University of Messina

Department of Economics

DANGEROUS WATERS

THE ECONOMIC IMPACTS OF MARITIME PIRACY

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Introduction

The thesis is the result of a three-year intensive research entirely devoted to the assessment of the economic impacts of the maritime piracy. During the Ph.D. program, I improved my research and working methodology thanks to the support of my supervisor ***Prof. Bruno S. Sergi****, as well as other relevant scholars and experts, such as* ***Prof. Ursula E. Daxecker*** *(University of Amsterdam) and* ***Dr. Luca Sisto*** *(CONFITARMA). Building on their suggestions, my research has attracted interest from some relevant academic journals. In particular, one part of this work has already been published by the academic journal* ***Studies in Conflict & Terrorism****—in co-authorship with my supervisor Prof. Bruno S. Sergi—, while another part is in under review process, after having been conditionally accepted at* ***Journal of East Asian Studies****. Another two parts have been submitted to other academic journals, i.e.* ***African Affairs*** *and* ***Marine Policy****. This work aims to enrich a part of the academic literature in Economics about maritime piracy, which is a threat to the global economy.*

Maritime piracy is one of the contemporary challenges to the maritime industry. The Gulf of Guinea, the Western Indian Ocean, and Southeast Asia are considered to be High Risk Areas in terms of maritime piracy activities. In this regard, both the international community and the coastal countries of the regions have deployed every effort to address the problem.

While progress has been made recently with the adoption of antipiracy measures, vessels are urged to remain vigilant when sailing High Risk Areas, since the threat of maritime piracy is not "eradicated." Maritime piracy represents a serious and sustained threat to economic security, affecting international trade through an increasing insecurity related to the prompt delivery of the transported goods. The global economic cost of maritime piracy is immense (over US$ 7.2 billion in 2015), but the human cost of piracy is incalculable. In addition to the resulting significant and increasing costs related to the security measures, maritime piracy seriously jeopardizes the economies of the coastal countries affected by the phenomenon.

Although the threat of maritime piracy is one of the main international security issues, the repercussions for the global economy have not been analyzed in depth in quantitative

economic literature. This is mainly due to the rather unsatisfactory data availability as well as to a general interest on that topic which has only recently emerged, i.e. during the recent intense period of maritime piracy attacks (between 2008 and 2011). Therefore, after an extensive study of the existent literature, I decided to analyze this topic in Economics applying quantitative methods.

The topic of the thesis is about the economic impacts of maritime piracy. In particular, the purpose of this work is to study how maritime piracy affects economic growth and international trade, and to assess the risk of pirate attacks. The aim of the research is to analyze these aspects by focusing on the three regions most affected by the phenomenon—i.e. the Gulf of Guinea, the Western Indian Ocean, and Southeast Asia. In doing so, I intend to enrich a part of the academic literature in Economics on this topic. In fact, as has already been mentioned, analyses in quantitative economic literature which have been made so far are not sufficient. Throughout the Ph.D. program, as suggested by my supervisor Prof. Bruno S. Sergi, I improved my research and working methodology carrying out a visiting period abroad, participating at several conferences and seminars in the field of International Economics both in Italy and abroad, and having the support of the principal scholars related to the literature of my research.

Considering the topic and in order to develop the thesis research, the main sources used are academic (such as papers, articles, journals, and books, especially on International Economics), institutional (such as official data of Ministry of Foreign Affairs, Italian Navy, and CONFITARMA), and non-governmental. In this regard, analyses of the most known research institutes and libraries of the main international organizations, such as the United Nations, the World Bank, the International Monetary Fund, and the International Maritime Organization, are also included.

The thesis is structured as it follows. The first and second parts introduce the topic of the thesis. The first part specifically reviews the literature revolving around maritime piracy, while the second part points out the recent trend in pirate attacks in the three regions most affected, and briefly illustrates the main data sources. In the third part, I examine the impact of maritime piracy on the economic growth of the Sub-Saharan African countries. The fourth part analyzes the case study of Southeast Asia, evaluating the effects of maritime piracy on the intra-regional trade. The fifth part assesses empirically the risk of maritime piracy in the three regions most affected by the phenomenon. In the last part, I show the main results of my empirical work and I present my conclusions, suggesting ideas for possible further research.

The Pirates' Curse

Economic impacts of the maritime piracy

Abstract

During the last decades, the activities of pirates have increased exponentially in Eastern Africa, with their attacks becoming considerably more violent. In addition to the intrastate and interstate conflicts, the lack of state capacity and the presence of terrorist groups, maritime piracy represents a serious and sustained threat to economic security. Indeed, from an economic point of view, pirates affect international trade through an increasing insecurity related to the prompt delivery of the goods transported. The aim of this work is to explore the main works on maritime piracy analyzed in quantitative economics.

Keywords: Africa, International Economics, Security, Trade

Introduction

Maritime piracy is a matter of great concern to the international community due to the extensive threat it poses to global security and development. It has been on the rise for much of the past decade, even if international efforts have helped reduce the number of successful hijackings, according to the International Maritime Bureau (IMB).

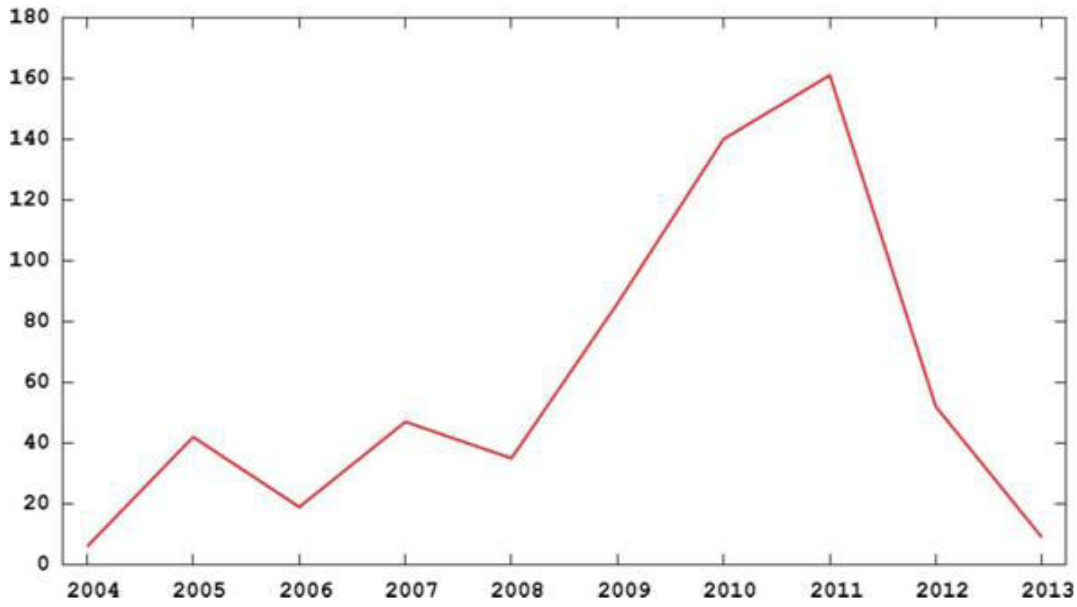
In recent years, there has been a significant increase of attacks on vessels by pirates, in particular in the Gulf of Aden and the Indian Ocean. Indeed, large-scale attacks off the coast of Somalia in 2008 prompted the deployment of an ongoing international coalition of navies to the Gulf of Aden.

Maritime piracy affects major shipping lanes, and puts the lives of seafarers and merchant seamen from all over the world, of whom hundreds are taken as captives every year, at risk. Piracy tactics have centered on hijackings and kidnappings in order to obtain large ransoms. As a consequence, millions of dollars are paid in ransom payments to pirates. Several researches estimated that in 2010, Somali piracy's impact on the global economy was in the range of US$ 7 to US$ 12 billion. Therefore, maritime piracy could likely be the second largest generator of money in Somalia.

In 2011, there were over 400 worldwide piracy attacks, around half of which were attributed to Somali pirates operating in the Gulf of Aden, the Red Sea, the Arabian Sea, the Indian Ocean, and off the coast of Oman. However, other piracy hotspots for 2011 included the coast off Nigeria and Benin in West Africa, and Southeast Asia, near Indonesia. In the case of Somalia, pirates have increasingly moved further off the Somali coast and thus deeper into the Indian Ocean as well as further south along the East African coast.

According to analysts, one of the largest drivers of maritime piracy is the lack of an efficient governing authority in Somalia. Despite numerous attacks in the last decade, as shown in Figure 1, Somali piracy emerged as a powerful force shortly after the regime of the military dictator Major General Mohamed Siad Barre collapsed in 1991. With the absence of any central governing authority, commercial fishing fleets began to exploit the country's coastline. Local fishermen responded by arming themselves, boarding illegal trawlers, and charging a fee of a few thousand dollars.

Figure 1: Maritime piracy attacks in Eastern Africa (2004–2013)



Due to the extent and nature of maritime piracy, international and cross-sector partnerships are vital in order to prevent, investigate, and prosecute these crimes. In addition to various military organizations and companies in the private sector, several international organizations, such as the United Nations (UN), the International Maritime Organization, the European Union, the African Union, Interpol, and Europol, are working together to face this threat.

As reported by the UN Convention on the Law of the Sea (1982), maritime piracy is a universal crime. This Convention subjects pirates to arrest and prosecution by any nation, and provides the legal foundation to help combat piracy and prosecute piracy cases. In recent years, the international community has taken a number of steps to tackle piracy since Somali pirates emerged as a threat to the international maritime security. In 2008, the UN Security Council passed a series of measures targeting Somali piracy, culminating in the unanimous approval of Resolution No. 1851, which facilitated the creation of the Contact Group on Piracy off the Coast of Somalia, in 2009. This group was tasked with addressing military and operational coordination, capacity building, and judicial issues, shipping self-awareness and public information related to piracy. In addition, three main naval missions have been deployed in the Gulf of Aden, including the North Atlantic Treaty Organization (NATO), European Union (EU), and U.S. operations. There are also independent navy ships—including those of Australia, China, India, and Russia—patrolling the corridor. However,

many Somali pirates have adjusted their tactics and managed to avoid naval patrols by operating farther offshore, outside the Gulf of Aden.

Because of these challenges, many ships have begun to hire armed guards as a preemptive deterrent for would-be attackers. Even if this tactic can be quite effective, there is not yet any real regulation on the guards, which creates potential legal complications, such as the incident off the coast of India where two Italian marines on a cargo ship shot and killed two Indian fishermen suspected of being pirates.

Literature Review

Maritime piracy around Somalia has emerged over the past two decades as a legitimate threat to international trade. The persisting political instability, the civil conflicts, a natural geographic choke point in the Gulf of Aden, and a significant flow of ships through the Gulf has allowed pirates to establish safe harbors from which to attack a plethora of available targets. Successful attacks have significant consequences: hijacked ships, kidnapped crews, expensive ransom negotiations, and loss of life.

Since mid-2010, piracy off the coast of Somalia has changed in character. Pirates and navies have become considerably more violent. Because of the increased difficulty of hijacking ships under the noses of warships from over 30 nations, pirates also seem to invest more resources into maximizing the return from each captured ship. Moreover, there are assertions that Al-Shabaab is offering attractive co-operative agreements to pirates (i.e., piracy might at some stage be funding regional instability and terror). There are therefore strong incentives to try a fresh approach to resolving the issue of piracy off the Horn of Africa. Given that a large number of interest groups prevent the restoration of effective central governance in Somalia, a land-based solution might involve replacing piracy as a source of income to relevant local communities.

The struggle against piracy and terrorism represents a priority for the growth and one of the unavoidable prerequisites for the achievement of the economic goals by the whole international community. In particular, the activities of the pirates do not only put the lives of the crew and the cargo of the vessels at serious risk, but also cause an incredible rise in both the direct real costs, such as the maintenance of the ships, and the indirect material costs, including the insurances on the cargo. These costs are different from the macroeconomic ones, which are related to the effects that the phenomenon of piracy products within the economies of the countries belonging to the region or to different ones.

The costs of Somali piracy for the global economy are one of the least analyzed aspects and among the most undervalued. According to the estimates made by One Earth Future Foundation, the total annual cost of piracy for the global economy, in the period between 2008 and 2011, has amounted to around US$ 5 billion every year. Sixty-three percent of it is represented by costs of protection, while 24 percent is made up of the costs of the international tackle to piracy and is mostly borne by the States and the international

organizations. Nine percent can be attributed to the negative effects for the economies of the neighboring countries and causes a reduction of the GDP of the affected countries, whereas only 2 percent is represented by the real and material costs of piracy. Against a cost of piracy in the Aden Gulf that can be estimated being over US$ 5 billion, the actual compensation for those who are the primary cause of it is worth less than US$ 50 billion per year.

Despite this problem has global dimensions, research in economics on the subject is scarcer. In fact, while historians and sociologists have long dealt with questions relating to maritime piracy, research by economists on modern high seas piracy is very limited.

The aim of this work is to raise awareness on the works carried out within economics on maritime piracy (see Table 1).

Among those selected above, the main academic works in quantitative economics are analyzed in detail.

Table 1: The main quantitative academic works on maritime piracy

Authors	Year	Title	Main Results
Volker Nitsch Dieter Schumacher	2004	Terrorism and international trade: An empirical investigation	This paper examines the effect of terrorism and warfare on international trade. Investigating bilateral trade flows between more than 200 countries over the period from 1960 to 1993 and applying an augmented gravity model, the authors find that terrorist actions reduce the volume of trade.
James E. Anderson Douglas Marcouiller	2005	Anarchy and autarky: Endogenous predation as a barrier to trade	This paper presents a general equilibrium two-country Ricardian trade model with endogenous transactions costs that arise from individual utility-maximizing allocation of labor to production and piracy. In particular, in the absence of institutions for risk sharing and coordination of defense, autarky obtains over most of the parameter space.
Peter T. Leeson	2007	An-arrgh-chy: The law and economics of pirate organization	The author investigates the internal governance institutions of violent criminal enterprise by examining the law, economics, and organization of pirates. The author shows that pirate governance created sufficient order and cooperation to make pirates one of the most sophisticated and successful criminal organizations in history.
Anna Bowden	2010	The economic cost of Somali piracy 2010	This is the annual report by Oceans Beyond Piracy, which evaluates the economic and human costs of maritime piracy. It examines both human and economic costs incurred as a result of piracy occurring in the Horn of Africa.
Lena Calahorrano Philipp an de Meulen	2010	How to tackle the Gulf of Aden buccaneers	The authors set up a simple model to describe the choice of becoming a pirate in a setting with an industrialized and a developing country that both engage in fishing in the same waters. They show that, because of fishing competition, maritime piracy as an alternative to fishing becomes more attractive in the developing country.
Antonio Maria Costa	2010	The economics of crime: A discipline to be invented and a	The author analyzes the transnational organized crime and its economics in various levels, such as the illegal drug trade, human trafficking, and

		Nobel Prize to be awarded	maritime piracy. In particular, the author argues that unlike terrorists or insurgents, criminals do not have a political agenda, and when they take root in vulnerable regions, crime has a devastating economic impact.
Martin Daunton	2010	Rationality and institutions: reflections on Douglass North	The paper explores the difficulties and weaknesses of his account of this change, focusing in particular on the case of the United Kingdom, and the themes of property rights, state structures and warfare.
Xiaowen Fu Adolf K.Y. Ng Yui-Yip Lau	2010	The Impacts of maritime piracy on global economic development: The case of Somalia	This paper investigates the impacts of maritime piracy on global economic development. The authors model shipping demands and competition in the Far East-Europe container liner shipping service and investigate the economic welfare loss effects due to reduced volumes of trade and shipping, as well as efficiency loss due to geographical re-routing of shipping networks which would be otherwise uneconomical.
Nong Hong Adolf K.Y. Ng	2010	The international legal instruments in addressing piracy and maritime terrorism: A critical review	This paper critically reviews four international legal instruments in addressing piracy and maritime terrorism (UNCLOS, SUA, PSI and the ISPS Code). The authors offer several constructive recommendations to improve their effectiveness in controlling and deterring piracy and maritime terrorism from threatening the well-being of the maritime industries.
Michal Jakob Ondřej Vaněk Štěpán Urban Petr Benda Michal Pěchouček	2010	AgentC: Agent-based testbed for adversarial modeling and reasoning in the maritime domain	The authors present an agent-based system for modeling, analyzing and reasoning in the maritime domain with the emphasis on detecting, anticipating and preventing illegitimate activities, such as contemporary maritime piracy. The system provides a complete testbed for the development and evaluation of counterpiracy methods based on the multi-agent approach.
Anja Shortland Marc Vothknecht	2010	Combating “maritime terrorism” off the coast of Somalia	The authors show that the main effects of counter-piracy operations are the stabilization of attacks at a high level and the substitution between the relatively well-protected transit corridor in the Gulf of Aden and the open sea. However, the counter-piracy measures appear to deter pirates from forming alliances with Islamist movements.
Anastasia Varsami Corina Popescu	2010	Piracy in the Gulf of Aden – A problem of our days	This paper tries to elaborate on the causes of maritime piracy in the region of Somalia. The authors argue that there is no real incentive for the Somali government to contain piracy in the Gulf of Aden, apart from pressures of the international community and the need to improve one’s image therein.
Edward A. Alpers	2011	Piracy and Indian Ocean Africa	According to the author, Somali piracy is intimately connected to the Somali political economy, but it falls into a pattern of piracy that has much deeper historical roots. The author argues that piracy is a consequence of exclusion from the prevailing international trade networks of the Indian Ocean region and access to the wealth produced by those who dominate them.
Subhayu Bandyopadhyay Javed Younas	2011	Poverty, political freedom, and the roots of terrorism in developing countries: An empirical assessment	This paper finds that political freedom has a significant and non-linear effect on domestic terrorism, but this effect is not significant in the case of transnational terrorism. The authors show that, while geography and fractionalization may limit a county’s ability to curb terrorism, the presence of strong legal institutions deters it.
Anna Bowden Shikha Basnet	2011	The economic cost of Somali piracy 2011	This is the annual report by Oceans Beyond Piracy, which evaluates the economic and human costs of maritime piracy. It examines both human and economic costs incurred as a result of piracy occurring in the Horn of

			Africa.
Tilman Brück Friedrich Schneider	2011	Terror and human insecurity: Editorial introduction	In this paper, the authors identify research gaps and recent contributions in the economics of terror. They focus on the human drivers of insecurity as a key topic. They show that insecurity shapes growth, perceptions of individuals, and policy responses.
Joel M. Caplan William D. Moreto Leslie W. Kennedy	2011	Forecasting global maritime piracy utilizing the risk terrain modeling. Approach to spatial risk assessment.	In looking at the results from studies of international piracy, the authors report an increase in the predictive capability of risk-based mapping over the more conventional forecasts offered by retrospective hot spot mapping, reinforcing the idea that these approaches provide a greater focus for hazard detection and response.
Olaf J. de Groot Matthew D. Rablen Anja Shortland	2011	Gov-aargh-nance – "Even criminals need law and order"	The authors present a theoretical model postulating that the relationship between crime and governance is "hump-shaped" rather than linearly decreasing. They create a new dataset on piracy and find strong and consistent support for this non-linear relationship. The occurrence, persistence and intensity of small-scale maritime crime are well approximated by a quadratic relationship with governance quality.
Olaf J. de Groot Marc Vothknecht	2011	What can be done to reduce the occurrence of piracy in the short and long run?	The authors reflect how to stop piracy in the seas around Somalia and if there are specific policy options to be explored that could effectively address the problem. For example, they suggest to increase the disincentive of piracy by increasing punishment.
Geopolicity	2011	The economics of piracy. Pirate ransoms and livelihoods off the coast of Somalia	This is a report by Geopolicity that establishes a global economic model for assessing the costs and benefits of international piracy. The model includes cost-benefit analysis at the individual pirate level, the aggregate costs and benefits at the international systems level, and comprehensive data on the resurgence of piracy by functional classification and sovereign jurisdiction.
Andreas Graf	2011	Countering piracy and maritime terrorism in South East Asia and off the Horn of Africa	This paper analyzes the maritime violence identifying the violent attacks scenarios threatening international cargo shipping. In particular, it focuses on root causes of maritime violence in South East Asia and Horn of Africa. Evaluating the main factors of success of the remedies in the Malacca Straits, the author suggests a new strategic focus for endeavors to counter maritime violence at the Horn of Africa.
Brishti Guha Ashok S. Guha	2011	Pirates and traders: Some economics of pirate-infested seas	The authors examine the options and decisions open to pirates and merchants in a pirate-infested sea on which patrolling by international maritime police foils some attempts at piracy with the pirates being captured and punished. They show that even where all agents are risk-neutral, merchants can insure themselves against piracy.
Paul Hallwood Thomas J. Miceli	2011	"Keystone cops" meet "pirates of the Somali Coast": The failure of international efforts to control maritime piracy	This paper develops an economic of model of piracy that emphasizes the strategic interaction between pirates (offenders) and shippers (victims), a factor not previously studied in the law enforcement literature. The authors show that greater enforcement efforts will not necessarily result in less activity by pirates, while enforcement policies are complicated by the need for international cooperation to counter maritime piracy.
Paul Hallwood Thomas J. Miceli	2011	The law and economics of international cooperation against maritime piracy	This paper readily explains why more pirates captured are released than prosecuted; why the United Nations and International Maritime Organization are seeking to reduce enforcement costs; why some in the shipping industry want to apply the 1988 Convention against terrorism at

			sea; and why still others want to move prosecution of pirates out of national courts to an international court.
Stephanie Jones	2011	Security concerns: Piracy at sea and the carriage of essential commodities by merchant shipping – The impact on commodity pricing and availability	This paper attempts to quantify the issues involved and looks at global trends, all indicative that this problem is becoming greater rather than lesser. It looks also at the detailed economic implications, the background to how it began and what happens in an attack.
Stefan Mair	2011	Piracy and maritime Security. Regional characteristics and political, military, legal and economic implications	This paper examines piracy and maritime insecurity in Africa, Asia and America, which become a matter for action by the international community principally when the direct economic impact becomes conflated with a complex situation of regional insecurity. Military action is central to containing the problem, but cannot eliminate the causes of piracy.
Sarah Percy Anja Shortland	2011	The business of piracy in Somalia	The authors explain that it will be difficult to control Somali piracy for various reasons. In particular, they argue that piracy is an organized criminal activity and a business that improves with a more stable operating environment.
Jean-Loup Samaan	2011	Security governance in the maritime commons: The case for a transatlantic partnership	The author examines the performance of the European Union in the counter-piracy Operation Atalanta off the coast of Somalia and in the Gulf of Aden, illustrating the possibility that the EU will prove to be an unexpected player in the maritime commons in the twenty-first century.
Anja Shortland	2011	"Robin Hook": The developmental effects of Somali piracy	This paper evaluates the effects of piracy on the Somali economy to establish which (domestic) groups benefit from ransom monies. The author evaluates province-level market data, nightlight emissions and high resolution satellite imagery, and show that significant amounts of ransom monies are spent within Somalia.
Woosun An Diego F. Martínez Ayala David Sidoti Manisha Mishra Xu Han Krishna R. Pattipati Eva D. Regnier David L. Kleinman James A. Hansen	2012	Dynamic asset allocation approaches for counter-piracy operations	This paper proposes an algorithmic augmentation or add-on to Pirate Attack Risk Surface (PARS) that allocates interdiction and surveillance assets to minimize the likelihood of a successful pirate attack over a fixed planning horizon. In particular, for the surveillance problem, the authors propose a partitioning algorithm coupled with an asymmetric assignment algorithm for allocating assets to the partitioned regions.
Jonathan Bellish	2012	The economic cost of Somali piracy 2012	This is the annual report by Oceans Beyond Piracy, which evaluates the economic and human costs of maritime piracy. It examines both human and economic costs incurred as a result of piracy occurring in the Horn of Africa.
Sami Bensassi Inmaculada Martínez-Zarzoso	2012	How costly is modern maritime piracy for the international community?	This paper focuses on the impact of maritime piracy on international trade. Piracy increases the cost of international maritime transport through an increase in insecurity regarding goods deliveries. The authors find robust evidence indicating that maritime piracy reduces the volume of trade.
Ursula E.	2012	Insurgents of the sea:	According to the authors, piracy is a result of permissive institutional

