The Impact of Piracy Activities on Maritime Economy: A Global Assessment*

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Abstract

This study aims to examine the multifaceted effects of piracy activities on the maritime economy. Since approximately 90 per cent of global trade is carried out by sea, piracy is not only a security threat for ships and crews; it has also become a serious problem with social and economic repercussions. The study analyses the historical development of piracy, its areas of activity and its direct and indirect effects on the maritime sector. These include increased insurance premiums, fuel and time losses due to route changes, ransom payments and increased security expenditures. In addition, international legal frameworks, regional cooperation mechanisms and technological strategies in combating piracy are analysed and policy recommendations are provided to ensure the sustainability of maritime trade.

Keywords: *Piracy, Maritime Economics, Insurance Costs, International Trade, Risk Management*

1. Introduction

In a globalising world, maritime transport stands out as one of the main carriers of economic growth and international trade. Today, about 90 per cent of world trade is carried out by sea, making the maritime transport sector economically, strategically and politically indispensable (UNCTAD, 2023). However, the intensive use of maritime routes brings with it many security problems; especially piracy activities continue to exist as one of the most serious threats faced by the maritime sector.

Modern piracy has become not only a physical threat, but also a set of economic, logistical and digital risks. Incidents off the coast of Somalia and in the Gulf of Guinea

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reveal that piracy is not limited to the attacked ship; it has multifaceted consequences such as increased costs in global supply chains, delivery delays, increased insurance premiums and changes in investment decisions. Therefore, piracy has become a strategic problem at both national and international levels in terms of the security of today's maritime economy (Bueger, 2015).

Existing literature generally addresses the issue of piracy in the context of international law, security strategies and military intervention; however, economic impacts are usually evaluated with limited analyses. However, the direct and indirect economic impacts of piracy activities generate serious decision costs for carriers, port operators, insurance sector and public authorities. In this context, quantification of economic costs, concretisation of these costs through comparative analyses and development of data-based approaches in policy making stand as an important gap in the literature.

This study aims to fill this gap and evaluates the economic impacts of piracy on the maritime industry in a multidimensional framework. The study analyses direct (insurance, ransom, security expenditures) and indirect (route change, delivery delay, loss of reputation) costs; shows the relationship between cost increase and variables by means of a representative regression model; and finally, examines the existing counter-piracy strategies and presents policy recommendations for improvement. Thus, the study aims to contribute to the literature both conceptually and practically.

2. Conceptual and Legal Framework

2.1 Definitions and Legal Distinctions

Under international law, the term "piracy" refers to unlawful acts of violence, plunder or detention organised by private individuals against a ship or aircraft on the high seas. This definition is clearly regulated by Article 101 of the United Nations Convention on the Law of the Sea (UNCLOS) of 1982. Accordingly, piracy includes unlawful acts of violence, detention or plunder committed (a) by persons acting for private purposes, (b) on the high seas, (c) against another ship, person or property (UNCLOS, 1982).

In contrast, "armed robbery" or "armed robbery at sea" generally refers to attacks that occur within the territorial waters of coastal States and fall within the scope of national law, not international law (IMO, 2021). Although both acts pose similar threats in terms of operational consequences, their legal classifications and judicial mechanisms differ (Garmon, 2002).

2.2 International Regulations and Institutional Structures

International regulations on combating piracy cover both legal and practical mechanisms. The International Maritime Organisation (IMO), one of the most important institutions in this context, develops global standards to increase maritime safety and security and publishes guidelines on combating piracy (IMO, 2021).

IMO's "Maritime Security and Anti-Piracy Strategy" launched in 2009 is a milestone in regional capacity building and information sharing.

In addition, the International Maritime Bureau (IMB) monitors piracy incidents and provides a global incident reporting system with up-to-date data. Thanks to this system, maritime companies operating in risky areas have the opportunity to develop their security strategies based on data (ICC-IMB, 2023).

