Human Development, Climate Change, Disasters and Conflict:

Linkages and empirical evidence from the last three decades

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List of Acronyms

CRED	Centre for Research on the Epidemiology of Disasters
EM-DAT	Emergency events Database
PRIO	Peace Research Institute of Oslo
UCDP	Uppsala Conflict Data Program
WB	World Bank
UNDP	United Nations Development Programme
HDI	Human Development Index
GDP	Gross Domestic Product

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Finally, and as mentioned before, I hope that this work contributes to both the research project "When disasters meet conflict" and to current academic debate about the relationship between disasters and conflict. I am a firm believer that the complete understanding of the determinants and effects of conflict and disasters will help reducing the human losses that these events cause.

Abstract

The main aim of this research paper is to contribute to the current academic debate about the relationship between disasters and conflict. If a catastrophe can actually affect the current political stability of a country, what can we learn in order to minimize the negative effects of such events? Is there a relationship between conflicts and disasters and how are they connected? If any, is this relationship positive or negative?

Using a quantitative analysis this research aims to answer these questions. More precisely this paper builds a robust armed conflict explanatory model and tests whether disasters (in many of its forms) have an effect on conflict. In addition to the above and taking into consideration the increased risk of hazards due to climate change, this research also tests whether climate-related disasters have a different effect on conflict. The novelty of this research lies in merging different approaches and including the Human Development Index in a conflict explanatory model. This novelty leads to interesting results. The findings of this research show that there isn´t a statistically significant relationship between these two variables and therefore it is not possible to state (in a general manner) that disasters trigger, intensify or reduce conflict. This result empathizes with a strand of thought that argues that there isn't a statistical relationship between disasters and conflict and that conflict depends generally on other deep determinants.

Relevance to Development Studies

Conflicts and disasters lead to a decrease in the well-being of societies and in the worst cases, to deaths. Thus, it is of high relevance to understand both the causes and the effects of these two processes. Even though large contributions have been made in the understanding of this two processes separately, not much has been done with respect to their interconnection and to how these events are embedded in development. Conflict and peace studies are of high relevance to development studies to the extent that most of the states affected by conflict are also affected by under or uneven development. The interconnections between conflict and development are many and they need to be researched in the development context. In the same way, the vulnerabilities, coping capacities and therefore the resilience of human settlements to hazards that might turn into disasters are a central issue for development studies. This research paper explores in a quantitative manner the strength of the relationship between these two processes, therefore it is of high relevance for the current studies of development. More precisely, it explores to which extent the Human Development Index is a good explanatory variable of conflict and how it interacts with the presence of disasters.

Keywords

Conflict, armed conflict, disasters, natural disasters, climate change, human development.

Chapter 1

Introduction

On the night of the 26th of December of 2004 at 00:58:53 UTC[1] a rupture along the fault between the Burma Plate and the Indian Plate caused an undersea megathrust earthquake that hit 15 countries between Asia and Africa. This tremendous natural hazard that would be later described as the 2004 Indian Ocean earthquake and tsunami took the lives of at least 280,000 people and displaced at least another 1.7 million people[2]. Due to several reasons, two of countries that were most affected by this catastrophe were Indonesia and Sri Lanka, were estimations state that respectively 167,540 and 35,322 people died. In addition to that, a total of 1,516,150 were displaced in both countries and 37,063 people were declared missing in the case of Indonesia. Furthermore, it has been estimated that these large disasters not only left a dramatic death toll but also a huge economic loss in both countries. The total economic loss has been estimated in 9,991 Million US[3].

However, the socio-economic impacts of these disasters are not limited to these figures. Can a physical rupture such as the one of the Indian and Burmese plate also rupture the social bondings of the human settlements in these places? Can these massive ruptures help to heal some of their historic social ruptures? This is the question that a group of scholars has been trying to answer over the last decade and by now it has been largely documented that this tsunami had different impacts on the political stability and peace of Indonesia and Sri Lanka. While some argue that this disaster had a positive contribution to ending the conflict between the Free Aceh Movement (Gerakan Aceh Merdeka or simply GAM) and the Indonesian government (Le Billon and Waizenegger, 2007; Gaillard, Clave and Kelman, 2008; Beardsley and McQuinn, 2009; UNDP, 2011), others argue that this same disaster did not mitigate the conflict between the Liberation Tigers of Tamil Eelam (LTTE) and the Government of Sri Lanka, but that actually increased it (Le Billon and Waizenegger, 2007; Beardsley and McQuinn, 2009; UNDP, 2011). The authors that sustain that the Indian ocean Earthquake acted as a peace promoter in the Aceh province, base their conclusions mainly on the use of a disaster diplomacy framework (Gaillard, Clave and Kelman, 2008; UNDP, 2011). Meanwhile those who argue the contrary, focus mainly on the increased resource scarcities and tensions over land that this event produced (Le Billon and Waizenegger, 2007; Beardsley and McQuinn, 2009; UNDP, 2011). Nonetheless, this comparison has also been criticized and authors such as Hyndaman (2009) have argued that the political landscapes of these two countries and their respective conflicts are incomparable, and that more research needs to be done to correctly assess the dynamics of sovereignty and governance in the post-tsunami period.

This research has been highly motivated by the duality of outcomes observed by this same natural hazard and the academic debate that they produce. If a catastrophe such as the Indian Ocean earthquake can actually affect the current political stability of states, what can we learn in order to minimize the negative effects of such events?. If there is a relationship between conflicts and disasters, how are they connected? If any, is this relationship positive

[1] UTC, Universal Time Coordinated.
[2] World Health Organization - https://www.who.int/hac/crises/international/asia_tsunami/3months/report/en/
[3] Emergency Events Dataset (EM-DAT) – Centre for Research on the Epidemiology of Disasters (CRED) - https://www.emdat.be

or negative? Do those resource scarcities and land tensions prevail over the positive pathways proposed by disaster diplomacy? Does this connection depend on certain factors? And how can we avoid their negative consequences in the future?

