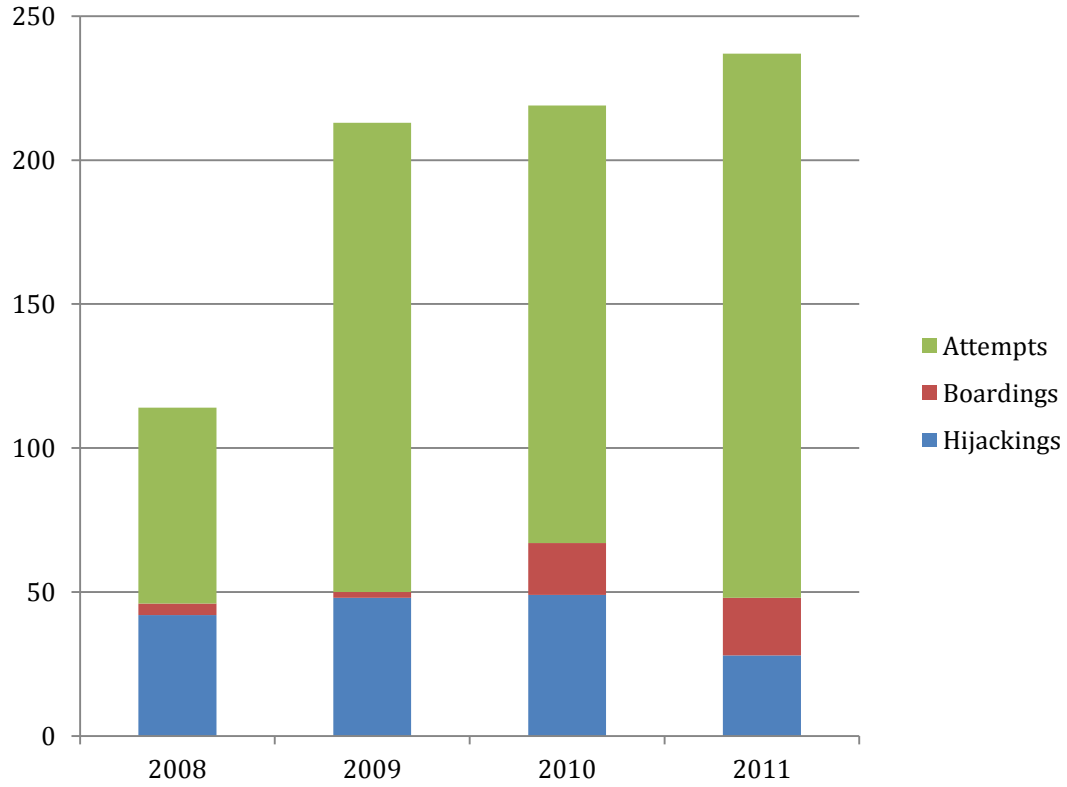
Moreover, the increasing number of attacks has led ship owners to look for alternate ways to transfer their cargo. The population of large oil tankers transiting the Suez Canal has plunged more than 50 percent in three years as vessels choose safer but longer routes (such as the Cape of Good Hope in South Africa) thus massively increasing their fuel consumption and decreasing the number of round trips they can complete in a year (Poten & Partners, 2011). Additionally, many vessels choose to increase their speeds when passing through the high-risk area since no successful hijacking has been documented when the cruise speed is of 18 knots or more (Bowden , 2011). This strategy though, also largely increases the fuel costs. In addition, ransoms are a major aspect of the costs that piracy creates. In 2010 79.8 million US Dollars were paid in ransoms. The number for 2011 was almost double at 146.2 million and in 2012 pirates have already earned 9.4 million (Potts, 2012). On the other hand there are also reports from shippers that shipping companies are charging extra for cargo transport through the high risk area: “The shipping lines are now charging a fee they are calling piracy risk surcharge, which is $10 on freight, and another $3 on insurance.” (Mungai & Redfem, 2012). Shipping lines are also turning to private security companies some of which are based in Northern Europe. They hire armed forces to accompany their vessels in the high-risk areas paying large amounts, which in 2011 were more than 1 billion US Dollars (Apps, 2012).

The majority of the research that has been performed so far around the cost effect of the Somali piracy phenomenon has mainly focused in quantifying its extent and not measuring its macroeconomic impact. A recent study though, which was focused on the dry bulk market, estimated that since the outburst of attacks in 2008, Somali Piracy has led to approximately a 10 percent increase in shipping costs and a welfare loss of more than 1,5 billion USD (Besley, et al., 2012). This research aims in measuring the effect that Somali Piracy has on the quantity and value of major international trade flows, production, prices and also consumer and producer surpluses, which will show what effect piracy has on welfare.

2.2 Recent Developments

Piracy in the area has increased relentlessly in the recent years (Geopolicity, 2011). According to the International Chamber of Commerce (ICC), in 2011 approximately 54% of worldwide piracy attacks were performed by Somali pirates (ICC, 2012). Of the 439 attacks reported to the IMB in 2011 worldwide, 275 took place off the Somali coast and the Gulf of Guinea in the West African coast. Figure 2 illustrates the increase in the number of attacks in the Somali area from 219 in 2010 to 237 in 2011 while the number of successful hijackings has increased from 2008 to 2010 (from 41 to 49 per year) and decreased afterwards in 2011 (from 49 to 28) (ICC, 2012). This later decrease in most likely because of the increased countermeasures shipping companies equip to repel attacking pirates, such as onboard guards and security equipment.

Figure 2-Somali Piracy Hijackings, Boarding & Attempts, 2008-2011



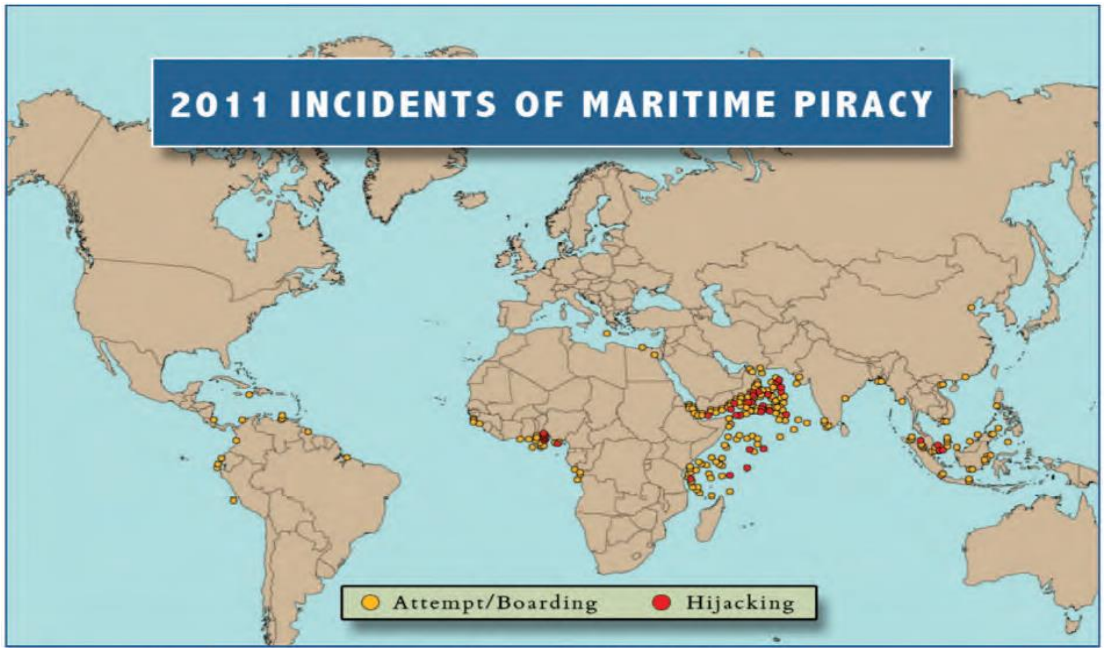
Source: Oceans beyond Piracy

The industry is generally adopting the Best Management Practices for Protection against Somalia Based Piracy" (BMP) and there is a much larger coordination of counter-piracy military forces in the area, which leads to lower success rates for the pirates' attacks. Moreover, there are increasing efforts towards the stabilization of Somalia on shore by the Transitional Federal Government and regional governments in Puntland and Galmadug. (EU NAVFOR, 2012).

Figure 3 demonstrates the global distribution of Piracy acts in 2011. As mentioned above, the largest concentration of incidents is in the wider area of the Gulf of Aden,

in the Gulf of Guinea and in the Malacca Strait near Malaysia and Indonesia, with the Gulf of Aden holding first place firmly. As mentioned above, incidents in the Gulf of Aden have increased in radius (Figure 1), thus continuously changing the countries affected by piracy. India and Pakistan but also the oil producing countries of the Gulf are facing increasing danger by the geographical spread of attacks.

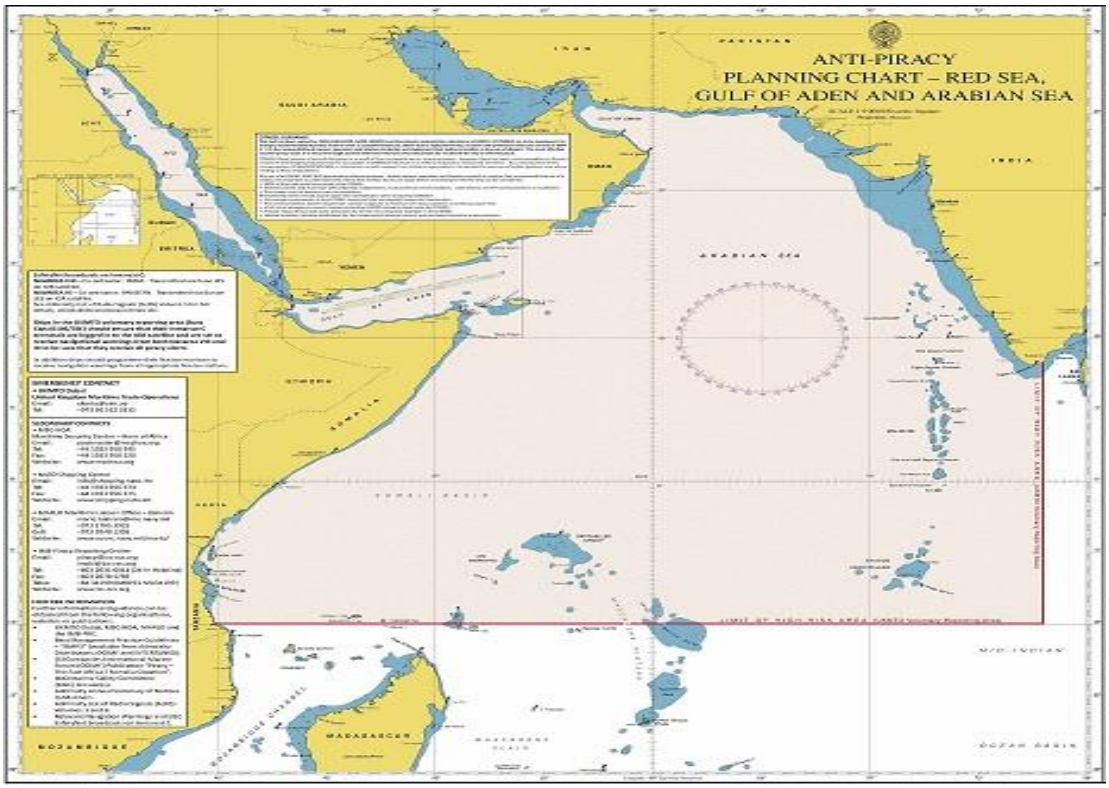
Figure 3-Global distribution of Maritime Piracy in 2011



Source: IMB Piracy Reporting Centre

Until July 29 in 2012, a total of 70 incidents were reported with 13 successful hijackings and 212 people held as hostages. As per August 2, 2012, the Somali pirates have 11 vessels with a total of 174 crewmembers in captivity (ICC, 2012). The area that indicates a higher risk of piracy attacks in the wider Gulf of Aden has been defined as a “High Risk Area” (HRA) and is displayed in Figure 4. As we will show in the next chapter, the HRA plays a very important role in measuring the costs associated with Somali piracy, since it highly affects seafarers’ wages and insurance premiums in that region.