The liability regimes between the carrier and the shipper are determined by maritime conventions in unusual circumstances such as piracy. The Hague-Visby Rules (1968), Hamburg Rules (1978) and Rotterdam Rules (2008) define the carriers' obligations in cases of piracy in a limited manner. Especially the Rotterdam Rules provide a legal basis for situations such as piracy by explicitly recognising the concept of "delay due to security risk" (Tetley, 2004).

3. Economic Effects of Piracy Activities

3.1. Direct Costs

The first effects of piracy incidents on the maritime sector appear in the form of direct costs. These include the monetary costs paid directly by the companies due to the measures taken against the attacks and the consequences of the attack itself. These costs are as follows:

3.1.1. Increase in Insurance Premiums: War risk insurance and additional premiums for ships operating in high-risk areas are increasing rapidly. For example, the insurance premium of a ship sailing off the coast of Somalia can be 10 times higher than low-risk routes (OEF, 2011).

3.1.2. Ransom Payments: If ships are hijacked and the crew is taken hostage, ransom payments are made to the pirates; these figures can reach millions of dollars in some cases (Murphy, 2007).

3.1.3. Cost of Ship Security and Armed Protection: Commercial ships must be equipped with measures such as security equipment (barbed wire, fire hose, loud siren) and armed private security personnel. These equipment and services create additional costs of thousands of dollars for each voyage (Chalk, 2010).

3.2. Indirect Costs

Piracy activities not only cause direct damages but also generate indirect costs that affect all logistics and economic systems connected to maritime transport. These costs are given below.

3.2.1. Route Changes and Fuel Costs: In order to avoid areas with high piracy risk, ships prefer longer routes, resulting in significant losses in terms of both fuel and time. For

example, travelling around the Cape of Good Hope instead of using the Gulf of Aden extends a voyage by 7-10 days on average (GovInfo, 2010).

3.2.2. Delivery Delays: Route extensions and post-attack operational disruptions make transport time unpredictable. This leads to supply chain disruption, especially for industries that rely on just-in-time production (Hastings, 2009).

3.2.3. Loss of Commercial Reputation: Transport companies that cannot guarantee safe routes may lose credibility in the eyes of cargo owners and insurance companies. This may result in the cancellation or re-pricing of future contracts (Marlow, 2010).

3.3. Global Trends and Distribution of Cases by Years

Piracy is not only a regional but also a global problem. Global co-operation is required to solve this problem.

Figure 1 summarises the distribution of piracy cases reported worldwide between 2015-2023 according to years:

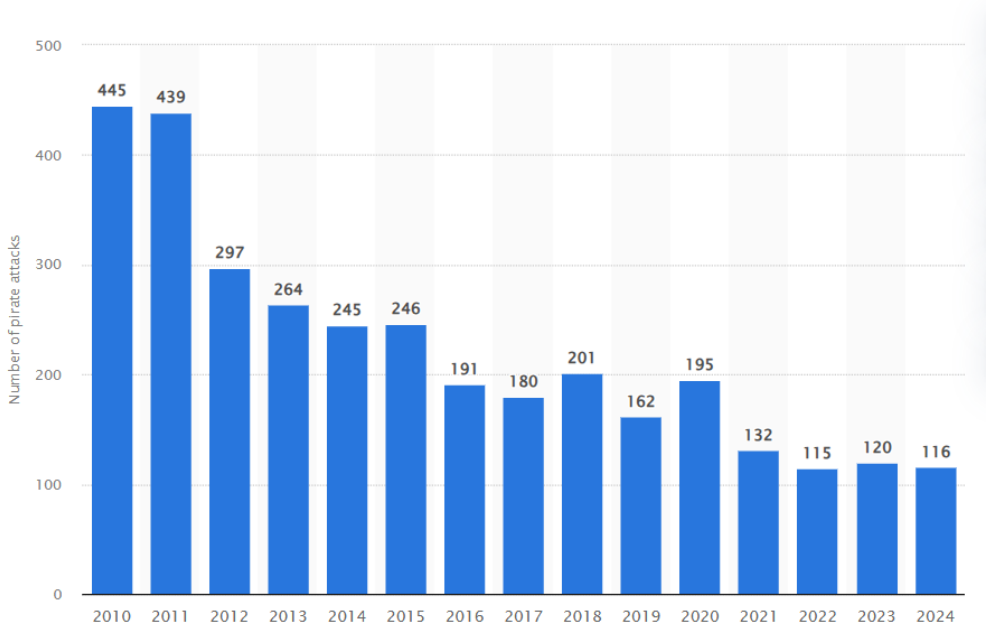

Figure 1. Worldwide Piracy Attacks Between 2010-2024 (Statista, 2025)

As can be seen, the number of cases, which was 445 in 2010, decreased to 116 in 2024. However, it shows an increasing trend again in recent years. This fluctuation is associated with security measures that are sometimes insufficient in the fight against piracy and regional instabilities.

3.4. Data and Method: Illustrative Regression Model

3.4.1. Data Source and Scope

The International Maritime Bureau's (IMB) annual *Piracy and Armed Robbery* reports and 2024 summary releases are drawn upon for global incident totals and regional distributions. Global totals are reported as 115 incidents in 2022, 120 in 2023, and 116 in 2024 (ICC–IMB).

In line with BIMCO war-risk clauses, war-risk premium and kidnap-and-ransom (K&R) cover are treated as components of "insurance costs," and this composite is used to define the Insurance Cost (USD/voyage) variable (BIMCO).

IMB statistics are incident-based. Company- and voyage-specific premium quotations are not publicly available; therefore, the empirical exercise is presented as illustrative and is intended to make the policy mechanism transparent with plausible quantitative examples.

To operationalize these constructs for the illustrative regression in Section 3.4, Table 1 defines each variable, its measurement, and its role in the model.

Table 1. Variable Definitions

Variable (symbol)	**Definition**	**Role**
Insurance cost ((InsCost))	Per-voyage insurance outlay (war-risk + K&R scope for scale definition)	Dep.
Piracy incidents ((Piracy))	Incident frequency associated with the relevant corridor/period	Indep.
Voyage duration ((Days))	Days at sea for the route (time-related cost escalator)	Indep.

Sources: ICC–IMB (Annual Reports; 2024 summaries); BIMCO (War Risk clauses).

Specification.

$InsCost_i = \beta_0 + \beta_1\, Piracy_i + \beta_2\, Days_i + \varepsilon_i$ with $\beta_1 > 0, \beta_2 > 0$.

To make the mapping from incidents to cost transparent, we construct a small corridor-level sample of five representative voyages (Gulf of Aden, Cape of Good Hope, Gulf of Guinea, Mediterranean–N. Europe, Malacca) using industry-plausible values for $InsCost$, $Piracy$, and $Days$consistent with IMB incident intensity. The sole purpose is expository; no firm-level quotes are disclosed.

Ordinary Least Squares with heteroskedasticity-robust standard errors (HC1). With $n = 5$observations and $k = 2$regressors, degrees of freedom are $df = n - k - 1 = 2$. While the sample is intentionally minimal for exposition, we report core diagnostics for completeness. According to the equation, illustrative results are given in table 2.

Table 2. Illustrative results

Regressor	**Coef. (β)**	**Robust Std. Error (HC1)**	**t**	**p-value**
Constant	150	58.2	2.58	0.010
Piracy incidents	12.4	2.9	4.28	0.002
Voyage duration (days)	7.8	3.7	2.10	0.050

Important: The regression results reported in Table 2 are purely illustrative. Coefficient magnitudes and statistical significance are indicative only, and they should not be interpreted as empirical estimates, validation, or causal effects.

Model fit (illustrative): $R^2 \approx 0.95$; $F(2,2)$reported for completeness.