Daxecker Brandon Prins		Institutional and economic opportunities for maritime piracy	environments and the lack of legal forms of employment in states' fishing sectors. The authors show that state weakness and reductions in fish catch affect piracy as expected. These findings suggest that international efforts in combating piracy should center on improving the institutional environments and labor opportunities driving maritime piracy.
Olaf J. de Groot Matthew D. Rablen Anja Shortland	2012	Barrgh-gaining with Somali pirates	The authors apply a theoretical model of the bargaining process to analyze the empirical determinants of ransom amounts and negotiation lengths. They find that ransom amount and negotiation length depend on the observable characteristics of both pirates and ships and on the "reference ransom" established by previous ransom payments for a specific ship type.
Brishti Guha	2012	Pirates and fishermen: Is less patrolling always bad?	The author explores the time allocation decision of potential pirates between piracy and an alternative non-violent occupation, fishing, when the returns of both piracy and fishing are sensitive to patrolling intensity. The author obtains the surprising result that sufficiently low patrolling can be a good strategy.
Theo E. Notteboom	2012	Towards a new intermediate hub region in container shipping? Relay and interlining via the Cape route vs. Suez route	This paper analyzes to what extent and for which trade lanes the Cape route could develop into a competitive alternative to the Suez route. The results show that the Cape route has the potential to serve as an alternative to the Suez route on 11 trade lanes.
Christian Schubert Leonhard K. Lades	2012	Fighting Maritime Piracy: Three lessons from Pompeius Magnus	Piracy risks generating significant negative externalities to third parties, justifying attempts to contain it. The authors argue that these attempts may benefit from a look back—through the analytical lens of public choice theory—to the most successful counter-piracy campaign ever undertaken, namely, the one led by the Roman general Gnaeus Pompeius Magnus.
Anja Shortland Federico Varese	2012	The business of pirate protection	Drawing on Protection Theory developed for the study of Mafias, the authors show that there is a clear distinction between protectors of piracy and pirates. They argue that the solution to piracy needs to focus on the enablers rather than the executors of the crime, and should be at the sub-state, clan level.
Currun Singh Arjun S. Bedi	2012	'War on Piracy': The conflation of Somali piracy with terrorism in discourse, tactic and law	This paper argues that since 2005, the global security discourse has confused maritime piracy off the Horn of Africa with terrorism. The authors propose a shift from military to developmental responses to piracy, with an emphasis on respecting local institutions of law enforcement and governance in Somalia.
Michał Gornowicz	2013	Marine piracy in Somalia – Past, present and future	In this paper, the author analyzes the Convention on the High Seas from Geneva (1958) and the history of piracy in Somalia. Showing the attitude of international community towards piracy and the recent data, the author suggests future scenarios in Somalia.
Stefan Halikowski-Smith	2013	International seaborne piracy and the state: Lessons to be learned from history?	In the light of the Operation Atalanta, the author recalls that the problem of seaborne piracy was addressed and suppressed by European powers in the past. Even if not all attempts at resolving piracy were successful, the author argues that these are lessons policy-makers today would do well to take heed.
Ryan Jablonski Steven Oliver	2013	The political economy of plunder: Economic opportunity and modern piracy	Using original data on over 3,000 pirate attacks, the authors argue that these attacks are, in part, a response to poor labor market opportunities. The authors show that changes in the price of labor- and capital-intensive

			commodities have consistent and strong effects on the number of pirate attacks in a country's territorial waters each month.
William A. Kerr	2013	Scourge of the seas – Again! Anti-piracy services and international trade costs	This paper shows that the costs associated with providing anti-piracy services are considerable and it is difficult to assess their cost-effectiveness. Piracy is imposing significant costs on the conduct of international trade, and the author argues that a return to the pirate-free status of the latter part of the 20th century is unlikely.
Inmaculada Martínez-Zarzoso Sami Bensassi	2013	The price of modern maritime piracy	This paper aims to investigate maritime transport costs as one of the channels through which modern maritime piracy could have a major impact on the global economy. The authors show that maritime piracy significantly increases trade cost between Europe and Asia.
Steven Oliver Ryan Jablonski Justin V. Hastings	2013	The Tortuga Disease: The perverse distributional effects of illicit foreign capital	Evaluating data on illicit capital flows into Somalia, the authors find robust evidence that inflows can have distributional effects: illicit capital can undermine long-term development as well as contribute to dependence—both political and economic—on transnational crime.
George Samiotis Vasileia Psarrou Michalis Pazarzis Vasilis Tselentis Georgios Dafnos	2013	Maritime piracy: Trends and future developments. A review	Analyzing the effectiveness of counter-piracy measures, the author suggests that piracy cannot be eliminated solely with force-oriented initiatives without addressing its root causes that are political instability, endemic poverty and the lack of social and economic safety and security.
World Bank	2013	The pirates of Somalia: ending the threat, rebuilding a nation	This is the report by the World Bank that shows that the costs imposed by Somali pirates on the global economy are so high. The international mobilization to eradicate piracy off the Horn of Africa not only has global security benefits, but also makes ample economic sense. This report affirms that the international community can and should assist Somalia to find solutions to the piracy problem.
Alfredo Burlando Anca D. Cristea Logan M. Lee	2014	The trade consequences of maritime insecurity: evidence from Somali piracy	By comparing trade volume changes along shipping routes located in pirate waters to those that are not, the authors estimate that Somali piracy reduced bilateral trade passing through the Gulf of Aden in the last years. They find larger reductions for trade in bulk commodities—generally shipped by sea and more likely to fall prey to piracy attacks.
Probal K. Ghosh	2014	Strategies for countering Somalian piracy: Responding to the evolving threat	This paper analyzes the solution to eradicate the Somali piracy, which has developed extensive linkages with terrorist organizations and well-financed organized criminal gangs based. The author suggests that the espousal of multi-pronged proactive approaches need to eradicate piracy. In addition, the author argues that all the major stakeholders and the affected states have to collaborate.
Thomas Gries Margarete Redlin	2014	Maritime piracy: Socio-economic, political, and institutional determinants	The authors argue that the number of maritime piracy and armed robbery incidents is characterized as count data and exhibits overdispersion. Therefore, they apply random-effects negative binomial regressions for a panel dataset and show that poor socio-economic, political, and institutional conditions in the host country increase the likelihood of piracy attacks.
Paul Hallwood Thomas J. Miceli	2014	Modern maritime piracy	This paper provides and economic analysis of the problem of modern-day maritime piracy. The authors review the current scope of the problem, and develop an economic of model of piracy that emphasizes the strategic interaction between the efforts of pirates to locate potential targets, and

			shippers to avoid contact.
Elio Marchione Shane D. Johnson Alan Wilson	2014	Modelling maritime piracy: A spatial approach	This paper presents a model to generate dynamic patterns of maritime piracy. Analyzing data on pirate attacks, vessels routes and flows through the Gulf of Aden in the year 2010, the authors employ agent-based modelling to simulate pirate, vessel and naval forces behaviors.
Ussif R. Sumaila Mahamudu Bawumia	2014	Fisheries, ecosystem justice and piracy: A case study of Somalia	In this paper, the authors argue that the origin of piracy in Somalia is a result of a combination of state failure, IUU fishing, toxic waste dumping and its impact on the ecosystem. They present some potential resolutions to the problem of piracy, which requires a multifaceted approach.
United Nations Conference on Trade and Development (UNCTAD)	2014	Maritime piracy – Part I: An overview of trends, costs and trade related implications	This is the first part of the report by UNCTAD that considers the costs and trade-related implications of maritime piracy and takes stock of regulatory and other initiatives pursued by the international community in an effort to combat piracy.
United Nations Conference on Trade and Development (UNCTAD)	2014	Maritime piracy – Part II: An overview of the international legal framework and of multilateral cooperation to combat piracy	This is the second part of the report by UNCTAD that considers the costs and trade-related implications of maritime piracy and takes stock of regulatory and other initiatives pursued by the international community in an effort to combat piracy.
Jens Vestergaard Madsen Conor Seyle Kellie Brandt Heather Randall Kellie Roy	2014	The state of maritime piracy 2013	This is the annual report by Oceans Beyond Piracy, which evaluates the economic and human costs of maritime piracy. It examines both human and economic costs incurred as a result of piracy occurring in the world, in particular in the Horn of Africa.
Zaili Yang Adolf K.Y. Ng Jin Wang	2014	A new risk quantification approach in port facility security assessment	This paper introduces a novel evidential reasoning approach to facilitate the quantitative analysis of port facility security assessment. Therefore, the authors quantify port facility security risks and to conduct the cost benefit analysis of the associated security control measures.
Timothy Besley Thiemo Fetzer Hannes Mueller	2015	The welfare cost of lawlessness: Evidence from Somali piracy	This paper estimates the effect of piracy attacks on shipping costs using a unique data set on shipping contracts in the dry bulk market. The authors look at shipping routes whose shortest path exposes them to piracy attacks, and find that the increase in attacks in 2008 lead to around a 10% increase in shipping costs.
Christian Bueger	2015	What is maritime security?	Given that no international consensus over the definition of maritime security has emerged, this paper suggests three frameworks by which one can identify commonalities and disagreements are needed. The author argues that these frameworks allow for the mapping of maritime security.
Ursula E. Daxecker Brandon C. Prins	2015	Searching for sanctuary: government power and the location of maritime piracy	This paper argues that states' ability to project power over distance affects pirates' decisions on where to organize and operate. Using geocoded data, the authors show that increases in state capacity are associated with greater median capital-piracy distances. These findings are robust to several changes in model specification. These results have important implications for the study of piracy and crime.
Matthias Flückiger Markus Ludwig	2015	Economic shocks in the fisheries sector and maritime piracy	The authors show that negative economic shocks in the fisheries sector are associated with an increase in maritime piracy. Using the variation in the

			phytoplankton abundance off the individual countries' coasts, they find that it is positively related to fish catches but negatively associated with the incidence of piracy, the onset of piracy and the absolute number of pirate attacks.
Anton A. Varfolomeev	2015	Piracy as a threat to international peace and security	This paper examines the adequacy of the classical approach treating piracy as a common crime with an international element, comparing contemporary piracy to other illegal activities committed by non-state actors. The author analyze a case study on the role of the UN Security Council in suppressing piracy off the coast of Somalia.
Matthew R. Walje Jens Vestergaard Madsen Conor Seyle Kellie Brandt Peter Kerins Megan Matthews Tyler Maybee	2015	The state of maritime piracy 2014	This is the annual report by Oceans Beyond Piracy, which evaluates the economic and human costs of maritime piracy. It examines both human and economic costs incurred as a result of piracy occurring in the world, in particular in the Horn of Africa.

Bensassi and Martínez-Zarzoso estimate the impact of maritime trade between Europe and Asia using the data on piracy incidents between 1999 and 2008. They apply the gravity model, widely used to investigate the role played by specific policy or geographical variables in bilateral trade flows.

Burlando, Cristea, and Lee lay out an empirical model of bilateral trade where piracy increases trade costs, and derive an augmented gravity equation to estimate the effect of pirate activities on trade volumes. Using a global panel data set combining information on bilateral volumes of trade and on reported pirate attacks, they show that the threat of violence and, more generally, the possibility of disruptions in the transportation network have a negative effect on trade.

In another research, Martínez-Zarzoso and Bensassi test the effect of modern maritime piracy on maritime trade cost proposing a simple model of transport cost determination and deriving a transport costs equation augmented with maritime piracy as an additional explanatory variable. Their results show a significant and positive impact of maritime piracy on maritime transport cost; in addition, they show that localized conflicts could selectively harm some international trade routes.

In a world where trade, economies, and populations are growing fast, the long-term availability of cost-effective, efficient, environmentally sustainable, safe, and secure maritime transport services is crucial. Maritime piracy has recently evolved from a localized maritime transport concern into a cross-sectoral global challenge, with a range of important

repercussions for the development prospects of affected regional economies as well as for global trade. In this regard, Shortland and Vothknecht quantitatively examine the period of high intensity counter-piracy operations off the coast of Somalia from January 2008 to June 2010. They show that improvements in private sector defensive measures have not resulted in a greater effectiveness of the transit corridor in the Gulf of Aden over time either, because pirates have also changed their tactics in response. They also argue that the threat of escalating military violence has crucially contributed to piracy remaining a business rather than becoming allied to violent insurgent movements.

B. Guha and A. S. Guha examine the options and decisions open to pirates and merchants in a "pirate-infested sea" on which patrolling by international maritime police foils some attempts at piracy with the pirates being captured and punished.

Patrolling should have a deterrent effect on piracy by reducing the probability of successful pirate attacks and increasing the probability of capture; but sometimes it may also have other impacts on incentives for piracy and on the relative attractiveness of piracy and fishing. In further research, B. Guha shows that when patrolling is sufficiently low, it could trigger a decline in both piracy and patrolling.

Jakob et al. explore how agent-based techniques can be employed to reduce the threat of contemporary maritime piracy to international transport. By means of a data-driven agent based simulation platform, they analyze information in the maritime domain with the emphasis on detecting, anticipating and preventing pirate attacks.

In particular, other studies on how to anticipate pirate attacks have been carried out by An et al., which have developed a piracy prediction model based on wind, waves, currents, as well as on the ground intelligence that could help predict the probability of a pirate attack on a given day. This model generates a map that shows the highest-risk areas and could be of further use by adding up to the minute on shipping traffic to identify likely targets for pirates. Whereas, using Risk Terrain Modeling, Caplan, Moreto, and Kennedy put forward three risk factors (State status, shipping routes and maritime choke points) to show if attacks locations can be predicted.

Academics debate whether the continuous patrolling of naval forces as well as the private contract armed guards aboard ships, could be successful in weakening pirate capabilities. According to Samiotis et al., piracy cannot be eliminated solely with force-oriented initiatives, without addressing its root causes (i.e., political instability, endemic poverty, and the lack of security).

Gries and Redlin examine the effects of socioeconomic, political, and institutional conditions on maritime piracy for 149 countries between 1991 and 2010. They show that, on average, less developed countries with higher political and institutional disorder have a higher probability of piracy attacks. Their findings suggest that to solve the problem of piracy, policy efforts should primarily be directed at strengthening economic conditions and the internal stability of the country. Daxecker and Prins propose a general explanation of maritime piracy that emphasizes the importance of institutional and economic opportunities. Using a monadic-year unit of analysis that includes all States in the international system and cases from 1991 to 2007, they show a positive and statistically significant relationship between piracy attacks and both State failure and economic opportunity.

Instead, de Groot, Rablen, and Shortland re-examine the relationship between crime and governance showing that in a country with initially low State governance, surrounding maritime piracy activities increase as State governance improves over land. They argue that increased State governance has the paradoxical effect of helping pirates protect their loot from theft once on land. Focusing on the link between state failure, fishing, and piracy, the study of Sumaila and Bawumia notes that State failure, or weakness, is not sufficient to the emergence of maritime piracy. They argue that the origin of piracy in Somalia is a result of a combination of state failure, IUU fishing, toxic waste dumping and its impact on the ecosystem. They show that resolving the problem of piracy requires a multifaceted approach, including the establishment of a viable Somali State with the rule of law, and action taken to prevent illegal fishing and toxic waste dumping to provide support for the local fishing industry.

Therefore, some academics have focused their research on the choice to pursue the pirate activities. Anderson and Marcouiller examine a two-country Ricardian trade model where individuals may choose between productive activity and piracy, and show that autarky obtains over a large parameter space. Analyzing the effect of variation in commodity prices on the number of pirate attacks, Jablonski and Oliver show that lower opportunity costs in the agricultural sector, induced by reduced prices for agricultural products, increase maritime piracy activity.

Calahorrano and an de Meulen set up a simple model to describe the choice of becoming a pirate in a setting with an industrialized and a developing country that both engage in fishing in the same waters. They compare the impact of several short- or medium-term measures on piracy and on well-being in the industrialized country, measured by per capita consumption. Because of fishing competition, maritime piracy as an alternative to

fishing becomes more attractive in the developing country. Analyzing the case of the fisheries sector, Fluckiger and Ludwig study the link between economic shocks in this sector and the incidence of piracy. Examining a panel of 109 coastal countries that spans the years 2004–2009, they use the variation in phytoplankton abundance off the individual countries' coasts as a source of economic shocks to the fishing industry. They argue that higher plankton abundance leads to an increase in the abundance of fish and, hence, to higher productivity in the fisheries sector: this signifies an improvement in economic conditions in this sector and therefore increases the opportunity cost for a fishermen to engage in piracy activity.

According to Oliver, Jablonski, and Hastings, in Somalia, ransom incomes appear to have increased returns in non-tradable sectors and especially among businesses that cater to pirates, like drug traffickers, construction workers, cooks, prostitutes, and vehicle importers. They suggest that the distributional effects of illicit capital generated by transnational crime can undermine long-term development by harming internationally tradable sectors, and by making the larger economy dependent on growth in the illicit sector.

De Groot, Rablen, and Shortland empirically examine the determination of ransom amounts and negotiation durations by using a new dataset of hijackings and ransoms in Somalia. They develop a simple bargaining model and estimate separate models for ransom amount and negotiation duration. They show "sophisticated" pirates (akin to organized criminal gangs) extract higher ransoms than "opportunists," who lack the infrastructure to sustain long negotiations. In addition, past higher ransoms are positively associated with subsequent ransom amounts. Hence, higher ransom amounts impart a negative externality on future victims.

Schubert and Lades argue that pirates are rational economic actors responding to costs and benefits, and that piracy is an occupational choice. Therefore, they suggest to look back to the campaign undertaken by the Roman general Pompeius Magnus in 67 B.C., which significantly reduced the incidence of piracy in the Eastern Mediterranean.

The negative impacts of piracy comprise not only casualties and ransom payments, but also damage to the region and the global economy (e.g., the transport sector). However, according to some academics, it contributes to people's incomes and thereby to economic development. Shortland evaluates data collected by internationally funded nongovernmental organizations (NGOs), monitoring rainfall and regional food and commodity prices, and demonstrate the impact of the piracy sector both on the local and on the national economy of Somalia. She argues piracy has created employment and considerable multiplier effects in the

Puntland economy even if a significant proportion of the proceeds from piracy are invested in foreign goods or are channeled back to foreign financiers.

According to Shortland, although coastal villages have gained little from hosting pirates, pirate incomes have widespread and significant positive impacts on the Somali economy. These positive economic impacts of piracy are widely spread and a military strategy to eradicate it could seriously undermine local development. In addition, analyzing the efforts of both private and public sector initiatives, Kerr shows that piracy imposes considerable costs on international commerce and taxpayers, thus inhibiting international trade.

Besley, Fetzer, and Mueller study the consequences of trade costs for trade patterns. They develop a statistical model to calculate the frequency of piracy attacks in Indonesia and Somalia to estimate how much an upsurge in piracy raises shipping costs. They argue that the extra shipping costs are mostly due to the increased security measures that are needed to repel pirate attacks and hence constitute a welfare cost as labor and resources are allocated from productive tasks to guard services. Therefore, developing a model to compare this extraction of resources through pirate attacks to a tax on shipping that finances an equivalent transfer, they show that predation is a lot more costly as a form of extraction than taxation.

Given the issues at stake and the broad range of costs and trade-related implications of maritime piracy at both the regional and the global level, sustained long-term efforts to combat and repress piracy clearly remain a matter of strategic importance. A study by the World Bank estimates the risk of piracy off the coast of Somalia to equate about a 1 percent ad valorem rise in trade costs, acting as a hidden tax on world trade. With over US$ 1 trillion of international trade passing through the affected area, the overall cost of piracy to global trade is assessed at about US$ 18 billion. Meanwhile, trade costs in Somalia alone are estimated at US$ 6 million annually, not including the impact on other sea-based economic activities.

In the literacy, finally, there are few contributions concerning the link between terrorism and piracy in Somalia, mostly done with a qualitative approach. Some areas of Somalia are controlled by Al-Shabaab, the *jihadist* terrorist group that launched its own insurgency on major Somali cities by 2009. According to official data, no direct connection exists between Al-Shabaab and Somali pirates, and the pirates show no interest in having any ideological affiliation with the *jihadis*.

Conclusions

Even if there have recently been signs of renewed piracy activities, the statistics show a drastic reduction of pirate attacks off Somalia. In particular, the deployment of armed private security guards on board ships, who have been 100 percent successful in deterring or defeating attacks, could be one of the factors that have contributed to the reduction of maritime piracy attack.

Among the others, a better management practice enacted by shipping companies—consisting for example in hardening their vessels or taking evasive action—and a preventive naval action in the region, have helped to ensure that pirates do not get out of their anchorages. Therefore, in order to fight against piracy, the international community should on an international level contribute in strengthening the law of the sea and its implementation; and on a local level, in assisting the Somali authorities to restore coastguard forces and to develop a modern judicial system, made up of rule of law, courts and police forces.

However, the source of the problem is also on land, and until Somalia can reach a certain level of stability and prosperity, the specter of maritime piracy is likely to hover over its coast for the years to come. Therefore, a particular effort has to be made for extended support on the creation of jobs and business projects for young Somalis in order for them not to be tempted to return to piracy. In doing so, also building adequate infrastructures such as schools and health centers, as well as supporting local NGOs and the civil society is absolutely essential.

In this sense, on the 6th of September 2013, the "Somalia New Deal Conference," co-hosted by the European Union and Somalia was held in Brussels. The conference was attended by delegates from countries across Africa, Europe and the Persian Gulf, as well as from global financial institutions and aid agencies. Several Somali regional leaders were present. A three-year plan has been designed to support Somalia: international donors have pledged around US$ 2 billion in aid to help the country rebuild after two decades of conflict.

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Maritime Piracy

A threat to the global economy

Abstract

Maritime piracy is a big threat to the safety of traffic, thus causing damage to the economy. In the last twenty years, the highest number of maritime piracy attacks was recorded off the coast of the countries of Middle and Western Africa, Eastern Africa, and Southeast Asia. In light of the increase in attacks and kidnappings of merchant ships transiting the Horn of Africa, the international community has shown more interest to face the problem of maritime piracy. Several military and non-military measures, both at the international-level—as the EU (Operation Atalanta) and NATO (Operation Ocean Shield) missions—and locally, have been taken in order to counter the phenomenon and ensure the safety of navigation of the merchant ships in transit. If not properly tackled, maritime piracy creates a chain of negative effects in the economy. This research note points out the recent trend in pirate attacks in the three regions most affected, and briefly illustrates the main data sources.