Figure 4 - The High Risk Area



Source: EU NAVFOR

Moreover, 2011 witnessed an increase in expenses for onboard-armed security personnel offered by private companies and - as we will show in the next chapter - this cost is a significant one. However, also in 2011, the number of vessels that chose the alternative itinerary around the Cape of Good Hope as a rerouting option to avoid the HRA decreased, hence reducing the overall cost of rerouting compared to the 2010 figures (Bowden , 2011). This was mainly the result of the aforementioned increase in the number of vessels that chose the option of onboard guards to secure their safe passage rather than the rerouting option. Nevertheless, vessels that transit through the HRA are under the constant fear of an attack, even now, that the international community has its eye focused on the matter.

Chapter 3 – The Economic Costs of Somali Piracy

3.1 Introduction

Somali Piracy has a broad range of effects for Somalia as a country, the wider geographical region and the world, which consists of the shipping industry and governments directly or indirectly associated with efforts to battle piracy. Major Trade Routes transit through the area, which makes the Somali Piracy issue a direct threat to international trade between large trade partners such as Europe and China.

3.2 Costs for the Somali Economy

The Somali economy is heavily impaired for various reasons. Companies and business partners are in general discouraged to engage in business in the area because of the instability and hostility. They demand high freight rates to deploy their ships to the country's ports. The small number of yearly berths results also in reduced port revenues and investment funds for related transport infrastructure as well as reduced income for local and central governments and communities, which rely on port revenues. Moreover, currency inflation exists as a result of the large entries of US Dollars that pirates gain through ransom payments from ship owners. In addition, a criminal economy exists that is sustained side by side with piracy and has links to human trafficking, illegal arms and drugs trading, money laundering etc. This situation dislocates the lawful economic activity and deprives the local society of social and economic welfare. At the same time it is very difficult for vessels of the World Food Programme (WFP) to deliver their cargo without naval escorting thus depriving citizens of Somalia the humanitarian aid they desperately require (UN Workshop, 2008).

3.3 Costs for the Wider Area and the Regional States

The aforementioned factors are some of the obstacles that delay and enmesh Somalia's unification with the international and trade community. Unfortunately, piracy off the coast of Somalia negatively affects the economies of the countries of the wider area of the Gulf of Aden as well. For instance, various shipping companies are boycotting the Suez Canal and avoiding the Gulf of Aden because of the high risk their vessels face of being attacked (and to force global intervention for the piracy issue), which would translate in immense extra costs (as we will show below) (Gibbs, 2011). This results in the reduction of the level of trade for the surrounding countries such as Yemen, Ethiopia, Saudi Arabia, Kenya, Djibouti and of course Egypt, which has a domino effect of reduced port and State revenues and general economic decline. The oil and gas exports from Saudi Arabia as well as Yemen's potential LNG exports could be endangered. Finally, the danger of an environmental disaster is always present under such conditions since Somali pirates attack large vessels that carry sensitive cargo such as crude oil, chemicals and gases, which have increased chance of explosion and can extensively harm the ecosystems of the area if they are spilled. The aforementioned types of costs though are very difficult to quantify and are not included in this research.

3.4 Costs for the Shipping Industry

3.4.1 The Cost of Increased Speeds & Maneuvering

Vessels transiting through the HRA often resort in increasing their speed to decrease the chance of being hijacked. Until the beginning of the year, no successful hijacking had been documented for vessels travelling at 18 knots or more (UKMTO, 2011). Taking into consideration the fact that over the past few years vessels (especially container vessels) have been slow steaming at speeds ranging from 11 to 15 knots it is obvious that an increase of 3 to 7 knots is an expensive one, considering the higher fuel consumption and prices. Nevertheless, increased vessels speeds mainly affect container vessels for two reasons. First, they have the technical capacity to travel at faster speeds than other vessel types, such as bulk carriers or tankers and they have experienced a larger reduction to their speeds over the past years, because of the increase in fuel costs. Large container ships streaming through the HRA at full speed might add up to 200.000 USD in extra fuel costs per voyage (Horn Portal, 2012). Second, according to the directions of the BMP4, Masters are encouraged to practice maneuvering techniques prior to entering the HRA so that they are prepared to apply them in case of an attack, without reducing the vessel's speed.

At the same time though, according to the 2011 Report of the One Earth Future Foundation, vessels do not transit at 18 knots through the entire Indian Ocean but rather increase to that speed when they approach the Gulf of Aden (Bowden , 2011). Additionally, in order to increase security, shipping companies arrange to travel alongside other vessels in convoys. This could potentially mean a decrease in speeds for vessels that have higher cruising speeds but most of the times arrangements are made to ensure that vessels of the same size and technical capabilities transit together and thus can maintain greater speeds.

The same report, assumes that the costs that stem from the increased container vessels speeds mainly regard excess bunkering costs and does not include other vessel types that pass through the HRA[2]. The number of container vessels that transit through the HRA are calculated to be around 16.165 from which only a 20% or 3.233 vessels travel through the Gulf of Aden and the rest 80% or 12.932 vessels transit through the Indian Ocean. The final additional cost under these assumptions and for container ships only, was calculated to be approximately 2,7 billion USD in 2011 (Bowden , 2011).

3.4.2 The Cost of Security Equipment and Onboard armed guards

The previous year witnessed a large increase in the use of armed personnel of private security companies that accompany the vessels through the HRA and protect it against pirate attacks. Several flag states (such as the Netherlands, USA, Denmark, Greece, Cyprus, Germany etc.) and insurance companies have started to

[2] The research team of the One Earth Future Foundation used BIMCO's Piracy calculator to calculate the costs that stem from increased speeds. This tool, apart from bunker costs, takes into consideration several factors such as charter hire, opportunity costs, insurance cost etc., which were not accounted for by the research team.

allow the use of this practice for the protection of the rights of the shipping companies but the latest Best Management Practices booklet remains neutral in this matter and does neither recommend nor discourages this method. In any case, armed security guarding should be used alongside other layers of protection and not as a standalone practice (UKMTO, 2011). A 2008 report from the United States Department of Transportation estimates the cost of hired armed protection to be 60.000 US Dollars per voyage (US Department of Transportation, 2008). The One Earth Foundation's estimation for 2010 was 80.000 USD per voyage, which was an average of two sources that calculated the cost at 60.000 USD and 100.000 USD respectively. The 2011 Report from the same Foundation estimated the cost per voyage through the HRA to be between 30.000 and 100.000 USD. Moreover, a 2011 article of Bloomberg reported that the average cost for hiring armed guardians is 50.000 USD (Arnsdorf, 2011). As we will later observe, ransom demands are on the rise therefore it seems more profitable for ship owners to hire Private Armed Security Teams (PASTs) than risk paying a much higher ransom.

According to the 2012 Report of the House of Commons approximately 15%-25% of vessels transiting through the HRA have PASTs onboard, sometimes in violation of the policy of their respective flag state (House of Commons , 2012). Another estimate by Peter Cook, director of the United Kingdom Security Association, states that by the end of 2012 20% of vessels will hire PASTs (Unite Press International, 2012). Approximately 42.450 vessels travel through the HRA each year (Bowden , 2011), thus the 20% of them counts for 8.490 ships that employ PASTs each year. With a calculated average cost of approximately 65.000 USD per journey, the resulting yearly cost for private armed security is an estimated 551, 9 million USD.

Additionally, an increasing number of shipping companies choose or are obliged to implement in their procedures, measures that the BMP4 suggests and equip their vessels with security equipment in order to repel pirates that attempt to hijack their vessels. Such measures include Watch keeping, with lookouts equipped with antiglare binoculars and night vision optics but also a Radar watch. Also, the use of good quality dummies to give the impression of larger number of people on watch is recommended. Another measure is the enhancement of the bridge's protection with Kevlar jackets and Helmets for the bridge team as well as sandbags, fabricated metal plates and security glass. Also, setting physical barriers such as razor wire, electrified barriers and metal spikes in combination with Water Spray/Water Cannons systems and Foam Monitors can stall pirates and make it more difficult for them to board the vessel especially if it is maneuvering. Finally, Alarm Systems and other means of early warning as well as "modern" means of repulsion and protection such as Sonic deterrent equipment, citadels, safe muster points, closed circuit television systems etc. (UKMTO, 2011).

Once again, One Earth Future Foundation has performed the most detailed cost analysis of the BMP-Suggested anti-piracy measures, which are shown in Table 1.

Table 1 - Security Equipment Cost

Security Equipment	Average Cost/Ship/year	Total Cost in 2011	
		Lower Bound	Upper Bound
Razor Wire	$12,796	$434,552,160	$434,552,160
Electrified Barrier	$1,529.80	$3,247.000	$9,741,000
Warning Signs	$4.50	$286,538	$286,538
Acoustic Devices	$21,000	$44,572,500	$133,717,500
Sandbags	$1,424.16	$48,364,473	$48,364,473
		$553,609,653	**$629,248,653**

Source: Oceans beyond Piracy

Since this research attempts not to follow a conservative set-up but also because many piracy costs are impossible to be counted due to missing or incorrect information, the "Upper Bound" calculation will be taken into consideration. In conclusion, the overall cost of armed onboard Security and Security equipment is close to 1,2 billion USD.

3.4.3 The Cost of piracy-related Insurance Premiums

Insurance costs vary depending on the vessel's type but in less than two years the market has witnessed a forty-fold increase in insurance premiums, from 500 USD per voyage in 2008 to 20.000 USD per voyage in 2009 (Gilpin , 2009). Another estimate reports an increase from 900 to 9.000 USD but the first one seems closer to reality because most estimates are around 20.000 USD (Pinchasik, 2010). Insurance underwriters at Lloyds in London have characterized the HRA as a "War Risk Zone" and as a result fees have risen and special clauses have been included. In addition, marine insurers are considering extending the war risk zone because of the increasing radius of attacks. The "Sirius Star" was captured by pirates in 2008, 450 nautical miles off the Kenyan coast, 250 miles further away from the limits that marine insurers urged vessels to travel. Of course, sailing further away from the shore raises extra costs. Some insurers offer lower premiums under the condition that the vessels have means of protection onboard such as equipment and PASTs.

The shipping industry is mainly concerned about vessels that carry oil, chemicals, wheat, coal etc. since these are more vulnerable to attacks by pirates in contrast to container ships that have higher freeboards and can reach higher cruise speeds (King, 2009). In any case, not all vessels operating in the HRA are insured against piracy. In fact some reports mention that only a 10% of vessels passing through the Gulf of Aden are insured against piracy. The other 90% passes uninsured mainly because of the economic depression (Pinchasik, 2010).

There are several types of Marine insurance, some with larger relativeness with the piracy phenomenon and others with less. For example, Hull insurance covers the physical damage that can occur in the case of collision, sinking, grounding, fire and also piracy attacks. Cargo insurance is dedicated for the compensation of damage to the carried goods on a vessel. In 2011 it has been increased by between 25 and 100 USD per container or 187.500 and 750.000 USD for a midsized vessel with full load

(Bakogiannis, 2011). On the other hand there are other types of Marine insurance especially dedicated to unlawful acts at sea such as War Risk Insurance, which is paid by vessels that transit through War Risk Zones (the HRA in the case of Somalia) and it is the most fitting way to cover piracy incidents. Finally, Protection and Indemnity Insurance (P&I) covers liabilities concerning the crew, piers and docks. In this category a separate Kidnap and Ransom Insurance (K&R) exists, which is dedicated mainly to the payment of ransoms for the release of the crew, in case of a piracy incident.