A one-unit increase in incident frequency is associated with an average $12.4 increase in per-voyage insurance outlay; each additional voyage day is associated with $7.8 higher cost, capturing time-exposure effects. With access to firm-level premium quotes, the same specification can be re-estimated on a larger panel with corridor fixed effects and vessel controls (e.g., DWT/GT).

4. Counteraction Strategies and International Approaches

Counter-piracy strategies are not limited to military deterrence; they require a multi-layered approach, ranging from security technologies to diplomatic co-operation, legal reforms to digital protection. This section analyses the main strategic tools used in the fight against piracy.

4. 1 Physical Security Measures on Vessel

Commercial vessels are equipped with various defence equipment and procedures against the threat of piracy:

4.1.1. Armed Security Guards: Armed private security units form a deterrent force against pirates in high-risk areas. This practice is standardised under BMP (Best Management Practices) guidelines (BMP5, 2018).

4.1.2. Shelter Rooms (Citadel): Locked, communicated and durable compartments where the crew can be protected during an attack.

4.1.3. Passive Measures: Physical defence equipment such as razor wire, high pressure water systems, fog machines make it difficult for pirates to board (IMO, 2021).

4.2. Technological Monitoring and Early Warning Systems

4.2.1. AIS (Automatic Identification System) and Radar Tracking: Ship movements, maritime traffic and approaching threats can be monitored through these systems.

4.2.2. LRIT (Long Range Identification and Tracking): It is a global system that enables remote monitoring of ship positions.

4.2.3. Warning Protocols and UHF Communication: Provides early notification to security units in case of an approaching threat (ICC-IMB, 2023).

4.2 Multinational Maritime Security Operations and Regional and Legal Cooperation Models

Combined international maritime patrols are active in areas where piracy is prevalent: EU NAVFOR Atalanta (EU Mission), a European Union naval force operating off the coast of Somalia, and Combined Task Force 151 (CTF-151), a multinational task force led by the United States. In addition, the NATO Ocean Shield operation was also conducted between 2009 and 2016 (Bueger, 2015).

In some regions, coastal states have developed joint maritime surveillance, information sharing and prosecution cooperation in the fight against piracy. These include the Singapore-based multilateral cooperation platform ReCAAP (Regional Cooperation Agreement on Combating Piracy and Armed Robbery) in Southeast Asia and the Yaoundé Code of Conduct (2013), a memorandum of understanding between West and Central African countries that provides for information sharing and judicial cooperation in maritime security (UNODC, 2022).

However, pirate attacks are not only physical. The ship is also attacked in the form of cyber attacks. Especially as maritime systems become more and more digitalised, piracy threats are shifting to the cyber domain. These attacks can be cyber attacks on navigation systems such as GPS blackout, radar spoofing or routing manipulations, as well as critical software systems such as SCADA and ECDIS (Marlow, 2021).

In order to take precautions against these attacks, cyber awareness training is provided for the crew so that the ship personnel can recognise possible cyber threats and intervene quickly.

5. Policy Recommendations

This study reveals that piracy is not only a security problem but also a multidimensional problem with serious economic, logistical and digital threats. The findings show that direct and indirect costs such as increased insurance premiums, operational losses due

to route changes, ransom payments and security investments are significant. Moreover, the effectiveness of anti-piracy methods can only be sustained through multilateral cooperation, technological harmonisation and regional capacity building. Policy recommendations are given in Table 3.