Keywords: Africa, Asia, International Economics, Security

Introduction

Over the past two decades, the phenomenon of maritime piracy has been a serious threat to free navigation of merchant vessels. Various international organizations, such as the World Trade Organization and the International Maritime Organization, expressed their concern over the economic and social risks caused by piracy. According to the data related to maritime piracy attacks released by the International Maritime Bureau, the most affected regions between 1994 and 2013 were Gulf of Guinea, the Western Indian Ocean region, and Southeast Asia.

As a result of the increase in incidents of maritime piracy, in 1992 the International Maritime Bureau established the Piracy Reporting Centre, which aims to raise awareness, within the shipping industry, around the high risk areas affected by pirate attacks and around the specific ports/anchorages where armed robberies on board ships have occurred. Piracy Reporting Centre is an independent and non-governmental agency-based in Kuala Lumpur. As laid down in Resolution A.1025 (26) adopted on 2 December 2009 at the 26th Assembly Session of the International Maritime Organisation, the Piracy Reporting Centre follows the definition of maritime piracy as stated in the United Nations Convention on the Law of the Sea (UNCLOS). In particular, according to the Article No. 101 of UNCLOS,

Piracy consists of any of the following acts:

(i) any illegal acts of violence or detention, or any act of depredation, committed for private ends by the crew or the passengers of a private ship or a private aircraft, and directed:

(ii) on the high seas, against another ship or aircraft, or against persons or property on board such ship or aircraft;

  (a) against a ship, aircraft, persons or property in a place outside the jurisdiction of any State;

  (b) any act of voluntary participation in the operation of a ship or of an aircraft with knowledge of facts making it a pirate ship or aircraft;

(iii) any act of inciting or of intentionally facilitating an act described in subparagraph (a) or (b).

In order to integrate the UNCLOS, the Security Council of the United Nations has adopted several resolutions on maritime piracy, following the increase of the attacks occurred off the coast of Somalia. After the adoption of the UN Security Council Resolutions 1814, 1816, 1838, and 1846 (2008), the countries engaged in commercial maritime routes off the coast of Somalia have taken measures to combat maritime piracy, adopting forms of international coordination. In this sense, the European Union has launched a military operation EU NAVFOR Somalia, known as "Operation Atalanta" in order to contribute to protecting vessels of the World Food Programme of the United Nations—who send humanitarian aid to displaced persons in Somalia—, to the protection of vulnerable vessels cruising off the Somali coast, and to the deterrence, prevention and repression of acts of maritime piracy off Somalia.

The North Atlantic Treaty Organization (NATO) is also involved in fighting sea piracy off the Horn of Africa, starting before the Operation "Allied Protector" and then "Operation Ocean Shield." NATO's contribution aims at providing naval escorts and deterrence, while increasing cooperation with other counter-piracy operations in the area in order to optimize efforts and to tackle piracy evolving trends and tactics. Finally, among the naval forces involved in counter piracy off the coast of the Horn of Africa since 2008, those of countries operating unilaterally, such as Russian Federation, Saudi Arabia, Japan, the Islamic Republic of Iran, India, and People's Republic of China, are also to be included. PR China dispatched People's Liberation Army Navy's escort missions to the Gulf of Aden before the end of 2008 under authorization by UN Security Council Resolutions. The maritime security off the coast of the Horn of Africa is intrinsically PR China's top priority in its foreign policy. Recently, PR China has begun building a naval base in Djibouti to establish a strategic foothold in close proximity to the oil trade routes from the Middle East and to the Indian Ocean. PR China is also actively participating in international cooperation to fight maritime piracy in the Gulf of Guinea, where the incidence of maritime piracy is rising.

Maritime piracy in the Gulf of Guinea has escalated from low-level armed robberies to more sophisticated violent hijackings and cargo thefts. In the Gulf of Guinea, pirates focus mainly on the theft of oil and petroleum cargo. Tankers are hijacked and taken out to the sea, where the cargo is siphoned into awaiting containers and then delivered to black market buyers. Like in the Gulf of Guinea, in Southeast Asia pirates turned their sights to the oil trade. Although robbery is still the prevailing *modus operandi*, the volume of maritime piracy attacks to oil and petroleum cargo is recently increasing. This region has long been prone to maritime piracy and armed robbery, especially when such ships are concentrated at the so-

called “chokepoints,” such as the Straits of Malacca and Singapore. Indeed, over half of the world’s commercial shipping passes through these waterways, which provide the shortest sea route between the Indian Ocean and the Pacific Ocean. They are the most important shipping lines in the world, carrying approximately one-quarter of all traded goods.

Therefore, the interest of the international community should be to adopt a commercial and military strategy in order to ensure better security to shipping lines. However, in addition to being a serious threat to free navigation of merchant vessels, maritime piracy jeopardizes the economies of coastal countries affected by the phenomenon and causes huge expenditure on measures to combat maritime piracy. The increased risk related to the activity of pirates inevitably causes a significant increase in the freight costs, mainly due to the rise in insurance premiums and benefits for seafarers operating in the High Risk Areas.

The recent military intervention by the international community has been crucial for reducing the number of maritime piracy attacks. According to the report of Oceans Beyond Piracy, even if there has been a decrease of maritime piracy attacks in 2015, they still represent a serious global threat. The aim of this research note is to show points out the recent trend in pirate attacks in the three regions most affected, and briefly illustrates the main data sources.

The research note is structured as follows: the second section focuses on the literature dealing with maritime piracy and the related economic consequences; the third section presents the main data sources, and the fourth section outlines the three case studies; the fifth section shows conclusions and ideas for further research.

Literature Review

As mentioned, the activities of the pirates are a serious threat to the global economy, causing significant costs relating to security measures and seriously jeopardizing the economies of the coastal countries affected by the phenomenon. Despite this problem has global dimensions, analyses in economics made so far about the impact of maritime piracy are not enough.

From an economic point of view, maritime piracy affects the global navigation of naval and merchant vessels. Bensassi and Martínez-Zarzoso (2012) estimate the impact of piracy on maritime trade between Europe and Asia using data on incidents of maritime piracy between 1999 and 2008. They apply the gravity model, widely used to investigate the role played by specific policy or geographical variables in bilateral trade flows. Burlando, Cristea, and Lee (2014) lay out an empirical model of bilateral trade where piracy increases trade costs, and derive an augmented gravity equation to estimate the effect of pirate activities on trade volumes. Using a global panel data set combining information on bilateral volumes of trade and on reported pirate attacks, they show that the threat of violence and, more generally, the possibility of disruptions in the transportation network have a negative effect on trade.

Several academics have analyzed the economic consequences of maritime piracy on various issues. Bendall (2010) has addressed the impact of piracy on the cost of maritime trade; Fu, Ng, and Lau (2010) have investigated the impacts of maritime piracy on global economic development. Analyzing the data between 2003 and 2008, they attempt to explain the changes in economic losses experienced by the global shipping industry over time in terms of costs potentially produced by maritime piracy. They use a simulation model to investigate how maritime piracy might affect losses through the increasing cost of insurance, and the potentially increasing costs associated with ships being forced to take (longer) alternate routes to avoid the risk of maritime piracy.

Analyzing the efforts of private and public sector initiatives, Kerr (2013) shows that piracy imposes considerable costs on international commerce and taxpayers, thus inhibiting international trade. In another research, Martínez-Zarzoso and Bensassi (2013) test the effect of modern piracy on maritime trade cost, by proposing a simple model of transport cost determination and deriving a transport costs equation augmented with maritime piracy as an additional explanatory variable. Their results show a significant and positive impact of piracy

on maritime transport cost; in addition, they show that localized conflicts could selectively harm some international trade routes.

Besley, Fetzer, and Mueller (2015) study the consequences of trade costs for trade patterns. They develop a statistical model to calculate the frequency of piracy attacks in Indonesia and Somalia to estimate how much an upsurge in piracy raises shipping costs. They argue that the extra shipping costs are mostly due to the increased security measures that are needed to repel pirate attacks and hence constitute a welfare cost, as labor and resources are allocated from productive tasks to guard services. Therefore, by developing a model to compare this extraction of resources through pirate attacks to a tax on shipping that finances an equivalent transfer, they show that predation is a lot more costly as a form of extraction than taxation. Analyzing the case of the fisheries sector, Flückiger and Ludwig (2015) study the link between economic shocks in this sector and the incidence of piracy. Examining a panel of 109 coastal countries that spans the years 2004–2009, they use the variation in phytoplankton abundance off the individual countries' coasts as a source of economic shocks to the fishery industry. They argue that higher plankton abundance leads to an increase in the abundance of fish and, hence, to higher productivity in the fisheries sector: this signifies an improvement in economic conditions in this sector and therefore increases the opportunity cost for a fishermen to engage in piracy activity.

As well as on global trade, maritime piracy has significant repercussions on the development prospects of affected regional economies. In this regard, analyzing the specific case of Somalia, Shortland (2011) evaluates data collected by internationally funded non-governmental organizations (NGOs), monitoring rainfall and regional food and commodity prices, and demonstrate the impact of the piracy sector both on the local and on the national economy of Somalia. She argues that piracy has created employment and considerable multiplier effects in the Puntland economy even if a significant proportion of the proceeds from piracy are invested in foreign goods or are channeled back to foreign financiers. According to Shortland (2012), although coastal villages have gained little from hosting pirates, pirate incomes have widespread and produced significant positive impacts on the Somali economy. These positive economic impacts of piracy are widely spread and a military strategy to eradicate it could seriously undermine local development.

Shortland and Vothknecht (2010) quantitatively examine the period of high intensity counter-piracy operations off the coast of Somalia from January 2008 to June 2010. They show that improvements in private sector defensive measures have not resulted in a greater effectiveness of the transit corridor in the Gulf of Aden over time either, because pirates have

also changed their tactics in response. On the contrary, Vespe, Greidanus, and Alvarez (2015) analyze the declining impact of piracy on maritime routes and vessel behaviors in the Indian Ocean. Analyzing the data between 2009 and 2014, they show the effectiveness of the efforts put in place against piracy in the Western Indian Ocean.

Patrolling should have a deterrent effect on maritime piracy by reducing the probability of successful pirate attacks and increasing the probability of capture. The continuous patrolling of naval forces, as well as the private contract armed guards aboard ships, should be successful in weakening maritime piracy. However, we believe that maritime piracy cannot be eliminated solely with force-oriented initiatives, without addressing its root causes—i.e. political instability, endemic poverty, and the lack of security. In fact, to solve the problem of piracy, policy efforts should primarily be directed at strengthening economic conditions and the internal stability of the country.

Finally, in this regard, we stress the importance of the work carried out by of Daxecker and Prins (2012), which propose a general explanation of maritime piracy that emphasizes the importance of institutional and economic opportunities. Using a monadic-year unit of analysis that includes all states in the international system and cases from 1991 to 2007, they show a positive and statistically significant relationship between maritime piracy attacks and both state failure and economic opportunity.

Data

The main sources of data on maritime piracy incidents are the International Maritime Organization and the ICC International Maritime Bureau – Piracy Report Centre. In addition, data provided by the reports of the UN Operational Satellite Applications Programme (2014) and the UN Conference on Trade and Development (2014) are also remarkable.

International Maritime Organization

The International Maritime Organization (IMO) is a specialized agency of United Nations, that aims to develop and maintain a comprehensive regulatory framework for shipping. With the support and cooperation from the shipping industry, IMO has through the years developed and adopted a number of anti-piracy measures. The threat posed by piracy and armed robbery against ships has been on the IMO's agenda since the early 1980s. Information regarding acts of piracy and armed robbery against ships is publicly available in IMO's Piracy and Armed Robbery module within the IMO's Global Integrated Shipping Information System (GISIS).

ICC International Maritime Bureau – Piracy Reporting Centre

The ICC International Maritime Bureau (IMB) is a specialized division of the International Chamber of Commerce (ICC). The IMB is a non-profit making organization, established in 1981 to act as a focal point in the fight against all types of maritime crime and malpractice. Faced with at the increasing number of maritime piracy attacks, IMB established the Piracy Reporting Centre (PRC) in 1992. Based in Kuala Lumpur (Malaysia), PRC aims to raise awareness within the shipping industry of high-risk areas for piratical attacks and specific ports and anchorages associated with armed robberies on board ships. In doing so, PRC works closely with various governments and law enforcement agencies, sharing information in order to reduce and ultimately eradicate maritime piracy.

UN Operational Satellite Applications Programme

UNOSAT is the UN Institute for Training and Research (UNITAR) Operational Satellite Applications Programme. The program provides satellite solutions to humanitarian aid and sustainable development organizations. In 2014, UNOSAT has released the "Global

Report on Maritime Piracy. A geospatial analysis 1995-2013," which assesses piracy at the global level with detailed geo-spatial analyses. The report also covers the financial aspects of global piracy, as well as anti-piracy activities and future outlooks in a changing meteorological climate.

United Nations Conference on Trade and Development

The United Nations Conference on Trade and Development (UNCTAD) is the principal organ of the UN General Assembly dealing with trade, investment, and development issues. UNCTAD aims mainly to formulate policies related to all aspects of development including trade, aid, transport, finance, and technology. In 2014, UNCTAD has released the report "Maritime Piracy," which consists in two parts:

- the first part ("An Overview of Trends, Costs and Trade-related Implications") presents overall trends in maritime piracy and related crimes, and highlights some of the key issues at stake by focusing on its costs and broader trade-related implications;
- the second part ("An Overview of the International Legal Framework and of Multilateral Cooperation to Combat Piracy") provides an overview of the contemporary international legal regime for countering piracy and identifies key examples of international cooperation and multilateral initiatives to combat the phenomenon.

Finally, among the main sources of data on maritime piracy incidents, we also note the Anti-shipping Activity Messages (ASAM) database. ASAM serves as system for loading, storing and disseminating reports concerning acts of piracy and threats to shipping worldwide. The database includes the locations and descriptive accounts of specific hostile acts against ships and mariners. ASAM is edited by the U.S. National Geospatial-Intelligence Agency (NGA), which delivers world-class geospatial intelligence that provides a decisive advantage to policymakers, war-fighters, intelligence professionals, and first responders.

Case studies

As mentioned, maritime piracy is a major threat to international security, given the high density of maritime traffic. Comparing the data related to maritime piracy attacks in the last twenty years, it emerges that the most affected geographical areas have been mainly Gulf of Guinea, the Western Indian Ocean region, and Southeast Asia. The most intense period of this phenomenon has started in the mid-1990s, reaching its peak between 2008 and 2011 in the Western Indian Ocean. Since 2011, there has been a significant decrease in the number of attacks, particularly off the coast of Somalia, due to measures to combat maritime piracy adopted by the international community.

In this regard, the concerns raised by maritime piracy attacks, combined with a reduction in the overall level of defense budgets, have facilitated the practice to embark teams of armed guards on vessels that transit through the High Risk Areas. These teams can be made up of military or civilian staff—i.e. the Maritime Security Companies (MSCs). Although it has proved to be useful, this countermeasure involves high costs. Moreover, the threat of maritime piracy has pushed many traders to identify new routes or to increase cruising speed, so raising fuel consumption. In addition, insurance premiums for vessels in transit through the High Risk Areas have risen because of kidnapping and hostage-taking.

Therefore, in addition to being a threat to international security, maritime piracy involves high costs to the global economy. The analysis of the costs of maritime piracy is one of the least studied topics in the economic literature due to the availability of data. In addition, the reluctance of different actors—private and public—to share information makes evaluations and estimates to identify the economic impact of maritime piracy uncertain. This topic should be analyzed first by making a distinction between different types of maritime piracy costs. In fact, there are the direct costs—such as those resulting from payment of ransoms and insurance premiums, from changing routes and the increase in speed—and the indirect costs, related to the economic and commercial impact and security of the coastal countries affected by maritime piracy.

With regard to the costs, the main reference estimates are provided by Oceans Beyond Piracy (OBP), a program of the One Earth Future Foundation, a privately funded and independent non-profit organization based in Broomfield (Colorado, United States). OBP aims to produce objective and well-researched studies on several topics related to maritime

piracy, including the related costs. In 2015, OBP has released the "The State of Maritime Piracy 2015" report, which examines the human costs and economic costs incurred as a result of maritime piracy occurring in the Gulf of Guinea, the Western Indian Ocean region, and Southeast Asia.

Gulf of Guinea

In 2015, the total costs related to maritime piracy in the Gulf of Guinea were US$ 719.6 million. The international community, regional states, and the shipping industry incurred significant costs while combating or preventing maritime piracy through capacity building, naval operations, contracted security, and ship protection measures. Those costs are estimated to amount to US$ 635 million, of which US$ 196.8 million have been spent to hire armed teams drawn from a state's armed forces or law enforcement agencies. There are also costs incurred as a consequence of maritime piracy—such as ransoms paid to recover hostages, increased labor costs, and insurance rates—that is estimated to be around US$ 84 million.

Western Indian Ocean

According to OBP data, in 2015 the international community spent around US$ 1.3 billion on measures designed to keep vessels safe from pirates in the Western Indian Ocean region. In particular: the estimated total cost of counter-piracy naval operations was around US$ 323 million; the shipping industry spent around US$ 618 million on guards for cargo and tanker vessels; the cost of increased speeds as a maritime piracy counter-measure is estimated to be US$ 272 million. Finally, the other costs associated with maritime piracy amount to US$ 129.2 million.

Southeast Asia

Economic costs of Southeast Asia were not calculated for the "The State of Maritime Piracy 2015" report. In fact, the complexity of shipping patterns and the nature of regional responses precluded OBP's ability to estimate aggregate costs of 2015. However, OBP points out that significant additional costs are directly attributable to countering piracy, especially in information-sharing efforts and military cooperation. In addition, there are also significant costs incurred as a consequence of maritime piracy, such as the theft of cargo ships. Pirates aim mainly to hijack oil tankers, and then sell their cargo to black market buyers. According to OBP data, the total value of oil products stolen in 2015 totaled US$ 8 million.

In conclusion, the total cost of maritime piracy to the global economy, during the year 2015, is estimated to be over US$ 7.2 billion. Yet, it is estimated that the actual gain of the pirates is minimized: in fact, according to security experts, the overall gain of pirates is about 1 percent than the total costs caused by maritime piracy. Around 10 percent of the total cost of maritime piracy is attributed to the economic consequences on countries affected by this phenomenon. In the literature, there are few contributions concerning the economic impact of maritime piracy on these countries, and mostly with a qualitative approach. As mentioned, this is primarily due to the availability of data on the coastal countries affected by maritime piracy.

Conclusions

Maritime piracy is a serious threat to the global economy causing significant costs, mainly relating to security measures, and affects the international trade. In particular, the activities of pirates inevitably cause a significant increase in the freight costs, especially in the High Risk Areas: insurance premiums for vessels in transit through the High Risk Areas have risen because of kidnapping and hostage-taking, and many traders prefer to sail new routes or to increase cruising speed, so raising fuel consumption.

According to the data related to maritime piracy provided by the International Maritime Bureau, the most affected regions in the last twenty years have been the Gulf of Guinea, the Western Indian Ocean region, and Southeast Asia. In particular, the most intense period of this phenomenon has been since the mid-1990s, reaching its peak between 2008 and 2011 in the Western Indian Ocean. Afterwards, there has been a significant decrease in the number of attacks due to the measures to combat maritime piracy adopted by the international community. However, the practice to embark teams of armed guards on vessels that transit through the High Risk Areas has been as useful as extremely expensive.

According to OBP data, in 2015 the estimated total cost of measures designed to keep vessels safe from pirates in the Western Indian Ocean region was about US$ 1.3 billion, of which around US$ 618 million to hire guards for cargo and tanker vessels. Instead, in the Gulf of Guinea, the total costs related to maritime piracy were US$ 719.6 million, of which US$ 196.8 million were spent to hire armed teams drawn from a state's armed forces or law enforcement agencies.

The recent decrease of maritime piracy attacks represents an undoubted success of the military strategy carried out by the international community in the High Risk Areas. On the other hand, according to security experts, the overall gain of pirates is minimized compared to the total costs to combat maritime piracy, to which we must also add the costs attributed to the impact on international trade and the economic consequences on countries affected by this phenomenon.

In this regard, we believe that it is interesting to analyze these two topics in economics, by applying quantitative methods. Despite the difficulties due to the availability of reliable data on some countries affected by maritime piracy, we think it is still possible to conduct a quantitative analysis of the impact of maritime piracy on the economies of these countries and

their trade flows. Therefore, this type of research would enrich the economic literature on quantitative analysis of maritime piracy.

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Maritime Piracy in Sub-Saharan Africa

Quantitative analysis of the impact on economic growth

Abstract

During the last decades, the activities of pirates have increased exponentially in Sub-Saharan Africa, and their incidents have become considerably more violent. In addition to the intrastate and interstate conflicts and the lack of state capacity, maritime piracy is a serious and sustained threat to economic growth of the region. Indeed, Sub-Saharan African countries that suffer from maritime piracy experience much higher levels of economic deprivation. Their economies are tied to the seas, which are the medium for which most of trade and transactions are conducted. The aim of this paper focuses on the impact of maritime piracy on the economic growth of the coastal countries over the 1994 to 2013. The purpose is to find the evidence to indicate how maritime piracy has affected the economic growth of Sub-Saharan Africa.

Keywords: Africa, Economic Growth, International Economics, Security

Introduction

The African continent includes 54 sovereign states, 48 of which make up the geopolitical area in the economic literature conventionally called Sub-Saharan Africa. The population of the vast Sub-Saharan region has grown rapidly over the last decades: according to the World Bank (2015), Sub-Saharan population has grown by over 667,740 million inhabitants in 2000 to over 1 billion inhabitants in 2015. According to the "2015 World Population Data Sheet" prepared by the Population Reference Bureau (PRB), Sub-Saharan population will be more than double in 2050 (over 2,1 billion inhabitants). However, Sub-Saharan Africa is still one of the most deprived and least developed regions of the world. The lack of state capacity, intrastate and interstate conflicts, political instability, high rates of AIDS and HIV, and high child mortality, are among the major factors that have affected on economic trends in the region over the last years.

In Sub-Saharan Africa, a high proportion of the population lives in extreme poverty. Therefore, the area represents a priority for international aid, such as subsidized loans or donations, which comes from international institutions—particularly, the Food and Agriculture Organization of the United Nations, the International Monetary Fund, and the World Bank—development aid agencies and by individual states, besides non-governmental organizations and foundations. International institutions interact with national policies, imposing conditions negotiated with governments who receive aids that are an important source of financing for investment, as well as foreign direct investment (FDI). However, the political and institutional fragility indices—such as the number of conflicts, cases of corruption, etc.—show Sub-Saharan Africa as a not conducive region for productive investment. Despite the recent economic growth and structural reforms to create more conducive environment for business and investment, the lack of state capacity does not guarantee to attract FDI and to boost trade.

In the last twenty years, the presence of China has increased in Sub-Saharan Africa, both in terms of aids, trade and FDI. Given that the region is significantly less-developed and politically unstable, China has been seeking a greater role as regional security provider. In particular, the maritime security—especially off the coast of the Horn of Africa and the Gulf of Guinea—is intrinsically China's top priority in its foreign policy. China has been actively participating in international cooperation to fight maritime piracy off the coast of Sub-Saharan

Africa. In addition, China dispatched People's Liberation Army Navy's escort missions to the Gulf of Aden before the end of 2008 under authorization by UN Security Council Resolutions. Recently, China has also begun building a naval base in Djibouti to establish a strategic foothold in close proximity to the oil trade routes from the Middle East and to the Indian Ocean.