From the above categories the main ones directly related to Piracy are the War Risk Insurance and the K&R Insurance. Vessels travelling through the HRA are obliged to pay war risk premiums. In the case that war risk insurers are satisfied by the vessel's prevention measures (such as PASTs or other BMP4 measures) they will most likely make reductions to the rates. On the other hand if a ship has a feature that may increase its chance of being hijacked, such as a low freeboard or speed, the war risk premium might be increased or possibly decreased again if the vessel is also covered by K&R insurance. Nowadays, compliance with the BMP4 is considered as a standard and in most cases it is an underwriter's requirement (Marsh, 2011).

K&R underwriters provide coverage on a global and annual basis or for specific high risk voyages and it is for the protection of the vessel's crew and not the vessel itself. K&R insurance basically covers ransoms that are used to free live kidnapped crewmembers. In the case of Somali piracy, K&R policies are extended to secure the release of seized property since pirates demand a single ransom to release the whole ship (Marsh, 2011). The K&R market is a relatively fast growing one as more and more ship owners realize its benefits.

Valuing the level of the insurance cost the shipping industry faces is not an easy task and very few analytical calculations have been performed in that direction. There is also a lack of data on insurance premiums and variations exist depending on each vessel, also because of the possible aforementioned deductions. A 2010 report valued the extra insurance costs to around 400 million USD (Pinchasik, 2010). The 2010 report of the "Oceans beyond Piracy" estimated the piracy-related insurance costs to be somewhere between 460 million USD and 3.2 billion USD (Bowden , 2010). The OBP team received concerns from the insurance industry about the upper bound of this calculation and by working alongside them, managed to reach a more precise result, which estimates the total piracy associated insurance premiums paid in 2011 to be around 635 million USD (Bowden , 2011).

3.4.4 The Cost of Rerouting

As a result of the increasing number of attacks many shipping companies decided to make use of the "alternative" option and sail around the Cape of Good Hope. Depending on the port of origin and destination this route can add approximately 3.500 miles to the trip, which considering the rise in oil prices can be a huge burden for ship owners (Gilpin , 2009). Additionally, rerouting adds many days to the original trip. A voyage from Europe to the Far East can be extended from as long as 15 to 20 days, thus decreasing the yearly roundtrips a vessel can make and adding at least 74.4 million USD in fuel costs and 14.6 million USD in charter expenses (Stavridis &

LeBron , 2010). Also, such delays may be a viable option for low value cargoes such as bulk goods but this is not the case for high valued goods that mostly container vessels carry, which are needed for just in time supply chains. Table 2 shows the difference in nautical miles and the percentage of saving in the distance between selected ports of origin and destination.

Table 2 - Comparative Voyage Approach

From	To	Distance Naut. Miles (NM)		Savings	
		Suez Canal	Cape	NM	%
Ras Tanura	Constanza	4,144	12,094	7,950	66
	Lavera	4,684	10,783	6,099	57
	Rotterdam	6,436	11,169	4,733	42
	New York	8,281	11,794	3,513	30
Jeddah	Piraeus	1,320	11,207	9,887	88
	Liverpool	3,902	10,702	6,800	63.5
	Rotterdam	6,337	10,743	4,406	41
Bombay	Rotterdam	6,337	10,743	4,406	41
	Marseille	4,558	10,362	5,804	56
Tokyo	Rotterdam	11,192	14,507	3,315	23
Shanghai	Genoa	8,670	13,619	4,947	36.3
Singapore	Rotterdam	8,288	11,755	3,647	29

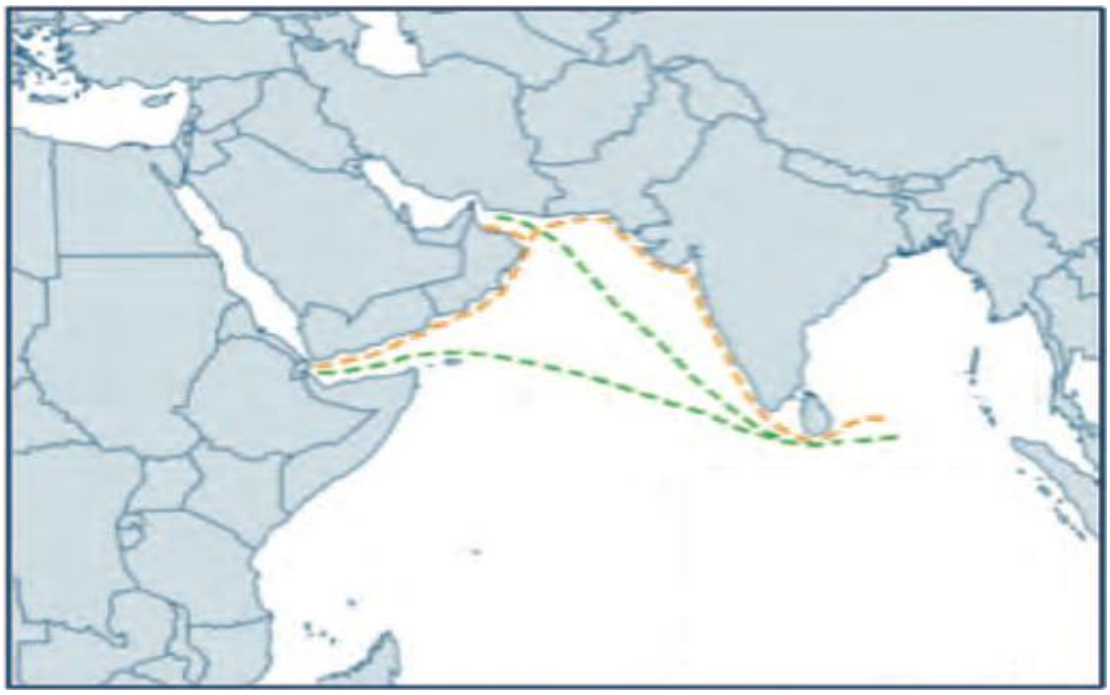
Source: Bendall 2009

A 2009 comparative voyage approach study on a 318.000 DWT VLCC and a 10.040 TEU Container Vessel calculated the costs deriving from rerouting due to Somali Piracy to be around 7,223 million USD and 2,843 million USD per year respectively (Bendall, 2009). Fuel costs, crew costs, operating costs and the reduction of a vessel's yearly capacity are the main issues with rerouting while on the other hand there are no costs for special insurance, onboard security measures and Suez Canal dues. The previous year experienced a great drop in the number of vessels that choose rerouting around the Cape of Good Hope as a piracy avoidance option. This is mainly due to fact that an increasing number of ship owners are equipping their ships with PASTs and prefer paying the extra insurance and canal costs rather than the huge fuel costs and roundtrips loss that come with rerouting around the Cape.

In 2011, a different rerouting option was observed. Many vessels chose to sail along the Indian coastline and to the northeast of the HRA (see Figure 5 – The rerouting itinerary is shown in orange; the original in green) thus adding only one extra day to the average trip from Singapore to Oman (Bowden , 2011). The 2011 OBP research was focused on this new rerouting option and especially on the two types of vessels that face larger danger of being hijacked, bulk carriers and tankers and assumed two scenarios: One where 50% of vessels reroute and the second where 70% of vessels reroute. Once again the BIMCO Piracy calculator was the tool to measure the different scenarios. The resulting cost of rerouting was between 486 and 680 million

USD, thus an average of approximately 580 million USD. We should note here that this cost refers to all shipping and not just container shipping. As we will see later on container shipping is not affected by the cost of rerouting.

Figure 5 – The new Rerouting Option (in green)



Source: Oceans Beyond Piracy

3.4.5 The Cost of Increased Crew Expenses

Since 2009 there have been reports of shipping companies having to increase crew wages due to the piracy effect. CMA – CGM announced that they had to pay double wages to crews on ships sailing off the Somali coast (Frump, 2009). These costs are sometimes imposed as a surcharge on the containers shipped. (Pinchasik, 2010) As of January 1st 2012, the International Transport Workers Federation (ITF) through the International Bargaining Forum (IBF) and after negotiations with ship owners and companies has decided on a "Warlike and High Risk" designation which provides benefits and secures rights for seafarers that travel through the designated areas. According to this document the crews operating on vessels passing through the HRA (as defined in the IBF List – See Appendix 2) are entitled to bonuses, double compensations, rights to refuse sailing, repatriation to their countries at the company's expense etc. (International Bargaining Forum, 2012).

However, not all seafarers are entitled to these rights. Only those signed with the ITF (over 600.000 people (ITF, 2012)) and Philippine seafarers (who are one third of all the world's seafarers) are eligible for these benefits (McGeown, 2011). The total cost deriving from increased wages due to the Somali Piracy effect was calculated to be around 195 million USD for 2011 (Bowden , 2011). This approximation does not include the opportunity cost of the time that seafarers are held hostages in the case of a successful hijacking, due to lack of information. The crew held in captivity cannot work and the shipping company must employ new personnel for that time. Also the abducted crew may not be able to return directly to work after its release for

psychological reasons. This non-included excess cost could very likely increase the overall piracy-associated labor cost even more.

3.4.6 The Cost of Ransoms

The payment of ransoms is the most straightforward and easy to comprehend cost that derives from piracy. After the successful hijacking of a vessel, pirates move it to a safe location and begin negotiations with the shipping company for its release. As mentioned in Chapter 2, the number of successful Piracy attacks has been decreased in the past year but what is observed is that the average ransom has been increased from 600.000 USD in 2007 to 4.7 million USD in the beginning of 2012 (Rothwell, 2012). The amount of ransom demanded is in general relatively low comparing to the value of the vessel and cargo thus ship owners prefer to pay up and free their vessel rather than delay and have much larger financial losses, also from opportunity costs. The current market situation and the volatility that characterizes the shipping markets requires from ship owners to have their fleet at a constant availability something which can be heavily disrupted from a monthly or yearly captivity[3].

The largest documented ransom paid to Somali Pirates until now was the one for the release of the Greek-flagged M/V Irene, a VLCC that was captured on February 9 2011 and 13.5 million USD were paid for its release (EU NAVFOR, 2011). A complete list of vessels hijacked in 2010/2011 (but whose ransoms were paid in 2011) is available in Appendix 3. Furthermore, the cost of ransoms includes extra costs such as the costs for negotiators, lawyers, consultants and psychologists for the crew. Also, the longer the negotiating procedure is, the larger the opportunity costs and the loss of earnings for the shipping company. With an assumed charter hire of 15.000 USD per day the cost for a captivity of three months would be 1.35 million USD. As we witnessed in the previous chapters the ransom amount is usually covered by the insurance companies thus is already included in the insurance costs. The above-mentioned excess costs are calculated to be about 159.60 million USD (Bowden , 2011).

3.5 Governmental Costs

3.5.1 The Cost of Military Operations

The Piracy phenomenon in the wider area of the Gulf of Aden has generated an unusual presentation of unity of military forces from all around the world, even by some that are openly hostile between them. At this moment several military operations are active in the area some of which are:

Operation Atalanta: Officially titled the “European Union Naval Force Somalia” (EU NAVFOR) as it name states, is the naval force of the European Union. It was launched on December 8 2008 and its mission is the protection of vessels of the

[3] The M/V Iceberg 1, M/V Albedo and others are good examples of prolonged captivity from Somali pirates as they have been under their control for over two years, with major human and capital costs.