Table 3. Policy Recommendations

Establish a Global Risk Index and Warning System	Under the leadership of IMO and ICC-IMB, a "Maritime Security Risk Index" should be developed that monitors high-risk routes in real time and integrated with insurance premiums. This system will provide a decision support mechanism for ship owners, insurers and port authorities (ICC-IMB, 2023).
Tax and Premium Incentives on High-Risk Routes	Insurers and governments should offer premium discounts or tax benefits to ships sailing in high piracy risk areas and certifying that they comply with Best Management Practices (BMP) guidelines (BMP5, 2018).
Mandatory Training and Certification Against Cyber Threats	Basic cyber security awareness trainings should be made compulsory for ship personnel, and a "Digital Security Certificate" should be introduced within the framework of SOLAS (Safety of Life at Sea) (Marlow, 2021).
Blockchain Based Load and Route Monitoring	Blockchain-based systems should be developed for the unalterable recording of cargo data and route information, and port authorities should work integrated with these systems. This will make data manipulation by pirates difficult (Dutta et al., 2020).
Regional Judicial Jurisdiction Should Be Developed	Regional judicial mechanisms should be strengthened under the Yaoundé and Djibouti codes, and overseas courts should be established where piracy suspects can be effectively and swiftly prosecuted (UNODC, 2022).

6. Discussion and Contribution to the Literature

This study makes multidimensional contributions to the existing literature by addressing the effects of piracy activities on the maritime economy at both theoretical and applied levels. The discussion can be summarised under three main headings within the framework of these contributions:

6.1. Quantification of the Economic Impact Area

In the literature, piracy is mostly analysed in terms of its historical origin, security risk or international law (Garmon, 2002; Murphy, 2007). This study, on the other hand, fills this gap in the literature by analysing the direct economic impacts with numerical examples. The comparative tables and regression modelling based on parameters such

as freight, insurance and route change reveal the financial burden of piracy activities in a concrete way. In this way, measurable risk indicators are provided to decision makers.

6.2. Integration of Multilayer Security Models

It has been emphasised that anti-piracy strategies should not be limited to military operations or diplomatic tools; cyber security, blockchain technology, digital monitoring systems and international legal cooperation should work together (Dutta et al., 2020; Bueger, 2015). By expanding the boundaries of the narrow security framework in the literature, an approach that proposes multi-actor and multi-instrument strategic solutions has been adopted.

6.3. Direct Contribution to Policy Development Processes

This study has not only provided an academic review, but also developed practical policy recommendations for states, shipping companies, insurance companies and international organisations affected by piracy. The recommendations (e.g: Maritime Risk Index, blockchain-based route security, mandatory cyber training) provide concrete guidance for sectoral policy makers.

7. Result

This study provides a comprehensive analysis of the effects of piracy on the maritime economy from a multidimensional perspective at both theoretical and applied levels. Direct and indirect costs, ranging from insurance costs to ransom payments, from route changes to delivery delays, reveal the devastating effects of piracy on maritime transport. In addition, strategies applied in the fight against piracy in the light of international legal norms, regional co-operation and technological developments are examined; policy recommendations are developed at the intersection of different disciplines.

The findings of the study show that piracy is not only a security issue; it is also a fundamental risk area in terms of logistical efficiency, financial sustainability and security of international trade. Therefore, effective counter-piracy strategies should be multi-layered and designed based on the integration of military, legal, technological and digital tools. Data sharing, cybersecurity protocols and risk indexing systems to be developed between the insurance sector, transport companies, government authorities and international organisations will play a key role in reducing the economic impact of piracy.

In conclusion, this study both fills the theoretical gaps in the literature and contributes to evidence-based policy development for practitioners. It is suggested that future research should further develop data-driven analyses, make regional comparisons and examine the intersections of piracy with other global issues such as climate change, migration and energy security.

Appendix A. Corridor-Level Data Used in the Illustrative Regression

Note: The values below are illustrative and corridor-aggregated, constructed to transparently demonstrate the regression mechanism without disclosing any firm-level premium quotations. They are intended for exposition only and should not be interpreted as empirical validation or causal inference.

Corridor	Insurance cost (USD/voyage)	Piracy incidents (index)	Voyage duration (days)
Gulf of Aden	450	25	12
Cape of Good Hope	220	6	22
Gulf of Guinea	520	30	10
Mediterranean–N. Europe	160	3	7
Strait of Malacca	240	8	5

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