The significant flow of ships in the Horn of Africa and the Gulf of Guinea has allowed pirates to establish safe harbors from which to attack a plethora of available targets. Since mid-2000s, maritime piracy off the coast of Sub-Saharan Africa has become considerably more violent, and successful attacks have had significant consequences: hijacked ships, kidnapped crews, expensive ransom negotiations, and loss of lives.

The global cost of maritime piracy remains uncertain, with existing assessments providing divergent estimates and conclusions. Oceans Beyond Piracy is a project of the One Earth Future Foundation, a privately funded and independent non-profit organization located in Colorado (United States). Oceans Beyond Piracy was launched in 2010 with the intent to develop researches and analyses on the contemporary maritime piracy. According to its estimates, the total annual cost of maritime piracy for the global economy, in the period between 2008 and 2011, has amounted to around US$ 5 billion every year. The 63 percent of it is represented by costs of protection, while the 24 percent is made up of the costs of the international efforts to tackle to maritime piracy and are mostly carried out by the States and the international organizations. The 9 percent can be attributed to the negative effects for the economies of the neighboring countries and causes a reduction of GDP of the affected countries, whereas only 2 percent is represented by the real and material costs of maritime piracy. Against the cost of maritime piracy in the Gulf of Aden that can be estimated being over US$ 5 billion; this means that the actual return for those who are the primary cause of it is worth less than US$ 50 billion per year.

Despite the interest in the global economic security, maritime piracy is one of the least analyzed aspects. In particular, in the case of Sub-Saharan Africa, the research on the economic consequences of maritime piracy has not been significative. Therefore, the purpose of this paper is to test the severity of the attacks of maritime piracy in Sub-Saharan Africa, and their impact on the GDP growth rate of the coastal countries over the 1994 to 2013. The paper is structured as follows: the second section focuses on the literature dealing with the consequences of maritime piracy on economic growth; the third section presents the data used, and the fourth section outlines the model, empirical estimation and main results; the fifth section shows conclusions and ideas for further research.

Literature Review

In the past, the conflicts in Sub-Saharan Africa created a strong political instability, which has negatively affected countries' economy. Intrastate and interstate conflicts have destroyed the infrastructures and created hostilities, which have limited trade and FDI. Nevertheless, the economic growth of Sub-Saharan African countries has not been affected significantly. Since 1995, it has averaged more than 5 percent per year, reversing a two-decade decline of real income per capita. Several scholars have been advanced about the effect of trade and FDI—as well as international aid, regime type, and violence—on economic growth. However, mixed empirical findings have resulted in a long-standing debate in academic literature. Since the works about this topic are numerous, it has been preferred to analyze the main recent works on the sub-Saharan African region.

Museru, Toerien, and Gossel (2014) investigate the effects of international aid and the volatility of public investment on economic growth in 26 Sub-Saharan African countries over the period from 1992 to 2011. Three volatility variables comprising aid, government revenue, and public investment are incorporated into one aid-growth model to test for their effect on economic growth. Using the Generalized Method of Moments technique and averaged data for five four-year sub-periods, they show that although international aid has a positive impact on economic growth once potential endogeneity has been accounted for, aid effectiveness may have been eroded by volatility in public investment. Adams, Evans, and Opoku (2015) examine the effect of FDI on economic growth and determine how the regulatory regime of the countries affects the relationship between FDI and economic growth for 22 Sub-Saharan African countries for the period 1980–2011. Using General Methods of Moments estimation technique, the findings of their study show that both FDI and regulations (total regulations, credit market regulations, business regulations and labor market regulations) do not have an independent significant effect; however, the interaction has a significant positive effect on economic growth. This implies that the economic growth effect of FDI is stimulated in the presence of effective and quality regulations. Therefore measures have to be put in place to strengthen regulations in Sub-Saharan Africa in order to realize the benefits of FDI.

Analyzing the Sub-Saharan African countries, P. K. Narayan, S. Narayan, and Smyth (2011) examine the relationship between democracy and economic growth. As proxy for democracy they first use the democracy index constructed by Freedom House and then check

the sensitivity of their findings using, as an alternative proxy for democracy, the Legislative Index of Electoral Competitiveness (LIEC). They find support for the Lipset hypothesis—that is to say, in the long run, real GDP Granger causes democracy and an increase in GDP results in an improvement in democracy—in Botswana and Niger with both datasets, for Chad with the Freedom House data only and for Cote d'Ivoire and Gabon with the LIEC data only. Support for the compatibility hypothesis—in the long run democracy Granger causes real income and an increase in democracy has a positive effect on real income—is found for Botswana with the Freedom House data and for Madagascar, Rwanda, South Africa and Swaziland with the LIEC data. Support for the conflict hypothesis—in the long run democracy Granger causes real income and an increase in democracy has a negative effect on real income—is found for Gabon with the Freedom House data and Sierra Leone with the LIEC data. Knutsen (2013) discusses how regime type and state capacity may interact in affecting economic growth. The empirical analysis finds a positive and robust effect of democracy on economic growth in Sub-Saharan Africa, a continent historically characterized by weak-capacity states. Furthermore, he identifies a robust interaction effect between democracy and state capacity on economic growth, both in Africa and globally; the effect of democracy on economic growth increases when state capacity is reduced. Democracy is estimated to have a positive effect on economic growth in weak-capacity states, but not in high-capacity states. Additionally, the results indicate that state capacity enhances economic growth only in dictatorships.

Starr (2010) uses time-series methods to examine interrelationships between economic growth and violent conflict in Sub-Saharan Africa. Results show bidirectional causalities, but the key determinant of conflict risk is prior conflict experience, not fluctuations in economic growth. Blomberg, Broussard, and Hess (2011) explore the extent to which the nascent economic growth in Sub-Saharan Africa is sustainable or not due to higher incidences of terrorism and commodity price declines. Their analysis is based on a rich unbalanced panel data set with annual observations on 46 countries from 1968 to 2004. They explore these data with cross-sectional and panel growth regression analysis and quantile regressions. They estimate the economic and statistical effect of terrorism on growth in Sub-Saharan Africa, controlling for a variety of other factors. They thus investigate the extent to which there appears to be a structural break in the estimated relationships. The result of this analysis is that the terrorist-oriented fragility of Sub-Saharan Africa has increased in the most recent period. They find that most of the fragility can be explained by the economic growth in countries that are primary fuel exporters. Indeed, their evidence points to the fact that

resource-rich countries have not done an adequate job of investing in counter-terrorist policies.

In the literature, there are few contributions concerning the impact of maritime piracy on economic growth, and mostly with a qualitative approach. Political and economic conditions are the main factors to enable the conditions of corruption and crime within a country. In particular, these conditions encourage maritime piracy off the coast of Sub-Saharan Africa, affecting especially the economic growth and development of the coastal countries. Daxecker and Prins (2015) propose a general explanation of maritime piracy that emphasizes the importance of institutional and economic opportunities. Using a monadic-year unit of analysis that includes all States in the international system and cases from 1991 to 2007, they show a positive and statistically significant relationship between piracy attacks and both State failure and economic opportunity.

Over the past few years, an extensive literature has developed around the economic consequences of maritime piracy. Analyzing the specific case of Somalia, Shortland (2011) evaluates data collected by internationally funded non-governmental organizations (NGOs), monitoring rainfall and regional food and commodity prices, and demonstrating the impact of the piracy sector both on the local and on the national economy of Somalia. She argues that piracy has created employment and considerable multiplier effects in the Puntland economy even if a significant proportion of the proceeds from piracy are invested in foreign goods or are channeled back to foreign financiers. According to Shortland (2012), although coastal villages have gained little from hosting pirates, pirate incomes have widespread and significant positive impacts on the Somali economy. These positive economic impacts of piracy are widely spread and a military strategy to eradicate it could seriously undermine local development.

The impacts of maritime piracy affect not only the region, but also the global economy (e.g., the transport sector). Martínez-Zarzoso and Bensassi (2013) test the effect of modern maritime piracy on maritime trade cost proposing a simple model of transport cost determination and deriving a transport costs equation augmented with maritime piracy as an additional explanatory variable. Their results show a significant and positive impact of maritime piracy on maritime transport cost; in addition, they show that localized conflicts could selectively harm some international trade routes.

Maritime piracy affects international trade through an increased insecurity concerning the goods delivery. Analyzing the data between 2003 and 2008, Fu, Ng, and Lau (2010) have investigated the impacts of maritime piracy on global economic development. They attempt to

explain the changes in economic losses experienced by the global shipping industry over time in terms of costs potentially produced by maritime piracy. They use a simulation model to investigate how maritime piracy might affect losses through the increasing cost of insurance, and the potentially increasing costs associated with ships being forced to take (longer) alternate routes to avoid the risk of piracy.

In another research, Bensassi and Martínez-Zarzoso (2012) estimate the impact of maritime trade between Europe and Asia using the data on piracy incidents between 1999 and 2008. They apply the gravity model, widely used to investigate the role played by specific policy or geographical variables in bilateral trade flows. Burlando, Cristea, and Lee (2014) lay out an empirical model of bilateral trade where piracy increases trade costs, and derive an augmented gravity equation to estimate the effect of pirate activities on trade volumes. Using a global panel data set combining information on bilateral volumes of trade and on reported pirate attacks, they show that the threat of violence and, more generally, the possibility of disruptions in the transportation network have a negative effect on trade.

A study by the World Bank (2013) estimates the risk of piracy off the coast of Somalia to equate about a 1 percent ad valorem rise in trade costs, acting as a hidden tax on world trade. With over US$ 1 trillion of international trade passing through the affected area, the overall cost of piracy to global trade is assessed at about US$18 billion. Meanwhile, trade costs in Somalia alone are estimated at US$ 6 million annually, not including the impact on other sea-based economic activities.

Given the significant dependence of Sub-Saharan African countries on international trade, the increase in acts of maritime piracy is clearly a serious threat to the economies of the region. In this paper, we focus on the impact of maritime piracy on economic growth. In doing so, we analyze the economic growth rates of Sub-Saharan African coastal countries, considering maritime piracy attacks as variables.

Data

According to United Nations Statistics Division, Sub-Saharan African countries lie fully, or partially, south of the Sahara desert. They can be classified according to the economic opportunities offered by the geographic location, which could offer different potential for growth and development. The coastal countries can benefit from lower transportation costs and easier integration in international trade, while the non-coastal and resource-poor countries would be penalized in access to international trade from the 'landlocked' position, in low-income areas or in conditions of conflict.

The sample analyzed here is made up of the Sub-Saharan African coastal countries; in particular, this paper registers the variations related to the geopolitical conditions over the period between 1994 and 2013. The selected countries are:

Angola	Kenya
Benin	Liberia
Cameroon	Madagascar
Democratic Republic of the Congo	Mauritania
Congo	Mozambique
Côte d'Ivoire	Nigeria
Djibouti	São Tomé and Príncipe
Equatorial Guinea	Senegal
Eritrea	Seychelles
Gabon	Sierra Leone
Gambia	Somalia
Ghana	South Africa
Guinea	Tanzania
Guinea-Bissau	Togo

Due to not available or insufficient data, have not been selected the following countries:

Cabo Verde	Namibia
Comoros	Réunion (FRA)

Mauritius	Saint Helena (GBR)
Mayotte (FRA)	TAAF (FRA) *

* *Terres Australes et Antarctiques Françaises*

The source of data on maritime piracy incidents is the ICC International Maritime Bureau. It is a specialized division of the International Chamber of Commerce (ICC) established in 1981 to act as a focal point in the fight against all types of maritime crime and malpractice. It maintains a round-the-clock watch on the global shipping lanes, reporting pirate attacks to local law enforcement and issuing warnings about piracy hotspots to shipping.

The economic data are compiled by the World Bank that allows free and open access to data on development in different countries around the globe.

The geographic data are compiled by the World Factbook, which is a reference resource produced by the Central Intelligence Agency that provides information on the history, people, government, economy, geography, communications, transportation, military, and transnational issues for over 250 world entities.

Finally, the source of State Fragility Index and Matrix is the Integrated Network for Societal Conflict Research (INSCR), established to coordinate and integrate information resources produced and used by the Center for Systemic Peace (CSP). The research of CSP is on the problem of political violence within the structural context of the dynamic global system, that is, global systems analysis. CSP supports scientific research and quantitative analysis in many issue areas related to the fundamental problems of violence in both human relations and societal-systemic development processes.

Methodology

To determine the influence of maritime piracy on economic growth, the study relies upon longitudinal data (also known as panel data), which reckon with 26 countries and different variables over a period of 20 years. Description and descriptive statistics of these variables are reported in the two following tables.

Table 1: Description of variables

Name	Definition
country	Country
year	Year
coastline	Length of coastline (km)
gdpgrowth	GDP growth (annual %)
popgrowth	Population growth (annual %)
fdi	FDI - Inward and outward flows and stock (annual %)
tradegrowth	Trade growth (annual %)
piracyattacks	Maritime piracy attacks
fragility	Fragility Index
effectiveness	Effectiveness Score
legitimacy	Legitimacy Score
securityeff	Security Effectiveness
securityleg	Security Legitimacy
politeff	Political Effectiveness
politleg	Political Legitimacy
economeff	Economic Effectiveness
economleg	Economic Legitimacy
socialeff	Social Effectiveness
socialleg	Social Legitimacy

Table 2: Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
gdpgrowth	518	5.035	10.499	-30.145	149.973
coastline	520	1016.385	1167.903	37.000	4828.000
popgrowth	518	2.666	0.766	-0.912	7.836
fdi	520	5.390	11.006	-65.411	90.456
tradegrowth	520	20.879	145.086	-87.227	3207.692
piracyattacks	520	3.052	11.266	0	159
fragility	494	16.119	3.929	7	25
effectiveness	494	8.506	2.394	2	13
legitimacy	494	7.613	2.239	2	12
securityeff	494	0.785	0.963	0	3
securityleg	494	1.427	0.822	0	3
politeff	494	2.051	0.968	0	3
politleg	494	1.405	1.095	0	3
economeff	494	3.154	1.055	0	4
economleg	494	2.235	0.998	0	3
socialeff	494	2.516	0.596	1	3
socialleg	494	2.547	0.622	0	3

It is worth mentioning that State Fragility Index and Matrix variables are reverse-scored, i.e. higher values correspond to lower fragility of its elements. These variables are not available for the year 1994; therefore, we run two versions of each regression model—with and without controlling State Fragility Index and Matrix to check the robustness of findings.

As part of a preliminary analysis, we look at the correlation between Maritime piracy attacks and GDP growth in each of the countries. Overall correlation between the two variables is very weak and statistically insignificant ($r = 0.0144$, $p = 0.743$). It appeared that moderate negative correlations are characteristic of Guinea ($r = -0.450$, $p = 0.046$), The Gambia ($r = -0.457$, $p = 0.043$), and Madagascar ($r = -0.607$, $p = 0.005$). The insignificance of

the maritime piracy effect for other countries may be partly due to some unobserved characteristics such as lower fragility, better law enforcement and military defense.

Therefore, the isolated effect of maritime piracy may be negative, but these individual country characteristics can prevent negative consequences of these attacks. It is possible that the effect will become more pronounced when we account for country-specific effects or add some control variables.

Table 3: Correlations

country			piracyattacks	gdpgrowth
Angola	piracyattacks	Pearson Correlation	1	.134
		Sig. (2-tailed)		.573
		N	20	20
	gdpgrowth	Pearson Correlation	.134	1
		Sig. (2-tailed)	.573	
		N	20	20
Benin	piracyattacks	Pearson Correlation	1	-.250
		Sig. (2-tailed)		.288
		N	20	20
	gdpgrowth	Pearson Correlation	-.250	1
		Sig. (2-tailed)	.288	
		N	20	20
Cameroon	piracyattacks	Pearson Correlation	1	.089
		Sig. (2-tailed)		.709
		N	20	20
	gdpgrowth	Pearson Correlation	.089	1
		Sig. (2-tailed)	.709	
		N	20	20
Congo, Dem. Rep.	piracyattacks	Pearson Correlation	1	.416
		Sig. (2-tailed)		.068
		N	20	20
	gdpgrowth	Pearson Correlation	.416	1
		Sig. (2-tailed)	.068	
		N	20	20
Congo, Rep.	piracyattacks	Pearson Correlation	1	.153

		Sig. (2-tailed)		.519
		N	20	20
	gdpgrowth	Pearson Correlation	.153	1
		Sig. (2-tailed)	.519	
		N	20	20
Cote d'Ivoire	piracyattacks	Pearson Correlation	1	-.004
		Sig. (2-tailed)		.986
		N	20	20
	gdpgrowth	Pearson Correlation	-.004	1
		Sig. (2-tailed)	.986	
		N	20	20
Djibouti	piracyattacks	Pearson Correlation	1	.316
		Sig. (2-tailed)		.175
		N	20	20
	gdpgrowth	Pearson Correlation	.316	1
		Sig. (2-tailed)	.175	
		N	20	20
Equatorial Guinea	piracyattacks	Pearson Correlation	1	-.131
		Sig. (2-tailed)		.582
		N	20	20
	gdpgrowth	Pearson Correlation	-.131	1
		Sig. (2-tailed)	.582	
		N	20	20
Eritrea	piracyattacks	Pearson Correlation	1	.120
		Sig. (2-tailed)		.636
		N	20	18
	gdpgrowth	Pearson Correlation	.120	1
		Sig. (2-tailed)	.636	
		N	18	18
Gabon	piracyattacks	Pearson Correlation	1	-.308
		Sig. (2-tailed)		.187
		N	20	20
	gdpgrowth	Pearson Correlation	-.308	1
		Sig. (2-tailed)	.187	
		N	20	20
Gambia, The	piracyattacks	Pearson Correlation	1	-.457*

		Sig. (2-tailed)		.043
		N	20	20
	gdpgrowth	Pearson Correlation	-.457*	1
		Sig. (2-tailed)	.043	
		N	20	20
Ghana	piracyattacks	Pearson Correlation	1	.254
		Sig. (2-tailed)		.281
		N	20	20
	gdpgrowth	Pearson Correlation	.254	1
		Sig. (2-tailed)	.281	
		N	20	20
Guinea	piracyattacks	Pearson Correlation	1	-.450*
		Sig. (2-tailed)		.046
		N	20	20
	gdpgrowth	Pearson Correlation	-.450*	1
		Sig. (2-tailed)	.046	
		N	20	20
Guinea-Bissau	piracyattacks	Pearson Correlation	1	-.074
		Sig. (2-tailed)		.758
		N	20	20
	gdpgrowth	Pearson Correlation	-.074	1
		Sig. (2-tailed)	.758	
		N	20	20
Kenya	piracyattacks	Pearson Correlation	1	-.259
		Sig. (2-tailed)		.270
		N	20	20
	gdpgrowth	Pearson Correlation	-.259	1
		Sig. (2-tailed)	.270	
		N	20	20
Liberia	piracyattacks	Pearson Correlation	1	-.236
		Sig. (2-tailed)		.316
		N	20	20
	gdpgrowth	Pearson Correlation	-.236	1
		Sig. (2-tailed)	.316	
		N	20	20
Madagascar	piracyattacks	Pearson Correlation	1	-.607**

		Sig. (2-tailed)		.005
		N	20	20
	gdpgrowth	Pearson Correlation	-.607**	1
		Sig. (2-tailed)	.005	
		N	20	20
Mauritania	piracyattacks	Pearson Correlation	1	.290
		Sig. (2-tailed)		.216
		N	20	20
	gdpgrowth	Pearson Correlation	.290	1
		Sig. (2-tailed)	.216	
		N	20	20
Mozambique	piracyattacks	Pearson Correlation	1	-.289
		Sig. (2-tailed)		.216
		N	20	20
	gdpgrowth	Pearson Correlation	-.289	1
		Sig. (2-tailed)	.216	
		N	20	20
Nigeria	piracyattacks	Pearson Correlation	1	.411
		Sig. (2-tailed)		.072
		N	20	20
	gdpgrowth	Pearson Correlation	.411	1
		Sig. (2-tailed)	.072	
		N	20	20
Senegal	piracyattacks	Pearson Correlation	1	.246
		Sig. (2-tailed)		.295
		N	20	20
	gdpgrowth	Pearson Correlation	.246	1
		Sig. (2-tailed)	.295	
		N	20	20
Sierra Leone	piracyattacks	Pearson Correlation	1	-.007
		Sig. (2-tailed)		.977
		N	20	20
	gdpgrowth	Pearson Correlation	-.007	1
		Sig. (2-tailed)	.977	
		N	20	20
Somalia	piracyattacks	Pearson Correlation	1	.168

		Sig. (2-tailed)		.479
		N	20	20
	gdpgrowth	Pearson Correlation	.168	1
		Sig. (2-tailed)	.479	
		N	20	20
South Africa	piracyattacks	Pearson Correlation	1	.038
		Sig. (2-tailed)		.874
		N	20	20
	gdpgrowth	Pearson Correlation	.038	1
		Sig. (2-tailed)	.874	
		N	20	20
Tanzania	piracyattacks	Pearson Correlation	1	.234
		Sig. (2-tailed)		.320
		N	20	20
	gdpgrowth	Pearson Correlation	.234	1
		Sig. (2-tailed)	.320	
		N	20	20
Togo	piracyattacks	Pearson Correlation	1	.007
		Sig. (2-tailed)		.976
		N	20	20
	gdpgrowth	Pearson Correlation	.007	1
		Sig. (2-tailed)	.976	
		N	20	20

**. Correlation is significant at the 0.05 level (2-tailed)*

***. Correlation is significant at the 0.01 level (2-tailed)*

Pooled regression model

First, we run several regression models without accounting for the panel data structure, i.e. the pooled regression model of *gdpgrowth* on various regressors (see Table 4). This helps us identify some of the most general relationships and also get rid of a few outliers.

While *fragility* is a significant predictor of GDP growth (at 5% significance level), one of its aspects (*effectiveness*) is significant at 1% level and is, therefore, somewhat more informative (Model 2).