World Food Programme (WFP) delivering aid to Somalia, the prevention and repression of acts of piracy off the Somali Coast, the protection of vulnerable shipping and the monitoring of fishing activities in the area. It consists of about 1,500 military personnel and it has a varying composition since the number and origin of its vessels frequently changes. In 2011 Operation Atalanta was funded with 8.05 million EUR (or 9, 9 million USD) that covered common costs such as Headquarter costs etc. (EU NAVFOR, 2010). In 2012, Operation Atalanta will operate with no more than 8 vessels (Wallis, 2011).

Combined Task Force 151: It is a multinational operation established in January 2009 under the "Combined Maritime Forces" (CMF) partnership and its mission is to disrupt piracy and armed robbery at sea and protect global maritime trade and ensure freedom of navigation. It consists of several nations-members of CMF that rotate in a four to six months basis and it is headquartered in Bahrain (CMF, 2012). The administrative costs for 2011 were estimated to be around 5.5 million USD (Bowden , 2011).

Operation Ocean Shield: It is NATO's input in the fight against piracy in the Horn of Africa. It is active since August 2009 with involvement of NATO warships and aircrafts. Its mission is to contribute to international efforts in combating maritime piracy while partaking in capacity building efforts alongside local governments. As of March 2012 five nations provide assets to the mission, namely Denmark, the Netherlands, Turkey, the United States and Italy with 800 active personnel (NATO, 2012). Its operating Centre is based in Northwood UK and its administrative costs are around 5.5 million USD, which do not include staffing costs for the missions that are covered by the different member-nations (Bowden , 2011).

Combined Task Force 150: It is the second multinational naval force that operates under the CMF and its mission is to promote maritime security to counter terrorist acts and illegal activities. It is not aimed only on piracy acts but on Counter Terrorism in General (and consequently was "reinforced" with CTF-151). It consists of forces from countries such as Denmark, France, Germany, Italy, the Netherlands, the United States, the Republic of Korea and others, which rotate on a four to six months basis (CMF, 2012). No data could be retrieved regarding the financing of this operation.

Individual deployment: Several other countries have deployed forces in the area independently some of which are: Australia on May 2009 with one warship (McPhedran, 2009). India, with a total of 21 ships deployed since October 2008. China on December 2008 with two warships and a supply ship and 16 members of the Chinese Special Forces. Russia, with additional warships during the escalation of incidents in 2008 and also Pakistan, Japan, Iran, Saudi Arabia and other countries (AFP, 2008).

The above-mentioned managerial costs (excluding those of individual action and CTF-150, which is not directly related to battling Somali Piracy) are calculated to be around 21 million USD. This estimation does not include operating costs such as fuel

costs, basing costs, equipment costs, training costs and others[4]. OBP estimated these costs to be about 1, 26 billion USD in 2011 (Bowden , 2011). With the addition of the managerial costs the total figure is near 1, 28 billion USD.

3.5.2 The Cost of Organizations against Piracy

Due to the intensification of the piracy phenomenon in the recent years, several multinational or national organizations have surfaced. Some of them are:

The Contact group on Piracy off the Coast of Somalia (CGPCS): It was created by the International community as a forum to bring together nations, military forces, the shipping industry and other organizations to discuss on the Piracy issue and to find and implement solutions. CGPCS was also the one to provide the mandate for the "Trust Fund" against piracy, which will be mentioned below. It is split into four Working Groups (Foreign & Commonwealth Office, 2011):

Working Group 1 works alongside with the IMO and is aimed in improving naval operation and coordination as well as supporting the Eastern and Western African and Indian States to battle piracy. It is chaired by the UK.
Working Group 2 aims at creating the judicial structures for the arrest and prosecution of pirates. It is chaired by Denmark.
Working Group 3 is aimed at increasing commercial shipping self-awareness and self-defense. It is chaired by the USA.
Working Group 4 is targeted in strengthening diplomatic efforts between Somalia and the International community. It is chaired by Egypt.

The United Nations Office on Drugs and Crime (UNODC): Its counter piracy programme (CCP) was initiated in 2009 to assist Kenya in the fight against attacks by Somali Pirates. At this moment it is operating in six countries in the Somali region and supporting the efforts for efficient prosecutions, trials and imprisonment. The UNODC also manages a "Trust Fund" established by the UN Secretary-General Ban Ki Moon on January 2010. The main goals of this fund are to reinforce several anti-piracy related activities such as investigations, prosecutions, public communication initiatives and others. The Fund accepts contributions from Governments, Governmental Organizations, Private Organizations and the public and until January 31st 2011 it had accepted 5, 09 million USD from various sources (UNODC, 2012).

The Djibouti Code of Conduct: It was signed by the Djibouti Meeting on January 29th 2009 and remains open for signature at the IMO headquarters. The signatory members agree (among other things) to cooperate: in the investigation, arrest and prosecution of suspects, in the rescue of vessels and persons that are endangered by piracy, the execution of shared operations etc.

The Maritime Piracy Humanitarian Response (MPHRP): It was created in September 2011 with the mission to assist seafarers and their families after the

[4] Additional costs include the operational expenses for the use of Unmanned Arial Vehicles (UAVs) that are mainly used by the US, Spain and India.

traumatic incident that a piracy attack and a hostage situation can cause. It is funded by the ITF Seafarers' Trust and the TK Foundation (Swift, 2012).

Oceans beyond Piracy (OBP): It was launched in 2010 by the One Earth Future Foundation and it is privately funded. Its goal is to respond to maritime piracy through mobilizing the maritime community against this issue, developing public and private partnerships to create solutions and by discouraging the piracy phenomenon "*on the rule of law"* (OBP, 2012).

Other Organizations: The "UN Political Office for Somalia" and the "United Nations Development Programme-Somalia", which are funded by the "Trust Fund", the "Save our Seafarers" programme and others.

Overall, the cost for the funding of all the above organizations is calculated to be about 21.3 million USD (Bowden , 2011).

3.5.3 The Cost of Prosecutions and Imprisonment

According to the UN convention on the Law of the Sea, any state, whether it is directly connected to the piracy phenomenon or not, has the right to prosecute pirates under the condition that piracy is consider a crime under its domestic law but in reality the prosecution of pirates is a complicated procedure.

In the past few years, approximately 1.011 pirates have been arrested and were either trialed or are awaiting trial (UN Security Council, 2011). Due to many issues, such as the reluctance of countries to prosecute pirates because of legal issues that might surface, around 90% of pirates are being released without prosecution (Hopkins, 2012). Several proposals have been targeted to resolve this issue, the most important of them being the creation of a specialized court being established in Arusha, Tanzania, which would cost around 2.73 million USD in 2011 and 2.33 million USD in each coming year (Lang, 2011). The cost of assistance and funding of courts in Somalia (such as Somaliland and Puntland) are approximately 24.4 million USD for the course of three years and they are going to be provided by the UN Development Programme. Moreover, extensive financial support has been provided by the International community to Somalia due to the low prosecution rates and capacity that it has for imprisonment of suspects. These costs are not included in these calculations though since they are taken into consideration in the previous chapter.

The total cost of prosecutions in 2011 is derived from the average cost of trials related to piracy and the cost of imprisonment for suspected pirates in Africa, Europe, Japan and North America. These regions are not funded by any international organizations and thus are included in the calculation. In 2011, the total cost for piracy prosecutions and imprisonment was estimated to be close to 16.43 million USD (Bowden , 2011).

Therefore, after the addition of all the above individual costs the Total Cost of Somali Piracy for 2011 is calculated to be approximately 6, 77 billion USD. As mentioned earlier, this cost does not contain the cost of actual or potential environmental

disasters and it includes all kinds of maritime activity and seaborne trade such as bulk and tanker shipping.

Chapter 4 – Methodology, Framework and Data Selection

4.1 Introduction

From an economic perspective, Somali piracy acts as a negative externality levied on international trade. A complete "successful" Piracy incident from the viewpoint of the pirate, results in the payment of ransoms. Ship owners and governments pay these ransoms but also bear the other costs mentioned in Chapter 3, which are created for combating/avoiding piracy incidents. Ultimately these costs are most likely paid by consumers of final goods in the form of higher market prices (Besley, et al., 2012). As a result of piracy, the shipping industry, governments, shippers and consumers undergo welfare losses in relation to consumer and producer surpluses. This research is aimed at the Somali Piracy effect imposed through costs on container shipping and under some further assumptions, which will be presented below.

4.2 Methodology

4.2.1 Introduction to the GSIM Model

This research adopts a quantitative approach and is based on the Global Simulation Model. J. Francois and H. K. Hall developed GSIM in 2003 and it is suitable for the simultaneous assessment of trade policy changes at the industry level, on a global, regional or national level (Francois & Hall, 2003). GSIM is a partial equilibrium model meaning that it does not take into account many of the factors emphasized in general equilibrium trade theory. This limitation though creates a valuable advantage: It allows the fast and clear analysis of an extensive range of policy issues with limited data and calculation requirements. As long as its limitations are kept in mind, GSIM provides a convenient methodology to gain insights about many aspects of trade policy changes, such as consumer and producer surpluses, prices, trade flows etc. The model is built around the Microsoft Excel Solver, which is required for it to run. Using an advanced general equilibrium model (GEM) would be a very ambitious undertaking for this research given their larger complexity and their broader data requirements.

One of the basic assumptions of the GSIM is national product differentiation, which means that imports are imperfect substitutes of each other. Also, the elasticity of substitution and elasticity of demand are assumed to be equal and constant between products of different sources. Finally, the elasticity of import supply is constant as well.

GSIM requires as inputs the bilateral trade flows of the chosen sample of countries in USD, the initial bilateral import tariffs in the form of T=1+t (where t is the rate of the tariff markup relative to world price) and the final bilateral import tariffs, which in our case are the initial ones with the addition of the percentage of the cost of piracy per TEU over the cost to transfer a TEU between the aforementioned sample of countries. In addition, GSIM requires the initial and final bilateral export and production subsidies, which in our case are assumed to be 1; the resulting tariff revenues are assumed to be zero, since none of the sample countries is gaining from

the pirate attacks. Finally the composite demand, industry supply and substitution elasticities are required and they are held constant.

4.2.2 The basic GSIM Equations

Table 3 demonstrates the basic GSIM Functions and parameters:

Table 3 – GSIM Notations

Indexes	
r, s	Exporting Regions
v, w	Importing Regions
i	Industry Designation
Parameters	
Q*i,v*	The composite good in region *v*
A*v*	An efficiency term calibrated so that the price of Q, P=1
γ*(i,v), r*	The CES expenditure weight term
ρ	The CES exponent term, where the substitution elasticity $Es = \frac{1}{1-\rho}$
Es	Elasticity of Substitution
E*m(i,v)*	Aggregate import demand elasticity Defined for aggregate imports M*(i,v)* and composite price P*(i,v)* $= \frac{\Theta M_{(i,v)}}{\Theta P_{(i,v)}^{*}} \cdot \frac{P_{(i,v)}^{*}}{M_{(i,v)}}$
E*x, (i,r)*	Elasticity of Export Supply$= \frac{\Theta X_{(i,r)}}{\Theta P_{(i,r)}^{*}} \cdot \frac{P_{(i,r)}^{*}}{X_{(i,r)}}$
Calibrated coefficients	
N(i,v),(r,r)	Own price demand elasticity
N(i,v),(r,s)	Cross-Price elasticity
T(i,v),r	The power of the tariff, T=(1+t)
Θ*(i,v),r*	Demand expenditure share (at internal prices) $\Theta_{(i,v),r} = {M_{(i,v),r}T_{(i,v),r}}/{\sum_s M_{(i,v),s}T_{(i,v),s}}$
Φ*(i,v),r*	$\Phi_{(i,v),r} = {M_{(i,v),r}}/{\sum_w M_{(i,w),r}}$
Variables	
M	Imports quantity
X	Exports quantity
P	Composite domestic Price
P**(i,r)*	World Price for exports from region r
P*(I,r),v*	Internal Prices for goods from region r imported into region v
t *(i,r),v*	Import Tariffs for goods from region r imported into region v

Source: Francois & Hall

Import Demand is expressed as a function of industry prices and total expenditure on imports from *i* in country *v:*

(1) $$M_{(i,v),r} = f(P_{(i,v),r}, P_{(i,v),s\neq r}, y_{(i,v)}$$

By differentiating equation (1) we can derive the following equations that represent the cross-price (2) and own-price demand (3) elasticities used for the calculation of import demand:

(2) $$N_{(i,v),(r,s)} = \Theta_{(i,v),s}(E_m + E_s)$$

(3) $N_{(i,v),(r,r)} = \Theta_{(i,v),r}E_m - \sum_{s\,r} \Theta_{(i,v),s}E_s = \Theta_{(i,v),r}E_m - (1 - \Theta_{(i,v),r})E_s$

The internal prices imported into region *n* from region *r* are expressed as:

(4) $$P_{(i,v),r} = \left(1 + t_{(i,v),r}\right)P^*_{i,r} = T_{(i,v),r}P^*_{i,r}$$

Where *Pi*, *r* * is the export price received by exporters *r* on world markets.