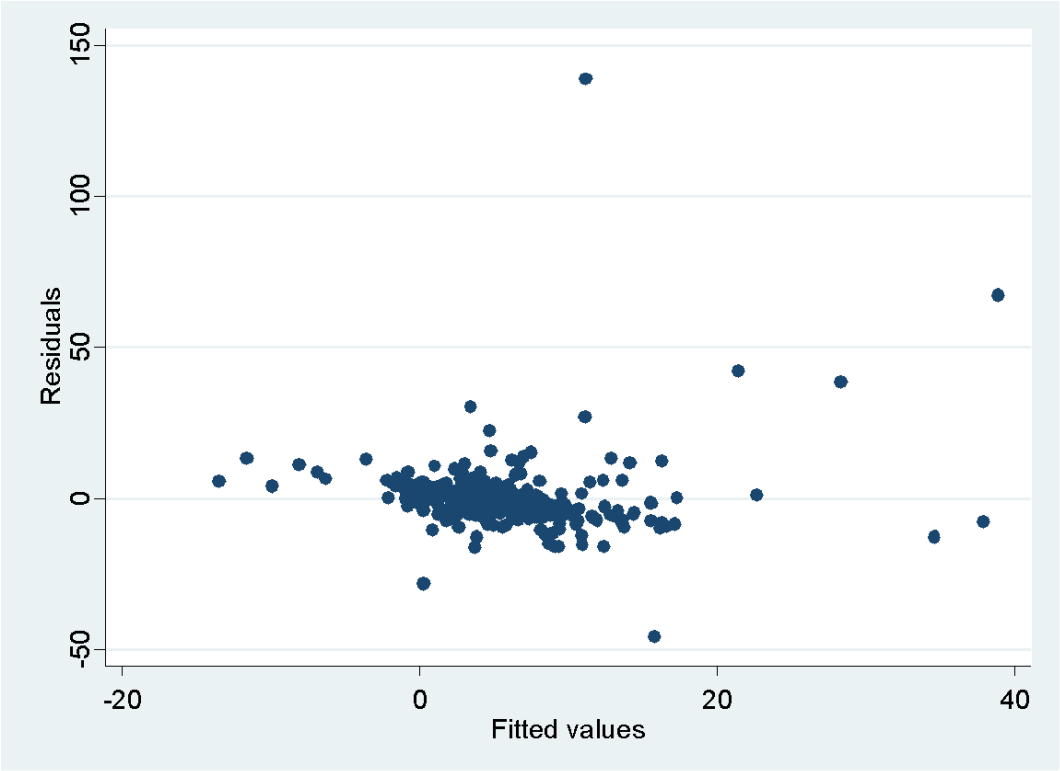
Table 4: Parameter estimates (Models 1–3)

	(1)	(2)	(3)
	gdpgrowth	gdpgrowth	gdpgrowth
coastline	-0.000464*	-0.000353	-0.000371
	(0.000266)	(0.000252)	(0.000256)
popgrowth	4.850***	5.019***	4.256***
	(1.289)	(1.319)	(1.162)
fdi	0.217**	0.215**	0.226**
	(0.107)	(0.106)	(0.109)
tradegrowth	0.00482*	0.00488*	0.00552
	(0.00290)	(0.00288)	(0.00336)
piracyattacks	0.0234	0.0259	0.00776
	(0.0184)	(0.0181)	(0.0163)
fragility	-0.180**		
	(0.0899)		
effectiveness		-0.497***	
		(0.186)	
_cons	-5.759	-4.992	-7.301**
	(3.706)	(3.433)	(3.048)
N	492	492	518
R^2	0.200	0.208	0.190
adj. R^2	0.191	0.198	0.182
AIC	3616.9	3612.1	3808.0
BIC	3646.3	3641.5	3833.5

Standard errors in parentheses
*p< 0.1, **p< 0.05, ***p< 0.01

The model with the highest adjusted R^2 and the lowest information criteria is Model 2. The analysis of residuals (see Figure 1) shows no obvious specification problems, but there might be several influential observations.

Figure 1: Residuals vs. fitted plot based on Model 2 residuals



To identify outliers, we compute a commonly used measure called Cook's distance. If Cook's distance is higher than 4/n, i.e., in our case higher than 0.0081, the observation is considered an outlier. According to other criteria, Cook's distance higher than 1 indicates a severe outlier. We omit only a few observations with Cook's distance higher than 0.1 (6 observations) to get rid of the most influential observations, but still retain the major part of our sample. Then, we re-estimate Models 1-3 without the most influential observations (see Table 5).

Table 5: Parameter estimates (Models 1–3, after deleting outliers)

	(1)	(2)	(3)
	gdpgrowth	gdpgrowth	gdpgrowth
coastline	-0.000164	-0.0000954	-0.000117
	(0.000182)	(0.000177)	(0.000181)
popgrowth	2.701***	2.765***	2.577***
	(0.443)	(0.454)	(0.440)
fdi	0.0884***	0.0879***	0.0904***
	(0.0296)	(0.0286)	(0.0297)
tradegrowth	0.0282***	0.0283***	0.0285***
	(0.0104)	(0.0102)	(0.0103)

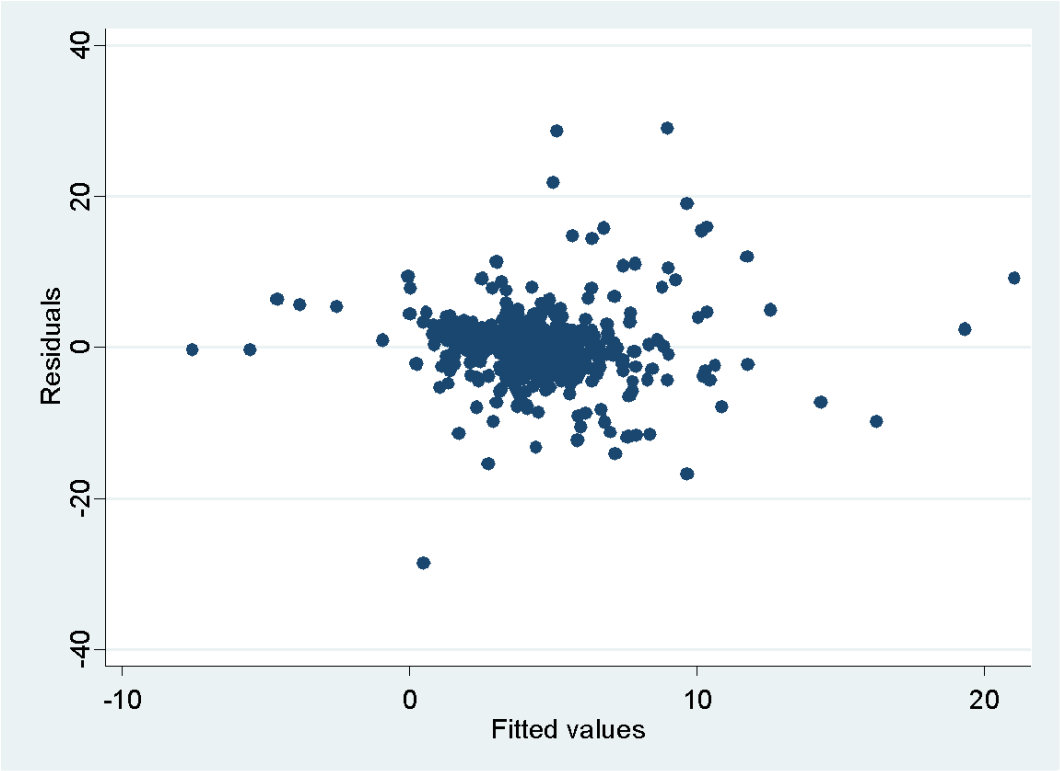
piracyattacks	0.0212	0.0196	0.00987
	(0.0170)	(0.0167)	(0.0154)
fragility	-0.126**		
	(0.0591)		
effectiveness		-0.260**	
		(0.114)	
_cons	-1.366	-1.417	-3.093***
	(1.458)	(1.318)	(1.107)
N	486	486	486
R^2	0.212	0.216	0.205
adj. R^2	0.202	0.207	0.196
AIC	2937.2	2934.4	2939.7
BIC	2966.5	2963.7	2964.8

Standard errors in parentheses
$^{*}p< 0.1$, $^{**}p< 0.05$, $^{***}p< 0.01$

Even though Model 1 and Model 2 are of similar quality, Model 2 is slightly better in terms of a higher adjusted R^2 and lower information criteria. This indicates that *effectiveness* variable is slightly more informative than a more general *fragility* variable.

This model is economically meaningful and explains more than 20% of the GDP growth's variance: Population Growth, Trade Growth, and FDI are significant at 1% level while lower *effectiveness* (higher value of Effectiveness Score) corresponds to a lower GDP growth ($p< 0.05$). Maritime piracy attacks have an insignificant impact on GDP growth according to the pooled model.

Figure 2: Residuals vs. fitted plot based on Model 2 residuals (after deleting outliers)



Even though the residuals vs. fitted plot does not indicate very obvious heteroscedasticity (see Figure 2), according to the Breush-Pagan's test of heteroscedasticity the homogeneity of residual variance assumption is not met ($\chi^2(1) = 61.25$, $p < 0.001$). Then, we use robust standard errors to estimate Models 1–3.

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of gdpgrowth

chi2(1)     =  61.25
Prob>chi2   =   0.0000
```

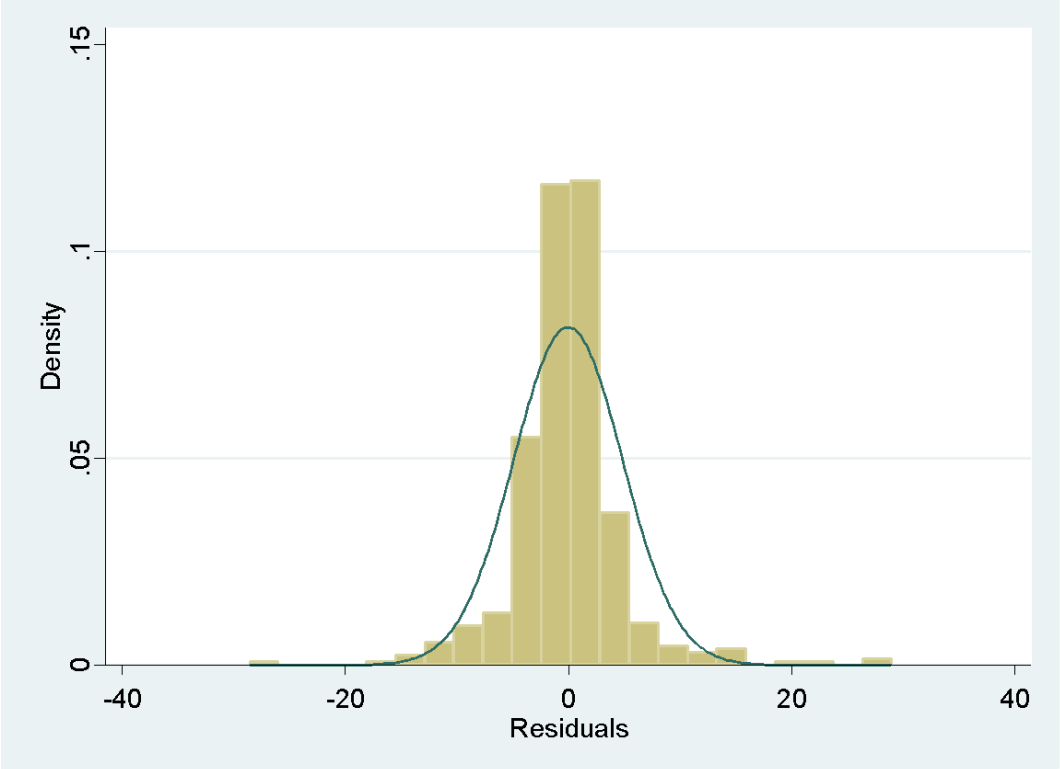
Model 2 does not suffer from inflated standard errors caused by multicollinearity, as indicated by the fact that all variance inflation factors (VIFs) are only slightly higher than 1 and are far from a commonly used threshold value of 5.

```
    Variable |       VIF       1/VIF
-------------+----------------------
popgrowth    |      1.10    0.912568
effectiven~s |      1.08    0.924487
piracyatta~s |      1.08    0.929427
coastline    |      1.04    0.960411
```

```
fdi          |      1.04    0.964621
tradegrowth  |      1.03    0.975515
-------------+----------------------
    Mean VIF |      1.06
```

Finally, the distribution of Model 2 residuals is close to being normal (see Figure 3), which is a desirable requirement for p-values to be valid.

Figure 3: Histogram of residuals (based on Model 2)



Fixed effects of panel regression model

Since there might be some unobserved country-specific effects that are correlated with maritime piracy attacks, we account for individual country effects by using the fixed effects models with robust standard errors (see Table 6). Coastline is a time-invariant variable; therefore, it is omitted from the regressions.

Table 6: Parameter estimates (Fixed effects Models 4–6, after deleting outliers)

	(4)	(5)	(6)
	gdpgrowth	gdpgrowth	gdpgrowth
popgrowth	2.650**	2.644***	2.637***
	(0.974)	(0.946)	(0.942)

fdi	0.0463	0.0538*	0.0569*
	(0.0311)	(0.0293)	(0.0295)
tradegrowth	0.0251*	0.0255*	0.0257*
	(0.0132)	(0.0132)	(0.0131)
piracyattacks	0.0187	0.0181	0.0182
	(0.0165)	(0.0178)	(0.0182)
fragility	-0.222		
	(0.168)		
effectiveness		-0.138	
		(0.244)	
_cons	0.417	-2.010	-3.187
	(4.301)	(3.433)	(2.463)
N	486	486	486
R^2	0.142	0.137	0.136
adj. R^2	0.133	0.128	0.129
AIC	2865.2	2868.2	2866.7
BIC	2886.2	2889.2	2883.5

Standard errors in parentheses
**p< 0.1, **p< 0.05, ***p< 0.01*

Model 5 has the highest fit indicators. According to the F-test country, fixed effects are significant (F(5,25) = 4.05, p = 0.0079). While Population Growth, Trade Growth, and FDI remain significant compared to the pooled regression, the last two regressors are barely significant at 10% level. In addition, neither *fragility*, nor *effectiveness* are significant, because these variables are probably correlated with some of the unobserved fixed effects (country institutions, traditions that do not change over time much) that are accounted for in these models.

In order to choose between the fixed effects and random effects models, we apply Hausman test. The null hypothesis of the test is that the difference between fixed effects and random effects models coefficients is not systematic, but in that case it is significant at 10% level (p = 0.0735). Therefore, to avoid risk of using inconsistent estimates from random effects model, we use fixed effects estimates that are always consistent.

```
                ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       fe           re         Difference          S.E.
-------------+----------------------------------------------------------------
```

```
   popgrowth |     2.644151     2.745914        -.101763        .2006453
         fdi |     .0537977     .0710781       -.0172804        .0095795
 tradegrowth |     .0255447     .0268188       -.0012741        .0006979
piracyatta~s |     .0180678     .0167962        .0012716        .0096821
effectiven~s |    -.1384668    -.2379038         .099437        .1639991
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       10.06
                Prob>chi2 =      0.0735
```

Even though, overall, maritime piracy attacks do not significantly explain GDP growth, correlation analysis has previously shown that it may be the case in certain countries. Therefore, we estimate Model 5 for The Gambia, Guinea, and Madagascar, but the insignificance of maritime piracy attacks is confirmed (see Table 7, Model 5.1). The result is also confirmed when we add other countries (see Table 7, Model 5.2) where the correlation coefficient is insignificant, but lower than -0.2 (Mozambique, Liberia, Kenya, and Benin).

Table 7: Parameter estimates (Models 5.1 and 5.2)

	(1)	(2)
	gdpgrowth	gdpgrowth
popgrowth	-0.207	8.940***
	(0.282)	(1.679)
fdi	-0.105	0.0809**
	(0.122)	(0.0256)
tradegrowth	0.00388	-0.00300
	(0.00138)	(0.00455)
piracyattacks	-0.403	-0.00331
	(0.156)	(0.108)
effectiveness	-0.410	0.207
	(0.646)	(0.481)
_cons	8.957	-23.25***
	(7.788)	(3.404)
N	38	114
R^2	0.111	0.438

adj. R^2	-0.028	0.412
AIC	177.4	807.3
BIC	179.0	821.0

Standard errors in parentheses
**p< 0.1, **p< 0.05, ***p< 0.01*

We also apply a number of robustness checks, such as using binary variables indicating whether there were any attacks or not, as well as whether the number of attacks was greater than 1 or not. However, none of these regressors appeared to be significant.

Conclusions

As explained before, Sub-Saharan Africa is one of the most resource-deprived and least developed regions of the world. Sub-Saharan Africa has experienced severe civil and inter-state conflicts, which coupled with the lack of state capacity, political instability, high rates of AIDS and HIV, and high child mortality. Despite the recent economic growth and structural reforms to create more conducive environment for business and investment, these factors have affected economic trends in the region over the last years.

In addition, in the last twenty years there have been several maritime piracy attacks off the coasts of the Sub-Saharan region. The period when this phenomenon recurred the most started in mid-1990s, reaching its peak between 2008 and 2011. Since 2011, there has been a significant decrease in the number of attacks due to the implementation of measures aimed at fighting maritime piracy, adopted by the international community in order to ensure better security to shipping lines. However, in addition to being a serious threat to free navigation of merchant vessels, maritime piracy jeopardizes the economies of coastal countries affected by the phenomenon.

Despite the interest lying in the issue, as it plays a significant role in global economic security, the research on the economic consequences of maritime piracy in Sub-Saharan Africa is one of the least analyzed. Given that so far no significant research has been conducted at this regard, we tested the severity of the attacks of maritime piracy in Sub-Saharan Africa, and their impact on GDP growth rate of the countries. In doing so, we have analyzed the geopolitical conditions over the period between 1994 and 2013, of the Sub-Saharan African region. Considering the nature of maritime piracy, we have focused our analysis only on the coastal countries of Sub-Saharan Africa.

Preliminarily, we showed that the correlation between maritime piracy attacks and GDP growth in each of the countries is very weak and statistically insignificant. Then, according to the pooled regression models results of GDP growth rate on several regressors, we showed that population growth, trade growth, and FDI are significant at 1% level, while maritime piracy attacks have an insignificant impact on GDP growth. However, since there might be some unobserved country-specific effects that are correlated with maritime piracy attacks, we accounted for individual country effects by using the fixed effects models with robust

standard errors. The results obtained reveal that maritime piracy attacks do not significantly explain GDP growth.

In conclusion, maritime piracy has no significant impact on the economic growth of the region. In addition, according to the World Bank (2015), there has been a decrease in the economic growth rate of sub-Saharan Africa coinciding with a decrease in the number of maritime piracy attacks in the region, comparing to those of the last twenty years. In fact, the World Bank data show that the recent downturn in Sub-Saharan economic growth was mainly due to the negative impact caused by the collapse in commodity prices and the general stagnation of the global economy. In addition, there are also other factors affecting Sub-Saharan Africa growth, such as electricity shortages in two large countries like Nigeria and South Africa, political instability, and terrorism.

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How Did Maritime Piracy Affect Trade in Southeast Asia?

Quantitative analysis of the impact on intra-regional trade

Abstract

Over the past thirty years, Southeast Asia has experienced rapid growth in intra-regional economic activity, but despite the remarkable diminution in the frequency and intensity of military conflict and crises, it has not been free of interstate disputes, such as maritime disputes. However, the struggle against maritime crime activities—such as maritime piracy—represents a priority for all countries of the region, as well as one of the unavoidable prerequisites for the achievement of the regional economic security. The paper focuses on the impact of maritime piracy on the Southeast Asian countries' trade. Bilateral trade flows among the Southeast Asian countries over the 1994 to 2013 period are used to estimate an augmented gravity model that includes various measures of maritime crime activities. The purpose is to find the evidence to indicate how maritime piracy has affected the volume of intra-regional trade.

Keywords: Asia, International Relations, Security, Trade

Introduction

Over the course of the past twenty years, there has been a substantial rise in the amount of economic activity in Southeast Asia. In addition, there has also been a significant increase in the number of economic institutions designed to promote and regulate trade, investment, and finance in the region. Only a few such institutions existed in 1980; currently, there are a few dozen. Moreover, plans are afoot to launch even more. Indeed, regional policy makers have commented on the desirability of forming additional economic institutions in the region.

In particular, People's Republic of China has explored the possibility of forming a free-trade area (FTA) with members of the Association of South-East Asia Nations (ASEAN), the region's most important institution. People's Republic of China has played a leading role in the recent economic rise of the region. In 1979, about 10 percent of intra-Southeast Asian trade stemmed from foreign commerce involving People's Republic of China; by 2009, the value exceeded 30 percent. In 2010, came into effect the ASEAN- China Free Trade Area (ACFTA) that is a free trade area among the ten member states of ASEAN and the People's Republic of China.

After the signing of the ASEAN Free Trade Area (AFTA) in 1992—that eliminated largely intra-ASEAN trade tariffs—, ACFTA is one of the most important steps toward an integrated regional economy. The free trade agreement reduced tariffs in the People's Republic of China and the six original members of ASEAN (Brunei, Indonesia, Malaysia, Philippines, Singapore, and Thailand), while the remaining four countries followed suit in 2015. In 2015, the ASEAN Economic Community was launched, that aims to create (1) a single market and production base, (2) a highly competitive economic region, (3) a region of fair economic development, and (4) a region fully integrated into the global economy.

Over the past thirty years, Southeast Asian countries have experienced rapid growth in intra-regional economic activity, and have also experienced a marked reduction in political-military conflict. According to data collected by the Peace Research Institute Oslo (PRIO), for nearly a quarter of a century, no one has perished in formal military combat. Indeed, although isolated incidents have occurred, there has been a complete absence of serious interstate military conflicts since the late 1980s. However, despite the remarkable diminution in the frequency and intensity of military conflict and crises, Southeast Asia has not been free of interstate disputes, such as maritime disputes. Southeast Asian countries intend maintaining

the military capabilities necessary to protect their political and economic interests, especially necessary for power projection on, under, and above the seas and to ensure national interest and territorial claims against potential threats, such as drug-trafficking, illegal fishing, and maritime piracy.

In particular, this last phenomenon plagues the region despite increased efforts by the regional countries to reduce their attacks, which take place on an alarmingly regular basis in what are some of the world's most strategically important waterways. Indeed, over half of the world's commercial shipping passes through the Straits of Malacca and Singapore, which provide the shortest sea route between the Indian Ocean and the Pacific Ocean. These are the most important shipping lines in the world, carrying approximately one-quarter of all traded goods. In particular, in this region there are 6 of the major world ports for container traffic and 20 among the busiest ports in the world. These data highlight the intense naval commercial traffic of the Southeast Asian countries.

In the last twenty years, all the major regional powers have taken measures in order to ensure their rights on these waterways. These are vital for the economies of the Southeast Asian countries, and especially for the People's Republic of China. Its main shipping lines of import of energy supplies and raw materials are through the straits, from the Middle East and Africa. Consequently, the Chinese government aims to adopt a commercial and maritime strategy in order to ensure better security to its shipping lines. In fact, these waterways have long been prone to maritime criminal activities, such as piracy, especially when such ships are concentrated at the so-called "chokepoints."

Chokepoints are points of natural congestion along two wider and important navigable passages. They are naturally narrow channels of shipping having high traffic because of their strategic locations, such as the Strait of Malacca. Therefore, because of their geographical nature, maritime criminal activities easily occur, consequently affecting regional trade. And avoiding these maritime chokepoints would contribute to a huge loss in the nature of shipping operations. With the increase in sea borne trade and shipbuilding tonnage worldwide, the amount of commercial traffic traversing the region's waterways has increased substantially, and it has resulted in the dramatic increase of maritime piracy in the region.

The Southeast Asian trade has historically suffered incidents of maritime piracy, which have fluctuated over the last twenty years but recently appear to be in another growth phase. Several initiatives have been carried out among the countries of the region in order to counter maritime criminal activities, especially through the article 43 ("Navigational and safety aids

and other improvements and the prevention, reduction and control of pollution") of the United Nations Convention on the Law of the Sea, which states:

> User States and States bordering a strait should by agreement cooperate:
> (a) in the establishment and maintenance in a strait of necessary navigational and safety aids or other improvements in aid of international navigation; and
> (b) for the prevention, reduction and control of pollution from ships.

However, the security measures adopted so far have been insufficient to reduce significantly the maritime criminal activities in the region. Particularly, the events related to claims of sovereignty of the Exclusive Economic Zone (EEZ) represent one of the main limits to regional cooperation.

The Malacca Strait Sea Patrols (MSSP) and the Regional Cooperation Agreement on Anti-Piracy (ReCAAP) are among the main regional cooperation initiatives, launched respectively in 2004 and 2006. In particular, the program ReCAAP has been established with the objective of increasing multilateral cooperation to combat the threat of maritime piracy and armed robberies through information sharing and cooperation agreements. Except for Malaysia and Indonesia, all the countries of the region join to the program.

In addition to the failure of regional cooperation in military terms for patrolling such a vast area, we highlight the difficulties of local governments to exercise effective internal security. These conditions have encouraged the increase of terrorist attacks, including in regional waters. In particular, this occurred mainly in the waters of the South China Sea, where some terrorist groups have carried out piracy activities to finance themselves and gain visibility. However, beyond some episodes, it is not possible to state that terrorist groups really commit piracy activities.

It is difficult to distinguish between piracy, terrorism, and other acts of maritime depredation. According to the International Maritime Bureau (IMB), maritime piracy is

> an act of boarding or attempting to board any ship with the apparent intent to commit theft or any other crime and with the apparent intent or capability to use force in furtherance of that act.

While the Council for Security Cooperation in the Asia Pacific (CSCAP) defines maritime terrorism as

the undertaking of terrorist acts and activities (1) within the maritime environment, (2) using or against vessels or fixed platforms at sea or in port, or against any one of their passengers or personnel, (3) against coastal facilities or settlements, including tourist resorts, port areas and port towns or cities.

What is the economic impact of the current situation in the region? The aim of this paper is to estimate the impact of maritime piracy on countries' trade in Southeast Asia. For the purposes of this paper, we use data on related attacks between 1994 and 2013, supplied by the ICC International Maritime Bureau, and measures necessary for empirical research based on the gravity model. Despite the recent peace and political stability of the countries of this area, we want to show that economic security issue matters analyzing how maritime piracy affect the Southeast Asian trade. In doing so, we account for omitted variable biases and control appropriately potential endogeneity between acts of maritime piracy and trade in the region.

The paper is structured as follows: the second section focuses on the literature dealing with the consequences of maritime piracy on international trade; the third section presents the data used, and the fourth section outlines the model, empirical estimation and main results; the fifth section shows conclusions and ideas for further research.

Literature Review

International trade is largely dependent on maritime transport, which covers trade in tankers, dry cargo shipments, liner shipments of containerized cargoes. According to the statistics of the United Nations Conference on Trade and Development (UNCTAD), in 2013 world seaborne trade measured in ton-miles increased by 3.6 per cent, taking the total to 50,000 billion ton-miles. Ton-miles generated by crude oil shipments fell by 1.8 per cent, while oil products and gas trade measured in ton-miles increased by 3.9 per cent due to rapid growth in oil products trade (6.2 per cent). Gas trade fell by 1.4 per cent reflecting lower volumes of liquefied natural gas (LNG) shipped during the year.

As mentioned, Southeast Asia is one of the most strategically important areas for international trade, and at same time also highly vulnerable to several threats that could undermine its security, especially in economic terms. The political instability in some countries and the conduct of criminal activities are the main threats. In particular, the weak control by some regional countries has allowed some individuals to engage in criminal activities, such as maritime piracy. The Southeast Asian waterways are known especially for the long-standing presence of maritime piracy. Although the data of the International Maritime Organization (IMO) demonstrate how it is declining in other parts of the world, maritime piracy is increasing dramatically in Southeast Asia. According to the 2014 and 2015 statistics, in this area there have been about 60 percent of total number of pirate attacks worldwide.

Despite the risk arising from an increase in this phenomenon, analyses in quantitative economics made so far now about the consequences maritime piracy in this region are not enough. From an economic point of view, maritime piracy affects international trade through an increased insecurity concerning the goods delivery. Bensassi and Martínez-Zarzoso (2010) estimate the impact of piracy on maritime trade between Europe and Asia using data on incidents of maritime piracy between 1999 and 2008. They apply the gravity model, widely used to investigate the role played by specific policy or geographical variables in bilateral trade flows.

The gravity model draws an analogy with Isaac Newton's law of universal gravitation, which states that a particle attracts every other particle in the universe using a force that is directly proportional to the product of their masses and inversely proportional to the square of

the distance between them. Tinbergen (1962) and Pöyhönen (1963) were the first authors to apply the gravity equation to analyze international trade flows. The standard gravity equation was originally applied to predict bilateral trade flows between any two countries as a function of their size and distance between them.

According to this model, exports from country *i* to country *j* are explained by their economic sizes, their populations, direct geographical distances, and a set of dummies incorporating some type of institutional characteristics common to specific flows. Economic size is measured as gross domestic product (GDP), and distance is typically measured as the distance between countries' capital cities. However, many researchers focused on producing better approximations for trade. The gravity model has been widely applied in international trade studies and successfully applied to flows of varying types such as migration, foreign direct investment, and more specifically to international trade flows.

In this way, several theoretical developments have appeared in support of the gravity model. Anderson (1979) made the first formal attempt to derive the gravity equation from a model that assumed product differentiation. Bergstrand (1985, 1989) also explored the theoretical determination of bilateral trade, in which gravity equations were associated with simple monopolistic competition models. Helpman (1987) used a differentiated product framework with increasing returns to scale to justify the gravity model. Deardorff (1995) has proven that the gravity equation characterizes many models and can be justified from standard trade theories.

There is a huge number of empirical applications in the literacy on international trade, which have contributed to the improvement of the performance of the gravity equation. The econometric specification of the gravity equation has been refined (Mátyás, 1997; Chen and Wall, 1999; Breuss and Egger, 1999; Egger, 2000), and new variables have been added (Wei, 1996; Limão and Venables, 1999; Bougheas, Demetriades, and Morgenroth, 1999; Soloaga and Winters, 2001).

In particular, many studies augment the gravity equation with variables that could ease trade costs. Sharing a common language, common historical events—such as colonial links, common military alliances or co-membership in a political entity—, common institutions or legal systems, common religion, common ethnicity or nationality, similar tastes and technology, and input-output linkages enhance international trade. In this way, the gravity equation has also been augmented with further variables that could reduce trade, such as artificial trade costs and violent crimes.

Indeed, insecurity decreases trade opportunities. Marcouiller (2000) and Anderson and Marcouiller (2002) have used the gravity model of trade to research empirically the extent to which insecurity deters trade. According to the analyses carried out by Anderson and Marcouiller (2005) and Blomberg and Hess (2004), several types of violent acts have a significant negative impact on bilateral trade.

Martínez-Zarzoso and Bensassi (2013) test the effect of modern piracy on maritime trade cost proposing a simple model of transport cost determination and deriving a transport costs equation augmented with maritime piracy as an additional explanatory variable. Their results show a significant and positive impact of piracy on maritime transport cost; in addition, they show that localized conflicts could selectively harm some international trade routes.

Burlando, Cristea, and Lee (2014) lay out an empirical model of bilateral trade where piracy increases trade costs, and derive an augmented gravity equation to estimate the effect of pirate activity on trade volumes. Using a global panel data set combining information on bilateral volumes of trade and on reported pirate attacks, they show that the threat of violence and, more generally, the possibility of disruptions in the transportation network has a negative effect on trade.

Generally, the negative impacts of maritime piracy disrupt the global economy. In fact, maritime piracy may have a significant impact on GDP of the trading countries through a drop in trade. Bendall (2010) has addressed the impact of piracy on the cost of maritime trade. Analyzing the efforts of private and public sector initiatives, Kerr (2013) shows that piracy imposes considerable costs on international commerce and taxpayers, thus inhibiting international trade.

Analyzing the data between 2003 and 2008, Fu, Ng, and Lau (2010) have investigated the impacts of maritime piracy on global economic development. They attempt to explain the changes in economic losses experienced by the global shipping industry over time in terms of costs potentially produced by maritime piracy. Therefore, they use a simulation model to investigate how maritime piracy might affect losses through the increasing cost of insurance, and the potentially increasing costs associated with ships being forced to take (longer) alternate routes to avoid the risk of maritime piracy.

Given the issues at stake and the broad range of costs and trade-related implications of maritime piracy at both the regional and the global level, sustained long-term efforts to combat and repress maritime piracy clearly remain a matter of strategic importance. In this paper, we focus on the impact of maritime piracy on intra-regional trade. In doing so, we

study the bilateral trade flows among the Southeast Asian countries, considering maritime piracy attacks as variables.

Data

The sample analyzed here is made up of 10 countries of Southeast Asia; in particular, this paper registers the variations related to the annual foreign trade over the period between 1994 and 2013. Therefore, the database is composed by 200 statistics units. The selected countries are reported in the following list.

Cambodia	People's Republic of China
Hong Kong	Philippines
Indonesia	Singapore
Macau	Thailand
Malaysia	Vietnam

Note that Hong Kong and Macau are special administrative regions of People's Republic of China. Even if they maintain their own legal system, the public security force, monetary system, customs policy, and immigration policy, the State Council of China is responsible for military defense and foreign affairs.

Among the selected variables, we chose the membership to the Association of Southeast Asian Nations (ASEAN) because it is the main regional organization which aims to facilitate economic integration and to promote intergovernmental cooperation amongst its members. In addition to the economic issue, we chose this variable because of the efforts of ASEAN in the regional security.

Data on ASEAN membership, geographic boundaries, and spoken languages are compiled by the World Factbook, which is a reference resource produced by the Central Intelligence Agency that provides information on the history, people, government, economy, geography, communications, transportation, military, and transnational issues for over 250 world entities.

The source of data on piracy incidents is the ICC International Maritime Bureau. It is a specialized division of the International Chamber of Commerce (ICC) established in 1981 to act as a focal point in the fight against all types of maritime crime and malpractice. It maintains a round-the-clock watch on the global shipping lanes, reporting pirate attacks to local law enforcement and issuing warnings about maritime piracy hotspots to shipping.

Finally, the economic data are compiled by the World Bank that allows free and open access to data about development in countries around the globe.

The following are descriptive statistics of the variables considered to determine the influence of maritime piracy on Export.

Variable	Obs	Mean	Std. Dev.	Min	Max
Export	1,645	7278133	2.53e+07	.508	3.84e+08
Distance	1,800	2037.118	1087.229	60.77057	5220.879
Contiguity	1,800	.1777778	.3824318	0	1
Language	1,800	.2666667	.4423395	0	1
GDPi	1,800	19376.3	24287.12	761.3493	140644.4
GDPj	1,800	19376.3	24287.12	761.3493	140644.4
Popi	1,800	1.79e+08	3.75e+08	391783	1.36e+09
Popj	1,800	1.79e+08	3.75e+08	391783	1.36e+09
ASEANi	1,800	.66	.4738404	0	1
ASEANj	1,800	.66	.4738404	0	1
Piracy	1,800	24.45	35.45704	0	218

Methodology

To determine the extent to which maritime piracy affects the Export of the selected countries, we apply the gravity model of trade. This is currently the most widely accepted framework for modeling bilateral trade flows. The gravity model has been widely used to investigate the role played by specific policy or geographical variables in bilateral trade flows. The standard gravity model for trade between two countries (*i* and *j*) is:

$$F_{ij} = G\frac{M_i^{\beta_1} M_j^{\beta_2}}{D_{ij}^{\beta_3}}\eta_{ij}$$

where *F* is the trade flow, *M* is the economic mass of each country, *D* is the distance and *G* is a constant. The model has been used by economists to analyze the determinants of bilateral trade flows—e.g. common borders, common languages, common legal systems, common currencies, common colonial legacies, etc.—and it has been also used to test the effectiveness of trade agreements and organizations, such as the World Trade Organization (WTO) and the Association of Southeast Asian Nations (ASEAN).

The model is often extended by including variables to account for language relationships, tariffs, and contiguity. In this case, we augment the traditional model using maritime piracy attacks off the coasts of the Southeast Asian countries to the trade hindering the main regional maritime routes. In particular, they often occur through especially narrow passages, such as the Singapore Strait and the Strait of Malacca. We have been able to count the number of maritime piracy attacks occurring annually off the coasts of the Southeast Asian countries, between 1994 and 2013.