The Export Supply as a function of World Price is defined as:

(5) $$X_{i,r} = f(P^*_{i,r})$$

Therefore, from equations (1), (4) and (5) we can derive the following equations:

(6) $$\hat{\mathrm{P}}_{(i,v),r} = \hat{\mathrm{P}}^*_{i,r} + \hat{T}_{(i,v),r}$$

(7) $$\hat{X}_{i,r} = E_{X(i,r)}\hat{\mathrm{P}}^*_{i,r}$$

(8) $$\widehat{M}_{(i,v),r} = N_{(i,v),(r,r)}\hat{\mathrm{P}}_{(i,v),r} + \sum_{s\,r} N_{(i,v),(r,s)}\,\hat{\mathrm{P}}_{(i,v),s}$$

Where ^ symbolizes a proportionate change so that: $\hat{x} = \frac{dx}{x}$

In order to reach at a workable model in terms of world prices we substitute equations (6), (2) and (3) into (8) and sum over import markets, which provides us with the following equation:

(9) $$\widehat{M}_{i,r} = \sum_v N_{(i,v),(r,r)}\left[\hat{P}^*_r + \hat{T}_{(i,v),r}\right] + \sum_v \sum_{s\,r} N_{(i,v),(r,s)}\,[\widehat{\mathrm{P}}^*_s + \hat{T}_{(i,v),s}]$$

By equalizing equation (9) with the modified version of (7) we can reach the global market clearing condition for every export variety. This is the core equation of the GSIM:

(10) $$\widehat{M}_{i,r} = \hat{X}_{i,r}$$

$$E_{X(i,r)}\hat{\mathrm{P}}^*_{i,r} = \sum_v N_{(i,v),(r,r)}\left[\widehat{\mathrm{P}}^*_r + \hat{T}_{(i,v),r}\right] + \sum_v \sum_{s\,r} N_{(i,v),(r,s)}\,[\widehat{\mathrm{P}}^*_s + \hat{T}_{(i,v),s}]$$

The consumer (11) and producer (12) surpluses are calculated as follows:

(11) $$\Delta PS_{(i,r)} = (R^{0}_{(i,r),r} \cdot \widehat{\mathrm{P}}^{*}_{i,r}) \cdot (1 + \frac{E_{X,(i,r)} \cdot \widehat{\mathrm{P}}^{*}_{i,r}}{2})$$

(12) $$\Delta CS_{(i,v)} = (\sum_r R^{0}_{(i,v),r} \cdot T^{0}_{(i,v),r}) \cdot ({}^{1}/_{2}\, E_{M,(i,v)} \widehat{\mathrm{P}}^{2}_{(i,v)} \cdot sign(\widehat{\mathrm{P}}_{(i,v)}) - \widehat{\mathrm{P}}_{(i,v)})$$

Where: $\hat{\mathrm{P}}_{(i,v)} = \sum_r \Theta_{(i,v),r} \hat{\mathrm{P}}^{*}_{r} + \hat{T}_{(i,v),r}$

Finally, Import Demand is defined by equation (13), which provides the Own Trade effect (14) and the Cross Trade effect (15), that represent trade creation because of tariff reduction and diversion from third countries because of lower tariffs respectively.

(13) $$\widehat{M}_{(i,v),r} = N_{(i,v),(r,r)} \hat{T}_{(i,v),r} + \sum_{s\, r} N_{(i,v),(r,s)} \hat{T}_{(i,v),s}$$

(14) $$TC_{(i,v),r} = M_{(i,v),r} \times [N_{(i,v),(r,r)} \hat{T}_{(i,v),r}]$$

(15) $$TD_{(i,v),r} = M_{(i,v),r} \times \sum_{s\, r} N_{(i,v),(r,s)} \hat{T}_{(i,v),s}$$

4.2.3 Methodological Complications

As we have observed, measuring the cost of Somali Piracy is a challenging task because of numerous reasons. First of all methodologically, the GSIM is a Model designed to measure the effect of tariffs on welfare, but in our case the piracy effect is assumed to be a tariff equivalent. Also, tariffs are in most cases levied to produce revenues, which is not the case with Somali Piracy. Revenues indeed exist for the Somali pirates in the form of Ransoms but obviously the countries included in our sample do not benefit from the piracy effect.

Also data-wise challenges have been addressed. Large deviations exist between the multiple stakeholders of the issue, but mainly between government and industry representatives, concerning the costs of piracy. Data limitations are the main issue this study faces but a large number of other previous studies, articles and researches have been taken into consideration to reach valid results. In any case, little research has been pointed either towards this area or at the welfare cost of Somali Piracy.

Furthermore, the number of reported piracy incidents is not accurate. Not all piracy occurrences are being officially reported because of various reasons but mainly due to the fact that shipping companies want to avoid bad publicity and delays derived from investigation procedures (Gwin, 2007). A 2010 paper from the Naval War College suggests that only a 30 to 40 percent of pirate attacks are actually reported

(Elleman, et al., 2010). Also, the exact ransom amounts are often reported inaccurately although nowadays a larger amount of information exists around the matter. Finally, there are many agencies and organizations that are responsible for the collection of data concerning the piracy phenomenon but no single body is accountable for collecting this information in a single, common database, which makes data collection a challenge but a spherical approach to these sources can provide sound information and results.

4.3 Framework and Data Selection

4.3.1 Cost of Somali Piracy per TEU

An estimated 16, 165 container vessels transit through the HRA (Bowden , 2011), which is close to 39% of the total 42,450 vessels that pass through the area each year. Therefore the adjusted Cost of Piracy only for Container Shipping is shown in Table 4. At this point it should be mentioned that the cost of rerouting concerning Container Shipping is a negligible one and therefore it is assumed to be zero. The technical characteristics of Container Ships make them harder to hijack and they can reach speeds that other types of vessels cannot. Consequently, liner-shipping companies prefer to take other precautions for their container vessels rather than rerouting, such as increased speeds, onboard-armed security etc. For example the Danish AP Moller-Maersk rerouted only its “slowest vessels and the ones with the lowest freeboard” (Tibbetts, 2008). Additionally, the military operations are meant to protect all kinds of potentially endangered vessels thus the cost is corrected to apply only to the percentage of container ships. The same applies for the Costs of security equipment and onboard guards, increased wages, counter piracy organizations and prosecutions and imprisonment. Ransoms are calculated based on the percentage of the type of vessels that were hijacked in 2011, which for container vessels was nearly 15% (Greyside Group, 2012)

Table 4 – Costs per year adjusted for Container Shipping

Types of Costs	Costs
Increased Speed	$2.700.000.000
Military Operations	$194.688.000
Security equipment and onboard guards	$179.478.000
Insurance	$247.650.000
Rerouting	$0
Increased Wages	$29.659.500
Ransoms	$9.336.600
Counter Piracy Organizations	$3.239.730
Prosecutions and Imprisonment	$2.499.003
Total	**$3.366.550.833**

With an average containership size of 7,200 TEU at 2011 (MIC, 2011) the number of TEUs transported through the HRA each year is close to 116, 4 million (116,388,000

TEU). Taking into consideration the above data, the Average Cost of Somali Piracy per Container can be calculated. In this case it is 29 USD/TEU per year and for the purposes of this research, this cost is a "tariff equivalent" on container trade (enforced by Somali Piracy).

The 29 USD/TEU are calculated as a tariff equivalent with the following approach: The percentage of the 29 USD over the cost to transfer a TEU between destinations is figured. For example, if it costs 1120 USD to import one TEU to Australia then 29/1120 = 0.03. Subsequently, the Final Bilateral Import Tariffs matrix is created by increasing the initial matrix's values with the percentage that was just calculated but only for the trade routes affected. Therefore, for example, the tariff equivalent for Australia to Japan remains the same in both matrices whereas EU27 to Australia is increased by 0.03; i.e. by 3 percent.

4.3.2 Bilateral Trade Flows, Bilateral Import Tariff Equivalents and Elasticities

The largest share of Global Trade revolves around a relatively small number of countries that handle the main portion of the world's imports and exports. This research will take into account trade flows between China (CHN), the European Union of 27 (EU27), the United States (USA), the United Arab Emirates (UAE), India (IND), Brazil (BRA), Australia (AUS), Japan (JPN), Singapore (SG), Saudi Arabia (SA) and the Rest of the World (ROW). This provides a sample of 36 countries (including 27 EU Members) and the Rest of the World. These countries handle more than 60% of world imports and exports (DG Trade, 2012) and by including the ROW we achieve an even larger coverage. Additionally, maritime trade amounts for 90% of World Trade (OECD, 2012) and container trade of nearly 60% of this amount (Stopford, 2009)[5]. Therefore the bilateral trade values have been multiplied initially with 0.9 to simulate maritime trade and afterwards with 0.6 to simulate container trade. Trade value and import tariff data for the aforementioned countries were collected from the Global Trade Analysis Project (GTAP), which was established in 1993 and it is a global network of researchers and policy makers conducting quantitative analysis of international policy issues. They correspond to 2007 values since it was the only complete dataset with no missing values. Finally, data for the cost of shipping containers between countries (per TEU cost) were collected from the database of the World Bank and correspond to 2005 values so that they are as unaffected as possible from the piracy effect that started escalating around 2006-2008. The shipping costs for the EU27 were calculated as the average cost of the 27 members.

The required composite demand, industry supply and substitution elasticities were not changed and were kept in-line with the elasticities used by J. Francois and H. K. Hall (2003). For a more accurate methodology the corresponding actual elasticities should be derived but in academic literature it is widely accepted that the aforementioned elasticities can be used (Holzner, 2008). Therefore, composite Demand Elasticity is assumed -1.25, Industry Supply Elasticity 1.5 and Substitution Elasticity 5.

[5] We make of the use of the 60% figure that according to M. Stopford refers to general cargo but the majority of which is transported by containers.

Moreover, a basic supposition of this research is that Somali piracy does not affect all trade routes between the aforementioned countries. Even though the radius of attacks has been expanding yearly, it always covers a finite area, outside of which vessels are (theoretically) not affected. For example, a container vessel carrying goods from Japan to the European Union transits through the HRA and thus bears the extra piracy cost. On the other hand if the vessel travels from Japan to Singapore, to Australia or the United States through the Pacific Ocean, it is not affected. Moreover, some routes are partially affected by the piracy phenomenon and we assume an effect that is 50% of the original. In order to simulate this situation in the GSIM, the final bilateral import tariffs remain the same for the unaffected routes but they are increased in the case of a full or partial piracy effect. The routes that are assumed to be fully affected (100%) are shown in red, partially affected (50%) in orange and the routes that are not affected (0%) are shown in green. Out of a total of 121 routes examined, 83 are affected by piracy.