Other variables are classical variables for the gravity equation, i.e. the geographical distance and common geographical boundaries between the importer and exporter. GDP (PPP) per capita and Total Population of the importer and exporter are used as control variables, as suggested in the standard gravity model of trade.

The model is generally estimated in log-linear form, and is specified as follows:

$$\text{Export}_{ijt} = \alpha_{ij} + \alpha_t + \beta_1\text{GDP}_{it} + \beta_2\text{GDP}_{jt} + \beta_3\text{Pop}_{it} + \beta_4\text{Pop}_{jt} + \beta_5\text{Distance}_{ij} + \beta_6\text{Piracy}_{ijt} + \psi_1\text{Contiguity}_{ijt} + \psi_2\text{Language}_{ijt} + \psi_3\text{ASEAN}_{ijt} + u_{ijt}$$

where

- $Export_{ijt}$ are the exports from country i (exporter) to country j (reporter) in period t in current USD thousands;
- GDP_i/GDP_j indicates the GDP (at purchasing power parity) per capita of the exporter/importer;
- Pop_i/Pop_j expresses exporter/importer populations;
- $Distance_{ij}$ is geographical distances between countries i and j;
- $Piracy_{ijt}$ is the number of piracy incidents off the coasts of the two countries i and j;
- $Contiguity_{ijt}$ is the common geographical boundary between countries i and j;
- $Language_{ijt}$ is the common language between countries i and j;
- $ASEAN_{ijt}$ is the common membership to the Association of Southeast Asian Nations (ASEAN) of the two countries i and j.

Note that $Contiguity_{ijt}$, $Language_{ijt}$, and $ASEAN_{ijt}$ are dummy variables and are generally used as proxies, which take the value of 1 when the countries have, respectively, a common geographical boundary, a common language, and a common membership to ASEAN.

The parameter estimates of the model are reported in Table 1, where Model 1.1 (with ordinary standard errors) and Model 1.2 (with robust standard errors) are contrasted.

Table 1: Parameter estimates (Models 1.1 and 1.2)

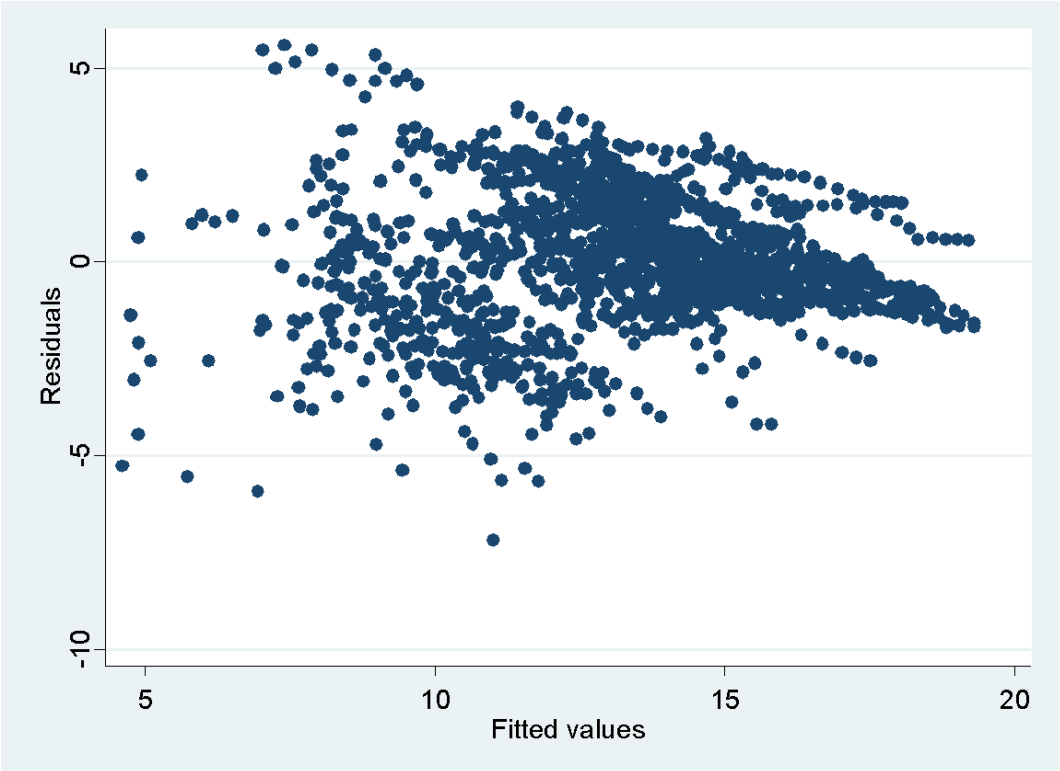
	(1.1)	(1.2)
	lnExport	lnExport
lnDistance	-1.112***	-1.112***
	(0.0670)	(0.0609)
lnGDPi	1.754***	1.754***
	(0.0540)	(0.0630)
lnGDPj	0.657***	0.657***
	(0.0449)	(0.0484)
lnPopi	1.449***	1.449***
	(0.0288)	(0.0326)
lnPopj	0.919***	0.919***
	(0.0274)	(0.0272)
Piracy	-0.0109***	-0.0109***
	(0.00125)	(0.00111)

ASEANi	1.450***	1.450***
	(0.0986)	(0.0951)
ASEANj	0.659***	0.659***
	(0.0944)	(0.0966)
Contiguity	0.345***	0.345***
	(0.119)	(0.0823)
Language	1.958***	1.958***
	(0.118)	(0.127)
_cons	-43.29***	-43.29***
	(1.162)	(1.181)
N	1645	1645
R^2	0.713	0.713
adj. R^2	0.711	0.711
AIC	6335.9	6335.9
BIC	6395.4	6395.4

Standard errors in parentheses
$^{*}p< 0.1$, $^{**}p< 0.05$, $^{***}p< 0.01$

Even though Breusch-Pagan's test detects heteroscedasticity in Model 1.1 ($\chi^2(1) = 331.27$, $p< 0.001$), and somewhat non-constant residual variance is observed in Figure 1, we show that the heteroscedasticity correction does not change standard errors a lot.

Figure 1: Residuals vs. fitted plot (based on Model 1)



Despite a relatively large number of regressors used in the model, there are not strong linear relationships between them as indicated by low values of the variance inflation factor (VIF). None of the VIFs exceed 2.4, whereas a typically used threshold value is 5.

Variable	VIF	1/VIF
lnPopi	2.36	0.423991
lnGDPi	2.30	0.434185
lnPopj	1.98	0.505652
lnGDPj	1.88	0.533012
Language	1.72	0.581204
lnDistance	1.58	0.634493
ASEANi	1.28	0.783292
Contiguity	1.25	0.797679
Piracy	1.21	0.823768
ASEANj	1.19	0.843456
Mean VIF	1.67	

All parameter estimates are statistically significant and have expected signs. The explanatory power of the model is very high: 71.3% of *lnExport* are explained using the regressors that enter Model 1. Every additional maritime piracy attack that happens either of the two partnering countries leads to a 1% decrease in export volume.

In addition, it is worth mentioning that variables describing exporter *i* have a stronger impact on its export volume than the corresponding characteristics of the importer *j*. For example, a 1% increase of GDP of the country *i* leads to a 1.754% increase in Export from country *i* to country *j*; while the same percentage increase of GDP of the country *j* leads to only a 0.657% increase in Export from country *i* to country *j*.

In order to figure out Export from which country is influenced by pirates the most, we conduct analysis by exporter, controlling the importer's characteristics and the distance between the two countries.

	Cambodia	Hong Kong	Indonesia	Macau	Malaysia	PR China	Philippines	Singapore	Thailand	Vietnam
	lnExport	lnExport	lnExport	lnExport	lnExport	lnExport	lnExport	lnExport	lnExport	lnExport
lnDistance	-1.862***	-0.00228	-2.433***	-0.953***	-1.479***	-1.005***	-1.798***	-1.211***	-3.083***	0.231
	(0.524)	(0.0826)	(0.206)	(0.161)	(0.129)	(0.259)	(0.606)	(0.0805)	(0.242)	(0.388)
lnGDPj	1.889***	1.144***	1.012***	1.090***	1.363***	1.637***	2.046***	0.992***	1.800***	0.695***
	(0.374)	(0.0657)	(0.0493)	(0.174)	(0.0614)	(0.0765)	(0.130)	(0.0791)	(0.102)	(0.156)
lnPopj	1.250***	0.818***	1.231***	0.865***	1.246***	1.113***	1.402***	1.037***	1.501***	0.859***
	(0.241)	(0.0503)	(0.0467)	(0.153)	(0.0509)	(0.0760)	(0.108)	(0.0510)	(0.0712)	(0.115)
Piracy	-0.0235***	-0.0193***	-0.00257	-0.0343***	-0.0130***	-0.0134***	-0.0179***	-0.00787***	-0.00918***	-0.0233***
	(0.00445)	(0.00164)	(0.00179)	(0.00531)	(0.00209)	(0.00260)	(0.00252)	(0.00155)	(0.00179)	(0.00303)
ASEANj	0.180	-1.090***	-0.266*	-0.886	0.115	-0.649**	1.955***	-0.00979	0.589***	1.782***
	(0.763)	(0.187)	(0.148)	(0.544)	(0.170)	(0.264)	(0.270)	(0.179)	(0.213)	(0.327)
_cons	-16.41*	-8.583***	2.699**	-8.523**	-8.502***	-9.622***	-17.58***	-2.689**	-5.527***	-10.36***
	(8.443)	(1.080)	(1.360)	(3.588)	(1.087)	(2.750)	(2.666)	(1.157)	(1.155)	(2.643)
N	122	180	177	171	180	180	162	171	180	122
R^2	0.323	0.872	0.825	0.667	0.788	0.750	0.787	0.743	0.749	0.623
adj. R^2	0.294	0.868	0.819	0.657	0.782	0.743	0.780	0.735	0.742	0.607
AIC	557.9	329.6	478.1	631.5	557.6	486.4	518.3	527.7	543.3	407.4
BIC	574.7	348.8	497.1	650.3	576.8	505.5	536.8	546.5	562.4	424.2

Standard errors in parentheses
**p< 0.1, **p< 0.05, ***p< 0.01*

The impact of the number of maritime piracy attacks is the highest on Macau's Export (more than 3% decrease of Export due to each additional attack). The weakest effect is on Indonesia's trade (the effect is negligible and the p-value> 0.1).

In addition, we find specific pairs of countries that are impacted by maritime piracy the most by running regressions of *lnExport* on Piracy for each pair of countries. Effects that are significant at 1% level are highlighted in the coefficients table below (p-value< 0.01). The

highest size of the effect (beta coefficient) is observed for export from Hong Kong to Cambodia (Exp(-0.195) = 0.82, i.e. each maritime piracy attack is associated with a 18% decrease in Export). Maritime piracy has a similar strong effect on Export from Cambodia to PR China as well (Exp(-0.184) = 0.83, i.e. i.e. each maritime piracy attack is associated with a 17% decrease in Export). Another adversely affected trade route is from Philippines to Macau (Exp(-0.189) = 0.83, i.e. each piracy attack is associated with a 17% decrease in Export).

Coefficients*

group(Reporter-Partner)	Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
Cambodia-Hong Kong	1	(Constant)	13.565	.195		69.696	.000
		Piracy	-.321	.195	-.430	-1.650	.125
Cambodia-Indonesia	1	(Constant)	8.369	.636		13.168	.000
		Piracy	-.006	.007	-.253	-.904	.384
Cambodia-Macau	1	(Constant)	3.792	.708		5.358	.001
		Piracy	-3.617	2.238	-.496	-1.616	.145
Cambodia-Malaysia	1	(Constant)	10.071	.408		24.683	.000
		Piracy	-.013	.014	-.267	-.959	.356
Cambodia-PR China	1	(Constant)	10.585	.479		22.113	.000
		Piracy	-.171	.145	-.321	-1.176	.262
Cambodia-Philippines	1	(Constant)	8.026	.344		23.338	.000
		Piracy	-.037	.046	-.228	-.811	.433
Cambodia-Singapore	1	(Constant)	11.305	.540		20.955	.000
		Piracy	.502	.638	.221	.786	.447
Cambodia-Thailand	1	(Constant)	10.747	.384		27.975	.000
		Piracy	-.179	.093	-.486	-1.927	.078
Cambodia-Vietnam	1	(Constant)	11.280	.540		20.878	.000
		Piracy	-.023	.058	-.116	-.403	.694
Hong Kong-Cambodia	1	(Constant)	12.895	.183		70.644	.000
		Piracy	-.195	.042	-.740	-4.673	.000
Hong Kong-Indonesia	1	(Constant)	14.372	.292		49.141	.000
		Piracy	-.003	.003	-.238	-1.039	.312
Hong Kong-Macau	1	(Constant)	14.483	.125		116.292	.000

		Piracy	-.018	.031	-.133	-.568	.577
Hong Kong-Malaysia	1	(Constant)	14.695	.140		105.033	.000
		Piracy	-.003	.005	-.154	-.661	.517
Hong Kong-PR China	1	(Constant)	18.738	.138		135.609	.000
		Piracy	-.040	.014	-.549	-2.785	.012
Hong Kong-Philippines	1	(Constant)	14.781	.056		263.031	.000
		Piracy	-.016	.005	-.584	-3.050	.007
Hong Kong-Singapore	1	(Constant)	15.550	.066		235.743	.000
		Piracy	-.014	.016	-.198	-.858	.402
Hong Kong-Thailand	1	(Constant)	15.095	.126		119.982	.000
		Piracy	-.046	.015	-.597	-3.157	.005
Hong Kong-Vietnam	1	(Constant)	14.143	.482		29.344	.000
		Piracy	.000	.050	.001	.005	.996
Indonesia-Cambodia	1	(Constant)	11.713	.341		34.385	.000
		Piracy	-.002	.004	-.122	-.522	.608
Indonesia-Hong Kong	1	(Constant)	14.552	.159		91.377	.000
		Piracy	-.002	.002	-.287	-1.273	.219
Indonesia-Macau	1	(Constant)	8.817	.342		25.818	.000
		Piracy	-.002	.004	-.160	-.628	.540
Indonesia-Malaysia	1	(Constant)	14.871	.472		31.534	.000
		Piracy	.001	.004	.027	.116	.909
Indonesia-PR China	1	(Constant)	15.686	.576		27.241	.000
		Piracy	-.003	.006	-.105	-.446	.661
Indonesia-Philippines	1	(Constant)	14.175	.420		33.721	.000
		Piracy	-.001	.005	-.076	-.324	.750
Indonesia-Singapore	1	(Constant)	15.899	.284		55.914	.000
		Piracy	-.001	.003	-.044	-.187	.854
Indonesia-Thailand	1	(Constant)	14.464	.476		30.373	.000
		Piracy	-.001	.005	-.032	-.135	.894
Indonesia-Vietnam	1	(Constant)	13.621	.480		28.354	.000
		Piracy	-.002	.005	-.084	-.356	.726
Macau-Cambodia	1	(Constant)	6.148	.708		8.679	.000
		Piracy	-1.097	1.260	-.206	-.870	.396
Macau-Hong Kong	1	(Constant)	12.342	.090		137.636	.000
		Piracy	-.013	.022	-.139	-.578	.571
Macau-Indonesia	1	(Constant)	5.780	.557		10.379	.000

		Piracy	-.005	.007	-.174	-.731	.475
Macau-Malaysia	1	(Constant)	7.798	.199		39.251	.000
		Piracy	.017	.008	.490	2.315	.033
Macau-PR China	1	(Constant)	12.291	.146		83.966	.000
		Piracy	.012	.024	.122	.508	.618
Macau-Philippines	1	(Constant)	9.213	.561		16.433	.000
		Piracy	-.129	.065	-.436	-1.999	.062
Macau-Singapore	1	(Constant)	8.774	.154		56.809	.000
		Piracy	.158	.174	.215	.907	.377
Macau-Thailand	1	(Constant)	7.096	.284		25.013	.000
		Piracy	.033	.048	.168	.702	.492
Macau-Vietnam	1	(Constant)	8.870	.310		28.586	.000
		Piracy	.047	.039	.276	1.185	.252
Malaysia-Cambodia	1	(Constant)	11.546	.221		52.295	.000
		Piracy	-.004	.008	-.113	-.481	.637
Malaysia-Hong Kong	1	(Constant)	15.697	.157		99.794	.000
		Piracy	-.004	.006	-.140	-.601	.555
Malaysia-Indonesia	1	(Constant)	14.745	.438		33.651	.000
		Piracy	.000	.004	.028	.119	.907
Malaysia-Macau	1	(Constant)	9.191	.232		39.614	.000
		Piracy	-.006	.009	-.150	-.642	.529
Malaysia-PR China	1	(Constant)	16.056	.405		39.690	.000
		Piracy	-.012	.014	-.205	-.890	.385
Malaysia-Philippines	1	(Constant)	14.370	.220		65.222	.000
		Piracy	-.001	.007	-.031	-.131	.897
Malaysia-Singapore	1	(Constant)	16.801	.112		150.181	.000
		Piracy	.000	.004	-.024	-.103	.919
Malaysia-Thailand	1	(Constant)	15.642	.224		69.769	.000
		Piracy	-.006	.008	-.188	-.812	.428
Malaysia-Vietnam	1	(Constant)	13.697	.432		31.671	.000
		Piracy	.003	.014	.056	.240	.813
PR China-Cambodia	1	(Constant)	13.522	.309		43.742	.000
		Piracy	-.184	.049	-.662	-3.751	.001
PR China-Hong Kong	1	(Constant)	18.647	.194		96.005	.000
		Piracy	-.058	.020	-.561	-2.874	.010
PR China-Indonesia	1	(Constant)	15.646	.718		21.798	.000

		Piracy	-.001	.008	-.030	-.129	.899
PR China-Macau	1	(Constant)	14.323	.150		95.406	.000
		Piracy	-.068	.025	-.533	-2.675	.015
PR China-Malaysia	1	(Constant)	16.053	.476		33.714	.000
		Piracy	-.015	.016	-.211	-.914	.373
PR China-Philippines	1	(Constant)	16.381	.260		62.906	.000
		Piracy	-.118	.020	-.819	-6.049	.000
PR China-Singapore	1	(Constant)	16.789	.246		68.194	.000
		Piracy	-.130	.041	-.602	-3.196	.005
PR China-Thailand	1	(Constant)	16.347	.271		60.283	.000
		Piracy	-.118	.026	-.726	-4.474	.000
PR China-Vietnam	1	(Constant)	15.831	.703		22.519	.000
		Piracy	-.056	.058	-.219	-.952	.354
Philippines-Cambodia	1	(Constant)	9.492	.219		43.297	.000
		Piracy	-.123	.026	-.767	-4.776	.000
Philippines-Hong Kong	1	(Constant)	15.501	.143		108.724	.000
		Piracy	-.088	.015	-.817	-5.667	.000
Philippines-Indonesia	1	(Constant)	13.129	.434		30.262	.000
		Piracy	-.005	.004	-.279	-1.161	.263
Philippines-Macau	1	(Constant)	9.772	.366		26.723	.000
		Piracy	-.189	.045	-.726	-4.227	.001
Philippines-Malaysia	1	(Constant)	14.154	.191		74.047	.000
		Piracy	.001	.006	.054	.218	.830
Philippines-PR China	1	(Constant)	16.072	.338		47.513	.000
		Piracy	-.169	.031	-.805	-5.423	.000
Philippines-Singapore	1	(Constant)	15.231	.182		83.821	.000
		Piracy	-.051	.021	-.512	-2.385	.030
Philippines-Thailand	1	(Constant)	14.330	.113		126.346	.000
		Piracy	-.027	.008	-.621	-3.170	.006
Philippines-Vietnam	1	(Constant)	13.320	.541		24.598	.000
		Piracy	-.070	.036	-.436	-1.937	.071
Singapore-Cambodia	1	(Constant)	13.105	.160		81.669	.000
		Piracy	.046	.153	.071	.302	.766
Singapore-Hong Kong	1	(Constant)	16.877	.154		109.927	.000
		Piracy	-.068	.038	-.391	-1.805	.088
Singapore-Indonesia	1	(Constant)	17.453	.254		68.715	.000

		Piracy	-.004	.003	-.368	-1.188	.265
Singapore-Macau	1	(Constant)	10.351	.183		56.437	.000
		Piracy	.391	.205	.410	1.906	.073
Singapore-Malaysia	1	(Constant)	17.197	.127		135.340	.000
		Piracy	-.001	.005	-.067	-.283	.780
Singapore-PR China	1	(Constant)	16.855	.259		64.971	.000
		Piracy	-.146	.043	-.627	-3.413	.003
Singapore-Philippines	1	(Constant)	15.783	.172		91.856	.000
		Piracy	-.079	.020	-.686	-4.001	.001
Singapore-Thailand	1	(Constant)	16.111	.117		137.163	.000
		Piracy	-.046	.020	-.482	-2.333	.031
Singapore-Vietnam	1	(Constant)	14.469	.335		43.133	.000
		Piracy	.083	.041	.434	2.046	.056
Thailand-Cambodia	1	(Constant)	14.093	.222		63.545	.000
		Piracy	-.115	.036	-.606	-3.233	.005
Thailand-Hong Kong	1	(Constant)	15.832	.149		106.304	.000
		Piracy	-.056	.017	-.603	-3.205	.005
Thailand-Indonesia	1	(Constant)	14.747	.559		26.383	.000
		Piracy	.000	.006	.006	.025	.980
Thailand-Macau	1	(Constant)	9.155	.218		42.078	.000
		Piracy	-.006	.037	-.040	-.169	.868
Thailand-Malaysia	1	(Constant)	15.426	.289		53.324	.000
		Piracy	-.006	.010	-.136	-.584	.566
Thailand-PR China	1	(Constant)	16.464	.248		66.359	.000
		Piracy	-.115	.024	-.749	-4.798	.000
Thailand-Philippines	1	(Constant)	15.168	.269		56.430	.000
		Piracy	-.079	.020	-.682	-3.951	.001
Thailand-Singapore	1	(Constant)	15.918	.079		201.764	.000
		Piracy	-.026	.013	-.425	-1.994	.062
Thailand-Vietnam	1	(Constant)	14.800	.615		24.081	.000
		Piracy	-.045	.053	-.195	-.846	.409
Vietnam-Cambodia	1	(Constant)	13.959	.834		16.745	.000
		Piracy	-.054	.089	-.172	-.605	.557
Vietnam-Hong Kong	1	(Constant)	13.973	.732		19.096	.000
		Piracy	-.050	.079	-.181	-.637	.536
Vietnam-Indonesia	1	(Constant)	14.413	.600		24.015	.000

		Piracy	-.009	.006	-.401	-1.517	.155
Vietnam-Macau	1	(Constant)	8.191	.809		10.124	.000
		Piracy	-.074	.091	-.279	-.821	.435
Vietnam-Malaysia	1	(Constant)	14.870	.440		33.768	.000
		Piracy	-.027	.012	-.548	-2.270	.042
Vietnam-PR China	1	(Constant)	16.226	.590		27.491	.000
		Piracy	-.095	.052	-.468	-1.835	.091
Vietnam-Philippines	1	(Constant)	14.542	.436		33.317	.000
		Piracy	-.060	.028	-.526	-2.144	.053
Vietnam-Singapore	1	(Constant)	14.310	.316		45.314	.000
		Piracy	.004	.033	.030	.106	.918
Vietnam-Thailand	1	(Constant)	15.171	.499		30.411	.000
		Piracy	-.137	.043	-.678	-3.197	.008

* Dependent Variable: lnExport

Conclusions

The Southeast Asian countries are major players in world maritime transport, with sizeable shares in several activities. In addition to being one of the focuses of the main East-West shipping routes articulated around world port leaders such as Hong Kong and Singapore, they are also the focus of an intensive and significant intra-Asian shipping trade. At present, maritime trade is developing at high speed in Southeast Asia, given the region's significant role in international commerce and the general progress of regional integration. About one third of international trade—and half the world's oil—pass through the Southeast Asian waterways, and this has affected on the maritime sector of the region, by boosting the economic growth of the related countries.

With the growing importance of seaborne trade, the maritime sector has increasingly played a significant role in the development of port cities and coastal communities in the region, contributing to their wellbeing and prosperity. However, there is a potential threat to maritime transport resulting from the explosion of maritime violence in the region. Indeed, commercial ships in this region have always been particularly vulnerable to maritime criminal activities—such as maritime piracy—due to the narrow waterways and countless small islands that define the region's geography.

According to security experts, the main threat to regional security in Southeast Asia would be the nexus between piracy and terrorism. Indeed, recently, piracy activity in the high sea has gradually been used as the tool for terrorist groups. Such attacks would halt international commerce and lead to the economic losses. Indeed, the shipping industry could exert additional pressure on regional governments given that ships and crew are at greater risk, driving up the cost of insurance premiums.

In order to estimate the impact of maritime piracy on countries' trade in Southeast Asia, we used data on piracy attacks over the period between 1994 and 2013 and employed measures necessary to conduct empirical research based on the gravity model of trade. The results of the empirical analysis show that every additional maritime piracy attack that happens at the expenses of either of the two trade partnering countries involved leads to a 1% decrease in export volume. In addition, we stress that variables describing exporter *i* have a stronger impact on its export volume than the corresponding characteristics of the importer *j*.

In order to figure out which country's export is influenced the most by piracy, we conducted the analysis by exporter, controlling for the importer's characteristics and the distance between the two countries. We show that the impact of the number of maritime piracy attacks is the highest on Macau's export (more than 3% decrease of export due to each additional attack), while the weakest effect is on Indonesia's trade. Then, we ran regressions of export on maritime piracy attacks for each pair of countries, and we proved the trade partnering pair most affected by the phenomenon: in particular, the most impactful effects are observed for exports from Hong Kong (PR China) to Cambodia, where each maritime piracy attack is associated with a 18% decrease in export. Maritime piracy has a similar effect on exports from Cambodia to PR China and from Philippines to Macau (PR China).

Recently, the number of maritime piracy attacks on oil tankers in the Strait of Malacca is increasing and could pose a serious threat to the economic security of the region. Hijacking oil tankers in order to transfer and sell their cargo is the most lucrative business model used by pirates in the region. Such incidents often occur in international waters, and are purportedly linked to transnational organized crime. Southeast Asian countries did not establish yet a composite special task force—or group from the Navy, Maritime Police, Air Force, and other maritime enforcement agencies—to conduct regular maritime presence in locations of concern. However, in the meanwhile, the countries have increased their defense expenditure and started to modernize their military capabilities, particularly in the air and naval domains. According to the statistics of the Stockholm International Peace Research Institute (SIPRI), Southeast Asia has seen a robust growth in military expenditure over the period between 2010 and 2013. There have been net increases for all countries of the region driven by a multitude of strategic rationales and domestic factors. In particular, maritime disputes between China and its neighbors have increased tensions and affected countries' modernization programs.

Despite these tensions have allowed to strengthen maritime surveillance capabilities, Southeast Asian countries have not shown any serious willingness to collaborate for creating a more effective and sustainable force to patrol regional waters. They should show a willingness to share intelligence and hold law-enforcement exercises. So far, the regional cooperation to counter maritime attacks adopted has been insufficient. This is due especially to unresolved conflicts between international and domestic laws concerning any coastal state's obligation and jurisdiction to combat pirates. Consequently, these conditions have encouraged the increase of maritime attacks in Southeast Asia, and also limited success of the

international cooperation on combating maritime attacks in the region, where the related rates of economic growth have been among the highest in the world in the past twenty years.

Therefore, the increasing development of maritime trade in Southeast Asia requires a stable maritime security. Achieving maritime security cooperation in this region requires that the relevant countries work hard to reach consensus and build up mutual confidence, and eliminate the concern that maritime cooperation will affect the claim of sovereign right. In addition, they should adopt effective measures to promote economic and social development, with the aim of eliminating threats to maritime security, such as maritime piracy. This solution would have the advantage of creating an area of strong stability in a strategic region for international trade.

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Maritime Piracy Risk

Assessing the risk of maritime piracy attacks

Abstract

Maritime piracy is a serious threat to international economics, having consequences on seaborne trade and the countries affected by the phenomenon. During the last two decades, maritime piracy attacks have occurred mainly off the coast of the countries of Middle and Western Africa, Eastern Africa, and Southeast Asia. Since 2011 there has been a decrease of maritime piracy attacks due to the military intervention by the international community. Although reduce the probability of successful maritime piracy attacks, the continuous patrolling of naval forces and the activities of private armed guards aboard vessels the related high costs are as complex as extremely expensive. And as consequence, many traders renounce to hire private armed guards, putting at risk the security of their vessels that transit through the High Risk Areas. Therefore, preventing the phenomenon would reduce the risk of maritime security and the related costs that involves. This research note aims to analyze the economic and institutional determinants of maritime piracy attacks. According to our findings, to reduce the risk of maritime piracy, a strategy ensuring strong economic growth of the countries affected by maritime piracy should be adopted.

Keywords: Africa, Asia, International Economics, Security

Introduction

Although occurring mainly in certain areas, maritime piracy affects the international security, involving high costs to the global economy. According to the data relating to maritime piracy provided by Oceans Beyond Piracy, since 2011 there has been a decrease of maritime piracy attacks. The recent military intervention by the international community has been crucial for reducing the number of maritime piracy attacks. However, during the last decades, there has been the most intense period of maritime piracy, reaching its peak between 2008 and 2011 in the Western Indian Ocean.

The phenomenon of maritime piracy off the coast of Somalia shows that the economical, political, and social factors of a defined geographical area could culminate in a serious global threat. The lack of state capacity of Somalia to patrol the Western Indian Ocean waters has allowed the emergence of maritime piracy off the coast of the country. During the 1990s, the Somali maritime piracy was reduced to a few attacks (especially cases of armed robbery), made by ill-equipped groups. Later, the range of Somali pirates has expanded considerably, involving a growing number of maritime routes, so that the international community has taken steps to intervene.

Given the increasing number of attacks to merchant ships transiting the Western Indian Ocean, in 2008 the Security Council of the United Nations has adopted several resolutions on the situation in Somalia. Condemning the incidents of maritime piracy and armed robbery against vessels off the coast of Somalia, the UN Security Council called upon states and interested organizations to provide technical assistance to Somalia and nearby coastal states—upon their request—to ensure their coastal and maritime security.

In doing so, the countries engaged in commercial maritime routes off the coast of Somalia have taken measures to combat maritime piracy, adopting forms of international coordination. The European Union launched a military operation EU NAVFOR Somalia—known as "Operation Atalanta"—, while the North Atlantic Treaty Organization (NATO) launched first the Operation "Allied Protector" and then "Operation Ocean Shield." In addition to these operations, in the Western Indian Ocean the naval forces of other countries, such as Russian Federation, India, and People's Republic of China operate unilaterally .

Although there has been a significant decrease in the number of maritime piracy attacks due to the recent counter-measures, these operations are so complex. In fact, geographical factors—such as the vast areas of waters affected by the phenomenon—limit the effectiveness of patrolling the Western Indian Ocean waters. In addition, the recent reduction in most countries' military expenditures has pushed many traders to embark teams of private armed guards on vessels that transit through the High Risk Areas.

Even if this practice has been useful so far, it is extremely expensive. Therefore, as an alternative, some traders prefer to identify new routes or to increase cruising speed, so raising fuel consumption. According to Oceans Beyond Piracy, the number of maritime piracy attacks could increase if the recent countermeasures should be reduced.

The continuous patrolling of naval forces, as well as the activities of private armed guards aboard vessels, is an effective deterrent to reduce the probability of successful pirate attacks. However, the related high costs represent a limit, and in the long term many traders could renounce to hire private armed guards, putting at risk the security of their vessels that transit through the High Risk Areas. In addition, the military operations to combat maritime piracy do not seem sufficient to eliminate the phenomenon. Therefore, it is necessary to find the most cost-effective solutions to combat maritime piracy.

Preventing the phenomenon would reduce the risk of maritime security and the related costs that involves, including even insurance premiums for vessels in transit through the High Risk Areas. The countermeasures will fail to generate the desired effects as long as the underlying regional problems are not addressed effectively. In fact, analyzing the regions most affected by the phenomenon, it is clear that maritime piracy must be tackled by taking into account the regional challenges. To eradicate this criminal phenomenon, it would be appropriate to adopt a preventive strategy, by strengthening the internal and economic conditions of the countries affected by maritime piracy.