Therefore, the Initial and Final Bilateral Import Tariff matrices are formed as follows:

Table 5 – Initial Bilateral Import Tariffs

	Australia	Brazil	China	EU27	India	Japan	SA	SG	UAE	USA	ROW
Australia	1.000	1.159	1.121	1.050	1.162	1.061	1.047	1.004	1.055	1.050	1.107
Brazil	1.066	1.000	1.116	1.050	1.120	1.078	1.049	1.012	1.069	1.052	1.120
China	1.060	1.202	1.000	1.059	1.139	1.050	1.049	1.003	1.055	1.048	1.129
EU27	1.058	1.194	1.130	1.060	1.163	1.054	1.051	1.003	1.058	1.050	1.133
India	1.065	1.210	1.125	1.061	1.000	1.057	1.050	1.004	1.057	1.051	1.120
Japan	1.059	1.167	1.129	1.052	1.130	1.000	1.048	1.004	1.055	1.047	1.102
SA	1.050	1.186	1.115	1.060	1.000	1.028	1.000	1.000	1.052	1.059	1.150
SG	1.054	1.174	1.121	1.056	1.161	1.038	1.047	1.000	1.050	1.049	1.112
UAE	1.060	1.197	1.122	1.061	1.144	1.041	1.049	1.009	1.000	1.062	1.150
USA	1.058	1.188	1.129	1.058	1.141	1.053	1.049	1.003	1.058	1.000	1.120
ROW	1.057	1.192	1.131	1.060	1.163	1.055	1.051	1.003	1.057	1.049	1.139

Table 6 – Final Bilateral Import Tariffs

	Australia	Brazil	China	EU27	India	Japan	SA	SG	UAE	USA	ROW
Australia	1.000	1.172	1.121	1.080	1.162	1.061	1.091	1.004	1.117	1.050	1.117
Brazil	1.079	1.000	1.155	1.050	1.132	1.093	1.092	1.051	1.132	1.052	1.130
China	1.060	1.215	1.000	1.089	1.151	1.050	1.093	1.003	1.117	1.048	1.139
EU27	1.084	1.194	1.207	1.060	1.186	1.084	1.095	1.082	1.120	1.050	1.143
India	1.065	1.224	1.163	1.091	1.000	1.088	1.094	1.083	1.120	1.076	1.130
Japan	1.059	1.180	1.129	1.082	1.153	1.000	1.092	1.004	1.118	1.047	1.112
SA	1.076	1.213	1.193	1.090	1.000	1.058	1.000	1.079	1.115	1.084	1.160
SG	1.054	1.187	1.121	1.085	1.185	1.038	1.091	1.000	1.113	1.049	1.122
UAE	1.086	1.224	1.200	1.090	1.168	1.071	1.093	1.088	1.000	1.087	1.160
USA	1.058	1.188	1.129	1.058	1.164	1.053	1.093	1.003	1.120	1.000	1.131
ROW	1.070	1.205	1.169	1.075	1.174	1.071	1.073	1.042	1.089	1.062	1.149

4.4 Economic Welfare and Consumer and Producer Surpluses

Economic Welfare refers to two related quantities: Consumer Surplus and Producer Surplus. Consumer Surplus is the excess monetary consumers' gain when they are able to purchase a certain product for a price that is lower than the highest one they were initially willing to pay. For example, if a consumer is willing to buy a product for 1000 USD but when he reaches the store he finds out that the product is sold for 800 USD then he has a surplus of 200 USD. Correspondingly, producer Surplus is the amount that producers gain when they can sell at a price that is higher than the minimum they were initially willing to sell for. For example, if a producer was willing to accept a selling price of 1000 USD for a certain product but consumers are willing to buy for 1200 USD, then if the producer sells at that price, he has a surplus of 200 USD. Both measures are good indicators of consumers' and producers' satisfaction and economic welfare. Total Welfare is portrayed by the summation of producer and consumer surplus. NET Welfare in the GSIM also includes the tariffs' revenues but since the "tariff" of piracy is not aimed at revenue generation and is imposed by "Somali Piracy" (hence none of the countries in our sample is supposed to benefit from it), they are assumed to be zero.

Chapter 5 – The economic effects of Somali Piracy

5.1 Key Findings

After feeding the model with the initial bilateral trade matrix (including intra-country trade) at world prices, the initial matrix of bilateral import tariffs in *ad valorem form*, the final matrix of bilateral import tariffs in *ad valorem* form and the required composite demand, industry supply and substitution elasticities, we run the model. The Model run provides an immediate indication of the effect of Somali Piracy. As expected, losses are observed for all countries in all welfare indicators. Table 7 displays a summary of the effects on welfare. Net welfare is calculated as producer surplus and consumer surplus. All values are in USD.

Table 7 - Summary of Piracy effects on welfare (billion USD)

	Producer surplus	Consumer surplus	Total net welfare effect
Australia	-0.05	-0.6	-0.6
Brazil	-0.4	-0.1	-0.5
China	-3.7	-13.1	-16.8
EU27	-4.2	-7.1	-11.3
India	-1.1	-0.9	-2.0
Japan	-0.8	-1.9	-2.7
S. Arabia	-1.9	-1.5	-3.4
Singapore	-0.3	-2.1	-2.4
UAE	-0.7	-3.4	-4.1
USA	-0.7	-1.1	-1.8
ROW	-17.3	-9.7	-27.0
TOTAL	**-31.1**	**-41.5**	**-72.6**

Immediately, we can observe that the effect of piracy is a great one on the welfare of both producers and consumers of the ten sample countries that we focus on and the rest of the world. In total there is a reduction of 31.1 billion USD in producer surplus and 41.5 billion USD in consumer surplus, which result in an overall net welfare loss of 72.6 billion USD. The countries that are immediately disturbed by Somali Piracy such as India, United Arab Emirates and Saudi Arabia show largely affected in comparison to their trade values. Also, as expected, fundamentally affected are large trade partners such as China and the EU of 27 that experience net welfare losses of 16.8 and 11.3 billion USD respectively. Surprisingly, Brazil, the United States and Australia are also largely affected even though they are not even remotely close to the HRA and relatively very little of their trade transits through that area. They are of course less affected than other countries, most likely because most of their large trade partners (like China) can be reached without transiting through the HRA. Australia though endures losses from its trade with the EU when Brazil and the United States do not.

Additionally, we can observe a general reduction in the quantity of trade affecting mainly countries whose bilateral trade routes pass through the High Risk Area. The reduction ranges from 1.0 percent, between the Rest of the World and Brazil, to 27.4 percent in the trade route between Singapore and the European Union of 27. In total 71 trade routes of the total 83 that endure the piracy threat, experience reductions in the amount of trade. Table 8 summarizes these results. As expected, we see that almost all trade routes that are affected by Somali Piracy are undergoing reductions in the quantity of trade. A notable observation is the increase in trade of majorly affected countries such as India, Saudi Arabia and the United Arab Emirates with the rest of the world. Even though they appear to trade less with the other sample countries they show larger trade quantities with the rest of the world, which is most likely a "reflex" to avoid the losses from Somali piracy.

Table 8 - Percentage change in the quantity of trade (exporter to the vertical axis)

	AUS	BRA	CHN	EU27	IND	JPN	SA	SG	UAE	USA	ROW
AUS	0.0	-4.8	9.3	-12.8	2.5	2.5	-8.7	11.4	-12.1	0.7	-2.6
BRA	-1.9	0.0	-6.3	3.0	-1.1	-2.9	-6.9	-6.4	-10.0	2.4	-0.9
CHN	5.1	-1.9	0.0	-10.0	0.0	5.1	-5.9	14.0	-9.4	3.3	0.1
EU27	-9.2	1.5	-24.3	1.8	-6.9	-11.3	-8.0	-27.4	-11.5	1.3	-1.9
IND	8.6	1.6	-1.6	-6.4	0.0	-5.7	-2.3	-21.4	-5.6	-5.0	3.6
JPN	3.2	-4.0	10.0	-12.1	-7.1	0.0	-7.9	12.1	-11.4	1.4	-1.9
SA	-2.8	-3.2	-18.0	-5.7	9.3	-5.2	0.0	-20.7	-5.0	-4.1	4.4
SG	3.9	-3.3	10.7	-11.3	-6.1	3.9	-7.2	0.0	-10.8	2.1	-1.2
UAE	-3.3	-3.7	-18.4	-6.2	-1.3	-5.6	-2.1	-21.0	0.0	-4.6	3.9
USA	2.8	1.3	9.6	1.6	-7.4	2.8	-8.3	11.7	-11.7	0.0	-2.3
ROW	0.0	-1.0	-4.1	-2.1	1.0	-1.1	5.4	-4.6	6.4	-1.7	1.1

Accordingly, the value of trade (in USD) between countries whose trade routes transit through the HRA is reduced up to an amount of approximately 16.4 billion USD (between the Rest of the World and the European Union of 27), whereas the value of trade between unaffected countries is increased up to approximately 24.8 billion USD in the intra European Union trade. The total loss in trade value is approximately 80 billion US Dollars. Table 9 presents these results. The European Union widely reduces its trade with its trade partners to the east and the rest of the world and only shows slight increases in its trade with the United States and Brazil. As aforementioned there is an expected turn in intra-EU trade as a result of the situation in the Gulf of Aden. Also, China is turning to the Japanese and US markets but in general suffers heavy losses especially from the reduction in the trade with the EU. Finally, we again detect a general turn of the sample countries that are near the HRA towards trade with the rest of the world.

Table 9 - Change in the value of Trade (billion USD, exporter to the vertical axis)*

	AUS	BRA	CHN	EU27	IND	JPN	SA	SG	UAE	USA	ROW
AUS	0.0	-0.0	1.3	-1.1	0.1	0.4	-0.08	0.1	-0.2	0.0	-0.7
BRA	-0.5	0.0	-0.7	0.5	0.0	-0.1	-0.07	0.0	-0.08	0.3	-0.5
CHN	0.5	-0.2	0.0	-15.9	-0.1	2.8	-0.3	1.0	-0.9	4.5	-1.0
EU27	-1.6	0.2	-14.4	24.8	-1.4	-3.7	-1.3	-2.3	-2.1	1.9	-10.7
IND	0.0	0.0	-0.2	-1.5	0.0	-0.2	-0.06	-0.3	-0.5	-0.8	0.7
JPN	0.2	-0.1	7.1	-6.6	-0.3	0.0	-0.3	0.7	-0.5	0.9	-3.1
SA	0.0	-0.0	-1.7	-1.4	0.9	-1.2	0.0	-1.0	-0.2	-1.2	1.2
SG	0.1	-0.0	0.9	-1.1	-0.2	0.1	-0.0	0.0	-0.1	0.1	-0.7
UAE	0.0	-0.0	-0.2	-0.2	-0.1	-1.0	-0.0	-0.6	0.0	-0.05	0.6
USA	0.3	0.1	3.6	1.8	-0.7	0.9	-0.5	1.0	-0.7	0.0	-7.8
ROW	-0.2	-0.5	-12.6	-16.4	0.2	-2.4	0.6	-1.6	1.0	-13.2	1.8

* Any value below 0.05 is rounded off to 0.0.

Moreover, consumer prices are affected and show overall increasing trends as we can see in Table 10. As we hypothesized in the previous chapters, the cost of Somali piracy is ultimately levied onto the markets' consumers in the for of increased market prices. As expected, all countries display price increases, the largest one being in the United Arab Emirates with 4.61 percent and the smallest one being 0.10 percent in the United States. The countries inside the HRA such as the United Arab Emirates and Saudi Arabia face relatively large price increases because of the lack of "alternatives" since all their trade is inevitably harassed by Somali piracy. Overall, prices are increased with an average of 1.44 percent. Additionally, we can observe that even though China and the EU are both affected, China shows higher increase in prices. This is most likely the result of the intra EU trade that compensates for the loss of trade that the Somali piracy creates. Again it is notable that even countries such as the United States, Brazil and Australia, which are relatively slightly affected by Somali piracy, endure higher prices up to 0.6 percent.

Similarly, also in Table 10, we can observe reductions in the Output of the sample countries. Here, there is an anticipated overall decreasing trend primarily in India, Saudi Arabia and the United Arab Emirates whereas Australia, the United States, the EU27 and Japan appear less affected. This most likely occurs because the trade of Australia, the United States and Japan are less disturbed by piracy and the EU has a large intra-trade that compensates for the problems that the Somali piracy imposes. The average Output decrease is approximately 0.91 percent.

Table 10 - Percentage Change in Consumer Prices and Output

	Percentage Change in Overall Consumer Prices	Percentage Change in Output
Australia	0.6%	-0.1%
Brazil	0.2%	-0.6%
China	2.4%	-0.9%
EU27	0.3%	-0.3%
India	0.6%	-1.9%
Japan	0.6%	-0.3%
Saudi Arabia	3.2%	-2.1%
Singapore	2.9%	-0.5%
UAE	4.6%	-2.0%
USA	0.1%	-0.2%
ROW	0.4%	-1.2%

In the case that intra EU trade is not taken into consideration, we observe a large decrease in both the producer surplus and consumer surplus indicators. Specifically, the EU now experiences a Producer Surplus reduction of 6.7 billion USD and a Consumer Surplus reduction of approximately 10.4 billion USD comparing to 4.2 and 7.1 billion USD reductions respectively, with intra-EU trade. The Producers' losses are most likely the result of the unstrengthening of their selling power since they appear not to trade at all with their European partner countries. Consumers on the other hand, also endure losses because of their larger dependence on world trade.

The total net welfare effect is nearly the same comparing to the data that take EU trade into account. From the previous loss in net welfare of approximately 72.6 billion USD we now observe a loss of nearly 72.7 billion USD. In general the rest of the sample countries and especially the rest of the world seem to benefit from the absence of intra-EU trade. The rest of the world has a gain of nearly 5.0 billion USD comparing to the previous values.

The same can be observed for the effect on prices and output. The EU now experiences an increase in prices of approximately 1 percent when previously the increase was less than 0.3 percent. This is most likely the effect of the larger dependence on imports since EU countries are assumed not to have bilateral trade. Also, the EU output is now decreased by 1.2 percent when before it was decreased by 0.3.

5.2 Combating Somali Piracy

At this point a hypothetical scenario will be introduced where we assume that Piracy is combatted successfully, leading to a significant reduction in the area where trade flows are affected. For the types of cost mentioned in Table 3 before, this means that some are reduced but others are not. Particularly, the successful combating of piracy

would lead to a smaller HRA. Therefore, The costs for increased speeds would be lower since vessels would have to speed up for a smaller amount of time. The same applies for the cost of security equipment and guards as well as military operations since fewer vessels would require protection. As a result less military vessels would be needed and they would have to patrol a smaller area. Insurance premiums would return to normal for vessels that could avoid transiting through the HRA and shipping companies would have to pay less in bonus wages since more vessels would transit for fewer days through the HRA or not at all. On the other hand, a possible complication could surface: Pirates might increase the ransom amounts to compensate for the fewer successful attacks, which as mentioned in chapter 3, has happened before. Table 11 shows the new cost of Somali piracy on container shipping that amount to a 30 percent decrease in costs. Ransoms are assumed to be increased by 30 percent.

Table 11 – Costs per year adjusted for Container Shipping (30% Scenario)

Types of Costs	Costs
Increased Speed	$1.890.000.000
Military Operations	$136.281.600
Security equipment and onboard guards	$125.634.600
Insurance	$173.355.000
Rerouting	$0
Increased Wages	$20.761.650
Ransoms	$12.137.580
Counter Piracy Organizations	$3.239.730
Prosecutions and Imprisonment	$2.499.003
Total	**$2.363.909.163**

Therefore, this cost is spread over 116, 4 million TEUs annually resulting in a yearly cost per TEU of 20.3 USD (when a route is 100% affected. 10.2 USD/TEU when it is 50% and 0 when it is 0%) In addition, our affected routes are slightly altered and the new tariff equivalent tables are as shown in Table 12 and Table 13.

Table 12 – Initial Bilateral Import Tariffs (30% Scenario)

	Australia	Brazil	China	EU27	India	Japan	SA	SG	UAE	USA	ROW
Australia	1.000	1.172	1.121	1.080	1.162	1.061	1.091	1.004	1.117	1.050	1.117
Brazil	1.079	1.000	1.155	1.050	1.132	1.093	1.092	1.051	1.132	1.052	1.130
China	1.060	1.215	1.000	1.089	1.151	1.050	1.093	1.003	1.117	1.048	1.139
EU27	1.084	1.194	1.207	1.060	1.186	1.084	1.095	1.082	1.120	1.050	1.143
India	1.065	1.224	1.163	1.091	1.000	1.088	1.094	1.083	1.120	1.076	1.130
Japan	1.059	1.180	1.129	1.082	1.153	1.000	1.092	1.004	1.118	1.047	1.112
SA	1.076	1.213	1.193	1.090	1.000	1.058	1.000	1.079	1.115	1.084	1.160
SG	1.054	1.187	1.121	1.085	1.185	1.038	1.091	1.000	1.113	1.049	1.122
UAE	1.086	1.224	1.200	1.090	1.168	1.071	1.093	1.088	1.000	1.087	1.160
USA	1.058	1.188	1.129	1.058	1.164	1.053	1.093	1.003	1.120	1.000	1.131
ROW	1.070	1.205	1.169	1.075	1.174	1.071	1.073	1.042	1.089	1.062	1.149

Table 13 – Final Bilateral Import Tariffs (30% Scenario)

	Australia	Brazil	China	EU27	India	Japan	SA	SG	UAE	USA	ROW
Australia	1.000	1.168	1.121	1.071	1.162	1.061	1.062	1.004	1.055	1.050	1.114
Brazil	1.075	1.000	1.143	1.050	1.128	1.089	1.079	1.040	1.113	1.052	1.127
China	1.060	1.211	1.000	1.080	1.139	1.050	1.064	1.003	1.055	1.048	1.136
EU27	1.076	1.194	1.184	1.060	1.179	1.075	1.081	1.058	1.101	1.050	1.140
India	1.065	1.220	1.125	1.082	1.000	1.057	1.065	1.004	1.079	1.060	1.127
Japan	1.059	1.176	1.129	1.073	1.130	1.000	1.063	1.004	1.077	1.047	1.109
SAS	1.059	1.205	1.142	1.081	1.000	1.039	1.000	1.028	1.096	1.067	1.157
SG	1.054	1.183	1.121	1.076	1.161	1.038	1.063	1.000	1.072	1.049	1.119
UAE	1.060	1.216	1.122	1.081	1.152	1.051	1.080	1.037	1.000	1.071	1.157
USA	1.058	1.188	1.129	1.058	1.149	1.053	1.065	1.003	1.079	1.000	1.127
ROW	1.066	1.201	1.158	1.070	1.171	1.066	1.066	1.031	1.079	1.058	1.146

As expected, the first observation we can make from the results on welfare of the new model run (shown in Table 14) is that there are increases in all indicators of economic welfare. Specifically, when previously the loss was near 72.6 billion US Dollars now the world experiences gains of nearly 25 million USD. China now has unbothered trade with India and the United Arab Emirates and therefore appears largely benefited from this new situation. The European trade does not benefit much since it still passes through the Gulf of Aden and through the epicenter of piracy activities. One would expect that India would be much better off by this development but its trade with the EU still undergoes issues therefore its benefits are limited. Finally the United Arab Emirates are experiencing large welfare gains mainly because of their unrestricted trade with China.

Table 14 - Summary of Piracy effects on welfare, 30 % Scenario (billion USD)*

	Producer surplus	Consumer surplus	Total net welfare effect
Australia	0.0	0.2	0.2
Brazil	0.2	0.0	0.2
China	1.4	4,4	5.8
EU27	0.9	2.1	3.0
India	0.7	0.5	1.2
Japan	0.3	0.8	1.1
S. Arabia	1.1	0.7	1.8
Singapore	0.1	0.9	1,0
UAE	0.4	1.9	2.3
USA	0.3	0.6	0.9
ROW	4.8	2.4	7.2
TOTAL	**10.2**	**14.5**	**24.7**

* Any value below 0.05 is rounded off to 0.0

Furthermore, the quantity of trade is increased in most trade routes with rates that range from 0.1 to 28.2 percent (Table 15). As anticipated, trade appears to be increased largely in trade routes that were previously 100% affected by piracy and

are now completely unrestricted. On the other hand intra European Union trade seems to drop most likely because of the increase in trade with China and Singapore. We can observe that even though piracy is still an issue for European trade, its lower effect provides ground for a turn towards the eastern markets.

Table 15 - Percentage change in the quantity of trade, 30% Scenario (billion USD exporter to the vertical axis)

	AUS	BRA	CHN	EU27	IND	JPN	SA	SG	UAE	USA	ROW
AUS	0.0	1.3	-3.2	3.6	-1.6	-1.2	7.5	-4.7	18.8	-0.4	0.7
BRA	0.6	0.0	1.6	-0.8	-0.3	0.6	0.2	0.6	-1.2	-0.7	0.4
CHN	-1.7	0.4	0.0	2.7	2.7	-2.0	6.7	-5.6	18.0	-1.3	-0.2
EU27	2.8	-0.3	6.5	-0.5	1.4	3.1	0.5	6.3	-0.8	-0.4	0.7
IND	-4.7	-2.6	9.7	-0.3	0.0	9.0	3.7	28.2	5.2	3.3	-3.2
JPN	-1.0	1.2	-3.3	3.4	8.4	0.0	7.4	-4.9	8.8	-0.6	0.6
SA	3.3	-0.8	14.3	-0.1	-5.3	4.5	0.0	15.6	-4.5	3.4	-3.0
SG	-1.4	0.8	-3.7	3.1	7.8	-1.7	7.0	0.0	8.6	-0.9	0.2
UAE	7.3	-0.9	25.5	-0.3	1.1	4.2	-3.4	15.2	0.0	3.3	-3.2
USA	-0.9	-0.4	-3.2	-0.6	4.9	-1.2	7.4	-4.8	8.9	0.0	0.6
ROW	0.1	0.5	1.0	0.7	-0.9	0.1	-3.3	0.2	-5.8	0.5	-0.1

Additionally, the value of trade is now increased by approximately 26 billion USD compared to the initial 80 billion USD losses. As aforementioned, intra European Union trade is reduced by almost 7 billion USD a result of the turn of Europe to the east and especially to China. The United Arab Emirates and China appear largely benefited with an increase of 1.7 billion USD but that is not the case for trade between Europe and the UAE that now drops by almost 150 million USD, possibly because of the aforementioned unrestricted trade with China. The turn of Europe towards the eastern markets of Japan, China and India is a noteworthy observation considering that Europe is the only trade partner in our sample that continues to be disturbed in a large extent by Somali Piracy. We therefore realize that even a small decrease of 30 percent in the cost of piracy can lead to larger trade extroversion especially between large partners such as the EU, China, Australia and India. This can have advantageous effects to the markets' customers since they are experiencing lower prices as we can see in Table 16.