Few researches have emphasized the importance of institutional and economic factors. The aim of this research note is to analyze which are economic and institutional determinants of maritime piracy attacks, assessing the risk of maritime piracy attacks. The research note is structured as follows: the second section focuses on the literature dealing with the determinants of maritime piracy; the third section presents the data used, and the fourth section outlines the descriptive statistics; the fifth section shows conclusions and ideas for further research.

Literature Review

Several quantitative analyses have been conducted on the prevention of maritime piracy attacks. An, Martínez Ayala, Sidoti, Mishra, Han, Pattipati, Regnier, Kleinman, and Hansen (2012) develop a maritime piracy prediction model based on wind, waves, currents, as well as on the ground intelligence that could help predict the probability of a pirate attack on a given day. This model generates a map that shows the highest-risk areas and could be of further use by adding up to the minute on shipping traffic to identify likely targets for pirates.

Whereas, using Risk Terrain Modeling, Caplan, Moreto, and Kennedy (2011) put forward three risk factors (state status, shipping routes and maritime choke points) to show if attacks locations can be predicted. Jakob, Vaněk, Urban, Benda, and Pěchouček (2010) explore how agent-based techniques can be employed to reduce the threat of contemporary maritime piracy to international transport. By means of a data-driven agent based simulation platform, they analyze information in the maritime domain with an emphasis on detecting, anticipating and preventing pirate attacks.

Patrolling of naval forces, as well as the private contract armed guards aboard ships, should have a deterrent effect on maritime piracy by reducing the probability of successful attacks. As mentioned, the lack of state capacity of Somalia to patrol the Western Indian Ocean waters has resulted in the emergence of maritime piracy. Sumaila and Bawumia (2014) argue that the origin of maritime piracy in Somalia is a result of a combination of state failure, IUU fishing, toxic waste dumping and its impact on the ecosystem. They show that solving the problem of maritime piracy requires a multifaceted approach, including the establishment of a viable Somali state with the rule of law, and action taken to prevent illegal fishing and toxic waste dumping to provide support for the local fishing industry. Guha (2012) explores the time allocation decision of potential pirates between maritime piracy and an alternative non-violent occupation, fishing, when the returns of both maritime piracy and fishing are sensitive to patrolling intensity. For a range of parameters, the static model yields multiple equilibria, an “efficient” one with no patrolling and low maritime piracy, a less efficient equilibrium with intermediate levels of both maritime piracy and patrolling and a highly inefficient high-patrolling high-piracy equilibrium. Analyzing the dynamic analogue, she shows that sufficiently low patrolling can be a good strategy.

Gries and Redlin (2014) examine the effects of socio-economic, political, and institutional conditions on maritime piracy for 149 countries between 1991 and 2010. They show that, on average, less developed countries with higher political and institutional disorder have a higher probability of maritime piracy attacks. Their findings suggest that to solve the problem of maritime piracy, policy efforts should primarily be directed at strengthening economic conditions and the internal stability of the country. According to Samiotis, Psarrou, Pazarzis, Tselentis, and Dafnos (2013), maritime piracy cannot be eliminated solely with force-oriented initiatives, without addressing its root causes (i.e., political instability, endemic poverty, and the lack of security).

Daxecker and Prins (2012) propose a general explanation of maritime piracy that emphasizes the importance of institutional and economic opportunities. Using a monadic-year unit of analysis that includes all states in the international system and cases from 1991 to 2007, they show a positive and statistically significant relationship between maritime piracy attacks and both state failure and economic opportunity. In another research, Daxecker and Prins (2015) argue that states' ability to project power over distance affects pirates' decisions on where to organize and operate. As state capacity increases, maritime piracy will locate farther away from government power centers, whereas maritime piracy can flourish closer to state capitals in weak states that struggle to extend control over space. Using geocoded data from the International Maritime Bureau for the 1996–2013 period, results show that increases in state capacity are associated with greater median capital-maritime piracy distances.

Analyzing the case of Somalia, Beloff (2013) explores the underlying reasons of why Somalis have turned to maritime piracy as a "profession," and offers recommendations for the international community to eliminate maritime piracy effectively through non-military means. Calahorrano and an de Meulen (2010) set up a simple model to describe the choice of becoming a pirate in a setting with an industrialized and a developing country that both engage in fishing in the same waters. They compare the impact of several short- or medium-term measures on maritime piracy and on well-being in the industrialized country, measured by per capita consumption. Because of fishing competition, maritime piracy as an alternative to fishing becomes more attractive in the developing countries.

Analyzing the case of the fisheries sector, Flückiger and Ludwig (2015) study the link between economic shocks in this sector and the incidence of maritime piracy. Examining a panel of 109 coastal countries that spans the years 2004–2009, they use the variation in phytoplankton abundance off the individual countries' coasts as a source of economic shocks to the fishery industry. They argue that higher plankton abundance leads to an increase in the

abundance of fish and, hence, to higher productivity in the fisheries sector: this signifies an improvement in economic conditions in this sector and therefore increases the opportunity cost for a fishermen to engage in maritime piracy activity.

We believe that the military operations to combat maritime piracy do not seem sufficient to eradicate the phenomenon. Therefore, due to recent reduction in most countries' military expenditures and the high costs to hire private armed guards on vessels that transit through the High Risk Areas, we believe it necessary to find the most cost-effective solutions to prevent maritime piracy. In this paper, we analyze economic and institutional determinants of maritime piracy attacks. In doing so, we focus on the coastal countries of the three regions most affected by the phenomenon.

Data

According to the data related to maritime piracy attacks released by the International Maritime Bureau, the most affected regions are Middle and Western Africa, Eastern Africa, and Southeast Asia. In compliance with the composition of macro-geographical regions defined by United Nations Statistics Division, the sample analyzed here is made up of the coastal countries of the three regions mentioned above.

In particular, this research note registers the variations related to the economic and institutional conditions over the period between 1994 and 2013. The three regions are made up as follows.

Middle and Western Africa

Angola	Ghana
Benin	Guinea
Cabo Verde	Guinea-Bissau
Cameroon	Liberia
Democratic Republic of the Congo	Mauritania
Congo	Nigeria
Côte d'Ivoire	São Tomé and Príncipe
Equatorial Guinea	Senegal
Gabon	Sierra Leone
Gambia	Togo

NOTE:
Due to unavailable or insufficient data, Saint Helena (GBR) has not been selected.

Eastern Africa

Comoros	Mauritius
Djibouti	Mozambique
Eritrea	Seychelles
Kenya	Somalia

Madagascar	Tanzania

NOTE:
Due to unavailable or insufficient data, have not been selected the following countries: Mayotte (FRA), Réunion (FRA), and the Territory of the French Southern and Antarctic Lands (FRA).

Southeast Asia

Brunei Darussalam	Philippines
Cambodia	Singapore
Indonesia	Thailand
Malaysia	Timor-Leste
Myanmar	Vietnam

The source of data on maritime piracy incidents is the ICC International Maritime Bureau. It is a specialized division of the International Chamber of Commerce (ICC) established in 1981 to act as a focal point in the fight against all types of maritime crime and malpractice. It maintains a round-the-clock watch on the global shipping lanes, reporting pirate attacks to local law enforcement and issuing warnings about piracy hotspots to shipping.

The economic data are compiled by the World Bank that allows free and open access to data about development in countries around the globe.

The geographic data are compiled by the World Factbook, which is a reference resource produced by the Central Intelligence Agency that provides information on the history, people, government, economy, geography, communications, transportation, military, and transnational issues for over 250 world entities.

Ratings on the guarantee of political rights and civil liberties are compiled by Freedom House, which is a nongovernmental, bipartisan organization committed to promoting peace and democracy around the world. Founded in 1941, Freedom House conducts research and advocacy on democracy, political freedom, and human rights. The organization's annual "Freedom in the World" report assesses each country's degree of political freedoms and civil liberties.

Finally, the source of State Fragility Index and Matrix is the Integrated Network for Societal Conflict Research (INSCR), established to coordinate and integrate information resources produced and used by the Center for Systemic Peace (CSP). The research of CSP is on the problem of political violence within the structural context of the dynamic global system, that is, global systems analysis. CSP supports scientific research and quantitative analysis in many issue areas related to the fundamental problems of violence in both human relations and societal-systemic development processes.

Methodology

In order to explore macroeconomic and institutional determinants of maritime piracy attacks, we have estimated a number of panel data logistic regression models. The probability of a maritime attack in country *i* in year *t* was assumed to be determined by the logistic cumulative distribution function:

The general specification was as follows:

$$Prob\ (attack = 1) = \frac{\exp(X\beta + u_i + \varepsilon_{it})}{1 + \exp(X\beta + u_i + \varepsilon_{it})}$$

The u_i component of the composite error term reflects unobserved country-specific time-invariant effects, while the ε_{ij} is the idiosyncratic error term.

We have estimated several specifications with a different number of explanatory variables to check the robustness of our findings. The sample size varies from specification to specification because of missing values. The first set of models use the incidence of any maritime piracy attacks (both actual and attempted) as the dependent variable (see Table 1), while the second one is aimed at explaining the occurrence of actual attacks only (see Table 2).

	(1)	(2)	(3)	(4)	(5)	(6)
	Any attack	Any attack	Any attack	Any attack	Any attack	Any attack
Any attack						
GDP growth (annual %)	0.977*	0.977*	0.977	0.981		
	(0.0135)	(0.0134)	(0.0137)	(0.0117)		
Population growth (annual %)	1.000***	1.000***	1.000**	1.000***	1.000***	
	(1.91e-08)	(1.79e-08)	(2.05e-08)	(1.97e-08)	(1.89e-08)	
Trade growth (annual %)	1.004	1.004	1.004	1.002		
	(0.00271)	(0.00274)	(0.00272)	(0.00233)		
Political Rights	1.030	1.043	1.035	1.018		
	(0.173)	(0.183)	(0.176)	(0.171)		
Civil Liberties	1.029	0.999	1.066	0.925		
	(0.266)	(0.246)	(0.278)	(0.218)		
Partial freedom	1.185	1.175	1.203	1.411		
	(0.552)	(0.545)	(0.569)	(0.654)		
Freedom	1.026	1.008	1.042	1.152		

	(0.743)	(0.722)	(0.772)	(0.808)		
Fragility Index	1.005					
	(0.0824)					
Effectiveness Score		1.045				
		(0.138)				
Legitimacy Score			0.957			
			(0.126)			
Difference between GDP and Population growth (annual %)						1.000***
						(1.89e-08)
Observations	683	683	683	772	790	775
AIC	651.4	651.1	651.2	722.4	727.0	715.2
BIC	696.7	696.4	696.5	764.3	741.0	729.2

Exponentiated coefficients
Standard errors in parentheses
$^{*}p< 0.1$, $^{**}p< 0.05$, $^{***}p< 0.01$

Population growth was systematically shown to be associated with somewhat increased probability of maritime piracy attacks. There is also weak evidence (based on some of the specifications and on 10% significance level) that GDP growth is associated with a lower probability of maritime piracy attacks (see Table 1).

Positive influence of Population growth (significant at 1% level) and negative impact of GDP growth (significant at 5% level) are much more pronounced if we concentrate on explaining the probability of actual attacks rather than both actual and attempted attacks. The difference between these two growth rates is a statistically significant predictor of maritime piracy risk.

	(1)	(2)	(3)	(4)	(5)	(6)
	Actual attack	Actual attack	Actual attack	Actual attack	Actual attack	Actual attack
Actual attack						
GDP growth (annual %)	0.959**	0.959**	0.958**	0.961**		
	(0.0168)	(0.0164)	(0.0173)	(0.0149)		
Population growth (annual %)	1.000***	1.000***	1.000***	1.000***	1.000***	
	(1.18e-08)	(1.09e-08)	(1.30e-08)	(1.24e-08)	(1.14e-08)	
Trade growth (annual %)	1.003	1.003	1.003	1.002*		
	(0.00235)	(0.00231)	(0.00250)	(0.00111)		
Political Rights	0.942	0.957	0.948	0.919		
	(0.169)	(0.177)	(0.167)	(0.169)		
Civil Liberties	1.006	0.968	1.054	0.925		
	(0.197)	(0.185)	(0.215)	(0.190)		
Partial freedom	1.049	1.035	1.058	1.257		
	(0.520)	(0.503)	(0.535)	(0.648)		

Freedom	0.906	0.886	0.912	0.975		
	(0.796)	(0.774)	(0.831)	(0.824)		
Fragility Index	1.004					
	(0.0799)					
Effectiveness Score		1.057				
		(0.137)				
Legitimacy Score			0.940			
			(0.117)			
Difference between GDP and Population growth (annual %)						1.000***
						(1.13e-08)
Observations	683	683	683	772	790	775
AIC	608.8	608.4	608.5	663.2	670.9	660.5
BIC	654.1	653.7	653.7	705.0	684.9	674.5

Exponentiated coefficients
Standard errors in parentheses
*p< 0.1, **p< 0.05, ***p< 0.01

The higher the difference between GDP growth and Population growth, the lower the risk of maritime piracy attacks. Therefore, strategies aimed at increasing this difference between GDP growth and Population growth rates would result in lower maritime piracy incidence.

Because of driving forces may still be different, we also analyzed each region separately as follows.

Middle and Western Africa

In Middle and Western Africa, the key force that increases the probability of maritime piracy is Trade growth. Holding other things equal, GDP growth decreases the probability of maritime piracy. Legitimacy score is another factor that reduces the probability of maritime piracy attacks.

	(1)	(2)	(3)	(4)	(5)	(6)
	Actual attack	Actual attack	Actual attack	Actual attack	Actual attack	Actual attack
GDP growth (annual %)	0.966*	0.967*	0.965*	0.973*		
	(0.0194)	(0.0182)	(0.0187)	(0.0147)		
Population growth (annual %)	0.789	0.772	0.787	0.768	0.807	
	(0.147)	(0.134)	(0.146)	(0.149)	(0.145)	
Trade growth (annual %)	1.007*	1.007*	1.008*	1.006*		
	(0.00409)	(0.00396)	(0.00424)	(0.00336)		

Political Rights	1.069	1.040	1.148	0.928		
	(0.332)	(0.342)	(0.337)	(0.330)		
Civil Liberties	1.149	0.997	1.274	0.919		
	(0.328)	(0.281)	(0.369)	(0.274)		
Partial freedom	1.766	1.617	1.818	1.494		
	(0.825)	(0.761)	(0.887)	(0.954)		
Freedom	2.050	1.724	2.253	1.147		
	(1.954)	(1.680)	(2.223)	(1.237)		
Fragility Index	0.890					
	(0.0887)					
Effectiveness Score		0.912				
		(0.164)				
Legitimacy Score			0.747**			
			(0.105)			
Difference between GDP and population growth (%)						0.981
						(0.0119)
Observations	323	323	323	353	360	353
AIC	338.7	340.4	337.2	368.7	362.2	361.4
BIC	376.5	378.2	374.9	403.5	373.8	373.0

Exponentiated coefficients
Standard errors in parentheses
*p< 0.1, **p< 0.05, ***p< 0.01

Eastern Africa

In Eastern Africa, the difference between GDP growth and population growth is not the key factor influencing the probability of maritime piracy attacks. Trade growth has a significant positive impact on the probability of maritime piracy attacks. Higher Political Rights ratings are associated with lower probability of maritime piracy.

	(1)	(2)	(3)	(4)	(5)	(6)
	Actual attack	Actual attack	Actual attack	Actual attack	Actual attack	Actual attack
GDP growth (annual %)	0.861*	0.861	0.860	0.870*		
	(0.0758)	(0.0798)	(0.0797)	(0.0635)		
Population growth (annual %)	0.531*	0.532*	0.527**	1.134	1.059	
	(0.180)	(0.187)	(0.165)	(0.562)	(0.382)	
Trade growth (annual %)	1.002***	1.002***	1.002***	1.002***		
	(0.000237)	(0.000273)	(0.000185)	(0.000202)		
Political Rights	0.748***	0.753**	0.744***	0.921		
	(0.0830)	(0.0936)	(0.0724)	(0.142)		
Civil Liberties	0.809	0.796	0.817	0.695		
	(0.493)	(0.526)	(0.447)	(0.371)		
Partial freedom	0.942	0.925	0.939	2.000		

	(1.223)	(1.236)	(1.194)	(2.764)		
Freedom	1	1	1	1		
	(.)	(.)	(.)	(.)		
Fragility Index	1.006					
	(0.105)					
Effectiveness Score		1.022				
		(0.190)				
Legitimacy Score			0.994			
			(0.0874)			
Difference between GDP and population growth (%)						0.935
						(0.0582)
Observations	131	131	131	158	158	158
Pseudo R^2						
AIC	140.4	140.4	140.4	161.3	161.4	159.6
BIC	160.5	160.5	160.5	185.8	170.6	168.8

Exponentiated coefficients
Standard errors in parentheses
$^{*}p< 0.1$, $^{**}p< 0.05$, $^{***}p< 0.01$

Southeast Asia

The effect of Population growth—and the difference between GDP growth and Population growth—on maritime piracy is the most pronounced in the case of Southeast Asia. Effects of institutional factors were not identified.

	(1)	(2)	(3)	(4)	(5)	(6)
	Actual attack	Actual attack	Actual attack	Actual attack	Actual attack	Actual attack
Actual attack						
GDP growth (annual %)	0.924	0.923	0.925	0.928		
	(0.0472)	(0.0450)	(0.0453)	(0.0431)		
Population growth (annual %)	1.000***	1.000**	1.000**	1.000***	1.000***	
	(1.20e-08)	(1.42e-08)	(1.67e-08)	(1.15e-08)	(1.12e-08)	
Trade growth (annual %)	1.015	1.015	1.016	1.007		
	(0.0153)	(0.0156)	(0.0151)	(0.0135)		
Political Rights	0.509	0.517	0.496	0.524		
	(0.440)	(0.452)	(0.424)	(0.433)		
Civil Liberties	1.184	1.163	1.235	1.239		
	(0.521)	(0.523)	(0.605)	(0.551)		
Partial freedom	0.236	0.236	0.230	0.260		
	(0.399)	(0.388)	(0.400)	(0.363)		
Freedom	1	1	1	1		
	(.)	(.)	(.)	(.)		
Fragility Index	1.034					

	(0.0718)					
Effectiveness Score		1.056				
		(0.214)				
Legitimacy Score			1.054			
			(0.263)			
Difference between GDP and population growth (%)						1.000***
						(1.14e-08)
Observations	125	125	125	133	160	152
AIC	124.2	122.2	122.2	128.5	134.3	124.3
BIC	146.8	142.0	142.0	148.7	143.5	133.4

Exponentiated coefficients
Standard errors in parentheses
*p< 0.1, **p< 0.05, ***p< 0.01

Conclusions

According to the data related to maritime piracy provided by Oceans Beyond Piracy, since 2011 there has been a decrease of maritime piracy attacks. The recent military intervention by the international community has been crucial for reducing the number of attacks. However, the military operations to combat maritime piracy are as complex as extremely expensive, especially after the recent reduction in most countries' military expenditures. Therefore, many traders prefer to embark teams of private armed guards on vessels that transit through the High Risk Areas, or to identify new routes or alternatively to increase cruising speed, so raising fuel consumption.

Although the continuous patrolling of naval forces and the activities of private armed guards aboard vessels reduce the probability of successful maritime piracy attacks, the related high costs represent a limit in the long term. Moreover, military operations do not seem to be the only solution to eradicate the phenomenon. Given that so far significant research in this regard has not been conducted, we have analyzed what are the economic and institutional determinants of maritime piracy attacks, assessing the risk of maritime piracy attacks.

In doing so, we have analyzed the economic, political, and social conditions, over the period between 1994 and 2013, of the most affected regions by the phenomenon—i.e. Middle and Western Africa, Eastern Africa, and Southeast Asia. Considering the nature of maritime piracy, we have focused our analysis only on the coastal countries of the three selected regions. Our results show that, on average, low GDP growth combined with high Population growth are key economic risk factors of maritime piracy. The difference between GDP growth and Population growth is a statistically significant predictor of maritime piracy risk. The higher the difference between these two growth rates, the lower the risk of maritime piracy attacks.

Finally, because the driving forces may still be different, we analyzed each region separately. It emerged that the effect difference between GDP growth and Population growth on maritime piracy is the most pronounced in Southeast Asia than in the African regions. In particular, in Middle and Western Africa, the main determinant of maritime piracy is Trade growth; in the Eastern Africa, Trade growth has a significant positive impact on the probability of maritime piracy attacks. About institutional factors, in Southeast Asia these are not identified; while in Africa, the ratings of Legitimacy Score and Political

Rights—respectively, in Middle and Western Africa and in Eastern Africa—are associated with lower probability of maritime piracy attacks.

In conclusion, the results about GDP growth and Population growth are significant: as mentioned, our findings have shown that low GDP growth combined with high Population growth are key economic risk factors of maritime piracy attacks. Therefore, to reduce the risk of maritime piracy, a strategy to ensure strong economic growth of the countries affected by the phenomenon should be adopted.

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Conclusions

Maritime piracy is one of the main international security issues affecting major shipping lanes, even though there has been a significant decrease in the number of attacks due to the recent countermeasures. Maritime piracy directly affects global economy but its effects have not been analyzed in depth in quantitative economics literature. The purpose of the thesis is threefold. It aims to examine the economic impacts of maritime piracy applying quantitative methods, to study how maritime piracy affects economic growth and international trade, and to assess the risk of pirate attacks. In particular, the research focuses on the three regions most affected by the phenomenon—i.e. the Gulf of Guinea, the Western Indian Ocean, and Southeast Asia.

After having analyzed the recent trends in pirate attacks, I examined the impact of maritime piracy in the sub-continent most affected, i.e. the Sub-Saharan Africa. Then, I tested the severity of the attacks of maritime piracy in Sub-Saharan Africa, and their impact on the GDP growth rate of the coastal countries. In doing so, I analyzed the geopolitical conditions of the Sub-Saharan African region over the period between 1994 and 2013. The results revealed that maritime piracy attacks have not significant impact on GDP growth of the coastal countries. These results are significant because they are opposed to the assumption that maritime piracy can seriously affect economic growth in sub-Saharan countries. On the other hand, as the literature has pointed out, the economic growth of these countries is threatened by other factors, such as lack of state capacity, political instability, and terrorism.

Therefore, I have decided to study the case of Southeast Asia, given the region's significant role in international trade and the general progress of regional integration. However, commercial ships in this region have always been particularly vulnerable to maritime piracy due to the narrow waterways and countless small islands that define the region's geography. Then, in order to estimate the impact of maritime piracy on trade in Southeast Asia, I have used data on pirate attacks over the period between 1994 and 2013 and employed measures necessary to conduct empirical research based on the gravity model of trade. The results of the empirical analysis show that every additional maritime piracy attack that happens at the expenses of either of the two trade partnering countries involved leads to a 1% decrease in export volume. In addition, variables describing exporter *i* have a stronger impact on its export volume than the corresponding characteristics of the importer *j*. In

addition, I have showed which country's export and trade partnering pair countries are most affected by the phenomenon. According to these significant results, the increasing development of maritime trade in Southeast Asia requires a stable maritime security. Indeed, despite the regional tensions have allowed to strengthen maritime surveillance capabilities, Southeast Asian countries have not shown any serious willingness to collaborate for creating a more effective and sustainable force to patrol regional waters. Achieving maritime security cooperation of Southeast Asian countries would allow strong stability in a strategic region for international trade.

However, military operations do not seem to be the only solution to eradicate the phenomenon. In fact, although the continuous patrolling of naval forces and the activities of private armed guards aboard vessels reduce the probability of successful maritime piracy attacks worldwide, the related high costs represent a limit in the long term. Then, I have examined the economic and institutional determinants of maritime piracy in order to prevent the risk of pirate attacks. In doing so, I have analyzed the economic, political, and social conditions, over the period between 1994 and 2013, of the most affected regions by the phenomenon—i.e. Middle and Western Africa, Eastern Africa, and Southeast Asia. The results show that, on average, low GDP growth combined with high population growth are key economic risk factors of maritime piracy. The difference between GDP growth and population growth is a statistically significant predictor of maritime piracy risk. Since the driving forces may still be different, I have analyzed each region separately. The results reveal that the difference between GDP growth and population growth on maritime piracy is the most pronounced in Southeast Asia than in the African regions; in particular, in Middle and Western Africa, the main determinant of maritime piracy is trade growth; in Eastern Africa, trade growth has a significant positive impact on the probability of maritime piracy attacks. Then, according to the results, to reduce the risk of maritime piracy, a strategy to ensure strong economic growth of the countries affected by the phenomenon should be adopted.

In conclusion, even if there has been a decrease of maritime piracy attacks since 2011, they still represent a serious global threat, which implies high costs. According to the security experts, the overall gain of pirates is minimized compared to the total costs to combat maritime piracy, to which we must also add the costs attributed to the impact on international trade and the economic consequences on countries affected by this phenomenon. Despite the current limited reliable data, it is worth analyzing the estimation of the global costs. In addition, research on the nexus between terrorism and maritime piracy is still in its infancy, and the most is done by adopting a qualitative approach. According to official data, no direct

connection exists between terrorist groups and pirates. However, drawing on this thesis it is possible to suggest adopting a game-theoretic approach. This one will in fact help analyze the risk of collaboration between pirates and terrorists, by examining the dynamics in the three regions which have been most affected by maritime piracy.

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