Prices now show decreasing trends with an average decrease of approximately 0.6 percent comparing to the initial average increase of 1.44 percent. Prices in countries whose trade was severely impaired by piracy such as Saudi Arabia and the UAE show the largest decrease in prices as a result of the smaller piracy effect. The countries that were less affected show lesser decreases. The European Union shows a very small decrease in the level of prices relatively to its trade size, something that is probably caused by its intra trade and the level of disturbance from piracy, which still largely affects it. Finally, the output is now increased with an average 0.5 percent compared to the previous average decrease of 0.91 percent. Again we see a general output increase in countries previously largely affected by piracy such as India, Saudi

Arabia and the UAE. Surprisingly, all the other countries in our sample have minor increases in output. A larger drop than 30 percent in the cost of piracy is probably needed for more substantial results. Nevertheless, we can conclude both trade and welfare would have substantial benefits even from a slight decrease in the cost of Somali piracy.

Table 16 - Percentage Change in Consumer Prices and Output, 50% Scenario

	Percentage Change in Overall Consumer Prices	Percentage Change in Output
Australia	-0.2%	0.1%
Brazil	-0.05%	0.2%
China	-0.8%	0.3%
EU27	-0.08%	0.1%
India	-0.4%	1.2%
Japan	-0.3%	0.1%
Saudi Arabia	-1.4%	1.2%
Singapore	-1.2%	0.2%
UAE	-2.4%	1.2%
USA	-0.05%	0.1%
ROW	-0.1%	0.3%

Chapter 6 - Conclusions and areas for further research

Piracy off the coast of Somalia has been threatening international shipping for many years but only in the recent years has the international community turned its eye on the matter with the gravity it deserves. In the meantime pirates have grown more sophisticated, better equipped and are attacking larger vessels further away from the Somali coast. Shipping companies, governments and international organizations have started using countermeasures to repel and put an end to pirate attacks since the Gulf of Aden is a major corridor of international shipping and especially for traffic between Europe and Asia.

Moreover as we have observed, piracy creates and levies on shipping in general and in container shipping specifically, additional costs. These costs consist of increased insurance premiums, higher fuel costs due to increased speeds, expenses for armed onboard protection, costs for organized military or non military action by the EU, NATO and individual countries, ransom payments and increased crew wages. We have divided these costs into two major categories: Costs for the Shipping industry and Governmental Costs. They were calculated to be close to 3.4 billion USD for container shipping in 2011 and consequently they add an extra cost per TEU transported, which was estimated to be approximately 29 USD.

We adopted a partial equilibrium approach and by treating the 29 USD per TEU as a tariff equivalent we applied the Global Simulation Model and figured the effects that this tariff equivalent of Somali piracy has on global container shipping trade. Our focus sample of 10 major world trade partners and the rest of the world showed that Somali Piracy has immediate consequences on international trade and economic welfare. Net welfare is decreased by nearly 73 billion US Dollars while the value of trade is decreased by approximately 80 billion US Dollars. Moreover, we witnessed increases in consumer prices of up to 4.6 percent while the countries' output is decreased up to 2.1 percent (in Saudi Arabia). We also observed the different effects that piracy has on each country or group of countries. Intra-European trade appears to rise drastically as a result of the existence of piracy in the trade route with is major partners to the east. The countries that are around the HRA turn towards the rest of the word since Somali Piracy hassles trade with their large trade partners. As expected countries such as the United States, Brazil and Australia are less affected since they can trade with Europe and China unbothered (Australia only with the US and Brazil). Nevertheless it is shocking to realize that even under these circumstances these countries still face welfare losses of up to 1.8 billion US Dollars (in the United States).

Furthermore, by performing a hypothetical 30 percent decrease in the costs of piracy we derived a lower cost per TEU of 20 US Dollars. This reduction has revealed welfare gains of up to nearly 25 billion US Dollars and a trade value increase of 26 billion US Dollars. Additionally, this reduction lead to up to 2.4 percent decrease in consumer prices and up to 1.2 percent increase in output. The countries whose welfare appears to benefit more from this decrease in the cost of piracy are the ones

that are around the HRA. Moreover, trade between Europe and its partners to the east such as China and Japan shows great signs of recovery. Finally, prices in countries such as the United Arab Emirates and Saudi Arabia show the largest decreasing trends.

Given the gravity of the situation this thesis is of great importance and it assists in better understanding the cost factors and economic impact of the Somali piracy phenomenon. Following this research, it would be interesting to investigate a few issues further. Additional studies should be conducted to define the extent of the cost and damage of a potential environmental disaster that unfortunately is not a farfetched scenario due to the severity of the attacks and the use of live ammunition against vessels that carry sensitive cargo such as crude oil and chemicals. Moreover, a valuable approach to the issue would be a general equilibrium methodology in order to derive more accurate and useful results about welfare and trade. Finally, a cost-benefit analysis of the Somali pirate would be an interesting approach to the issue in order to comprehend the incentives and motives behind piracy in Somalia.

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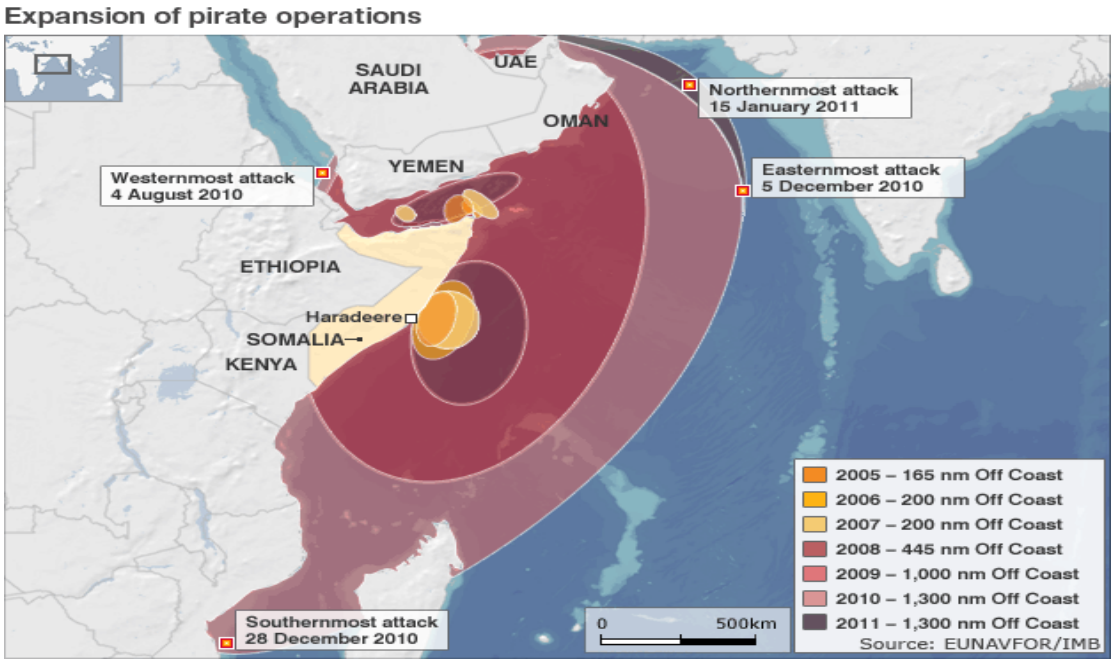
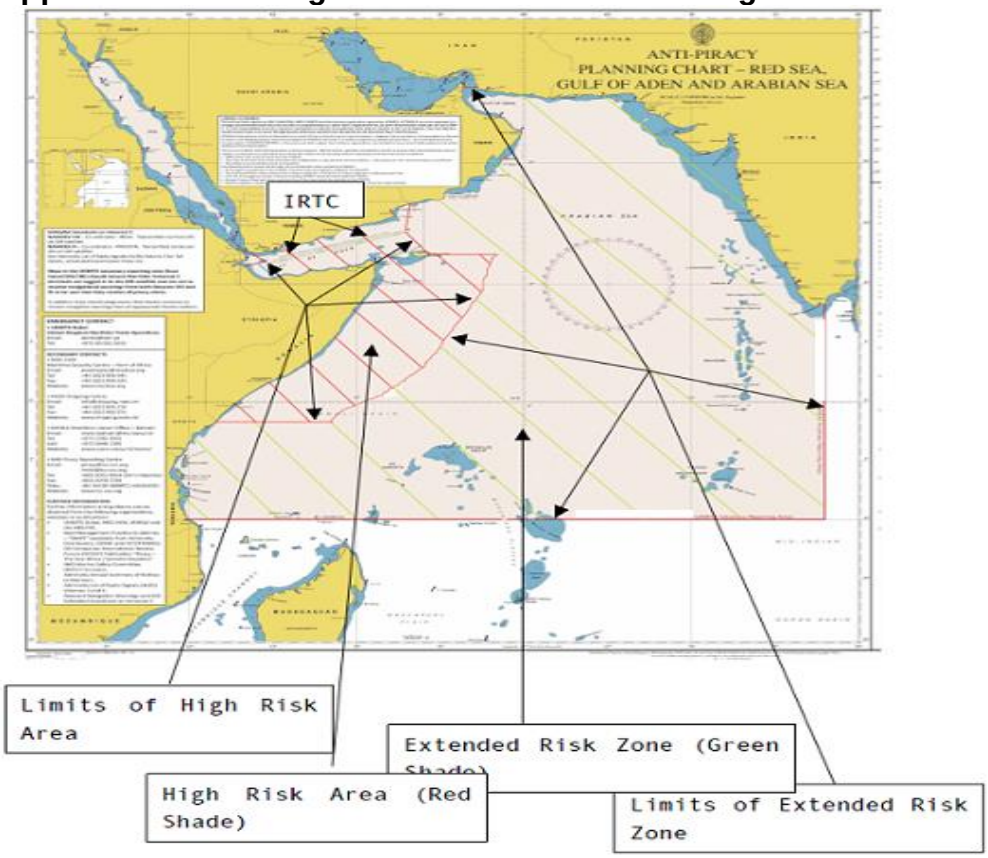
Appendices

Appendix 1 – Expansion of Pirate Operations in the Gulf of Aden



Source: EU NAVFOR

Appendix 2 – The segments of the HRA according to the IBF



Source: IBF

Appendix 3 – Ransoms Paid in 2011

Ship Name	Hijacked	Days Held	Ransom(million USD)
Motivator	7/2010	196	4,97
izumi	10/2010	141	4,50
EMZ River	12/2010	64	3,00
Rak Afrikana	4/2010	332	1,20
York	10/2010	137	4,50
Hannibal II	11/2010	120	2,00
Jahan Moni	12/2010	99	4,00
Irene SL	2/2011	57	13,50
Thor Nexus	12/2010	108	5,00
Beluga Nomination	1/2011	81	5,00
Asphalt Venture	9/2010	199	3,60
Renuar	12/2010	133	6,00
Jih Chun Tsai No. 68	3/2010	397	8,00
Sinar Kudus	3/2010	46	4,50
Yuan Xiang	11/2010	170	3,60
Vega 5	12/2010	134	5,00
Khaled Muhieddine K	1/2011	125	2,50
Zirku	3/2011	75	12,00
Suez	8/2010	315	2,10
Susan K	4/2011	69	5,70
Jubba XX	7/2011	11	0,20
Sinin	2/2011	182	4,00
Eagle	1/2011	214	4,00
Polar	10/2010	300	7,70
Panama	12/2010	270	7,00
SY ING	2/2011	195	3,00
Hoang Son Sun	1/2011	243	4,50
Dover	2/2011	214	3,50
Blida	1/2011	306	3,50
Rosalia D' Amato	4/2011	218	6,00
Gemini	4/2011	214	4,05
Savina Caylyn	2/2011	316	11,50

Source: Oceans beyond Piracy