This research aims to answer these questions and to understand and quantify the effect of disaster occurrence in the likelihood of experiencing conflict. More precisely, the two main research questions of this research are:

1. Can disasters trigger conflicts?
2. Do disasters contribute to maintain or to reduce ongoing conflicts?

This question is critical in an academic debate that is far from reaching a consensus yet (see conclusions by: Saleyahn, 2008; Nel and Righarts, 2008; Bernauer et al. 2012, Scheffran et al. 2012; Slettebak 2012; Theisen et al. 2013; Buhuaug et al. 2014). From an academic perspective, this research will contribute to shed some light in this current unconcluded academic debate by providing updated figures and also a robust quantitative statistical anlysis of the correlation between these two variables. This work also contribute in a theoretical manner by merging different strands of thought before specifying a conflict explanatory model. Finally, this research is of high relevance in the current climatic crisis because it explores the relationship between climate change and conflict and the differences between the so called climate-related and non-climate-related disasters and conflict.

The novelty of this analysis comes from three sources. First, it merges in a novel manner several approaches that aim to understand the relationship between disasters and conflict. A second novel aspect of this work is that it builds a conflict explanatory model including the Human Development Indicator (HDI) as a proxy for development instead of the most common measure for economic development which is Gross Domestic Product (GDP) per capita. The advantages of using the HDI are explained further in this document. Third and final, this research is novel because it examines the effects of several forms of disasters in several types of conflict such as conflict onset, ongoing conflict, ongoing minor conflict and ongoing wars.

As previously stated, this research has been designed with the aim of understand the effects that disasters can have on conflict. Nonetheless, and as it will be later introduced in this document, conflicts can also increase the vulnerability of societies in several forms and therefore increase the likelihood of a natural hazard to turn into a disaster. Therefore, it is highly suggested for future research to explore this relationship, meaning, the effects of conflict in disasters.

The rest of this document is structured as follows: Chapter 2 presents an extensive literature review that studies conflict, the relationship between climate and conflict and the relationship between disasters and conflict. Chapter 3 presents the research question and the methodology used to answer it. Chapter 4 explains the model specification and the empirical strategy followed to obtain the estimations that led to the conclusions of this research. Chapter 5 and 6 respectively present the data sources and some relevant trend. Chapter 7 presents the results of these estimations. In Chapter 8, several limitations are exposed and the final conclusions are presented in Chapter 9.

Chapter 2

Literature Review & theoretical framework

The literature that focuses on the linkages between disasters and armed conflict is in general scarce and recent. Studies that estimate the magnitude (quantitatively) of the relationship between disasters and armed conflict are even scarcer and have been published only within the last two decades (Nel & Righarts, 2008, Slettebak, 2012). However, the literature that focuses on the links between disasters and armed conflict can be considered as a subset of the literature that focuses on the links between climate change and conflict, which provides a wider spectrum of publications and information available for this research. Therefore, to carry out a complete review of the literature that examines the relationship between these two variables, it is necessary to broaden the focus of research and review the publications that study the interaction between climate change and armed conflict.

This chapter begins with a brief review of the literature that focuses on explanatory models for conflict. Then a review on the theory and findings about the relationship between climate change and armed conflict is presented. Finally, the literature about the relationship between disasters and armed conflict is examined.

2.1 Causes of armed conflict – The "Greed versus Grievance" debate

The argument for much of the economic and political science literature on civil conflict is rooted in the work by the Nobel-laureate Gary Becker (1968), who argued that the likelihood of committing a crime (in this case, the crime of participating in violent conflict) is a function of the payoffs and punishments associated with this criminal activity (Hendrix & Glaser, 2007). According to this theory, engaging in conflict is a rational decision which is the result of a cost-benefit analysis in which the benefits of committing this crime are higher than their costs. More precisely, this analysis is based on the difference between the expected economic returns from engaging in conflict (or joining a rebel group) relative to those from doing the conventional economic activity (agriculture). This theory gave grounds for what is nowadays understood as the "Theory of Greed" (also referred as "vertical inequality theory" or as "economic deprivation cause for conflict") which corresponds to the first of two phenomena that have been utilized to explain conflict onset, being the second one the "The Grievance theory" (Collier et al., 2009; Murshed & Tadjoeddin, 2009; Hoeffler, 2011).

On the one hand and according to Murshed & Tadjoeddin "The Greed Theory" is the more popular among economists and bases the explanation of conflict onset on the elite competition over natural resources rents, as the authors Murshed & Tadjoeddin, (2009:88) point out:

> "According to this view [the greed theory], conflict reflects elite competition over valuable natural resource rents, concealed with the fig leaf of collective grievance. Additionally, rebellions need to be financially viable: civil wars supported by natural resource based rents like blood diamonds or oil, or when sympathetic diasporas provide a ready source of finance, are more likely to occur."

On the other hand, "The Grievance theory" (also referred as "horizontal inequality theory" or "identity deprivation cause for conflict") refers to those arguments in favor that conflict onset is the result of the rebellion about other deprivations or due to issues of identity such as ethnicity, social class or others. And as Murshed & Tadjoeddin (2009:89) also reflect:

> "Ethnic identities, whether based on race, language, religion, tribal affiliation or regional differences, may serve as a more effective amalgam for the purposes of group formation, compared to other forms of more transient difference that are traditionally stressed by Marxist writers, such as socio-economic class. The formation of enduring identities are therefore central to mobilizing groups, including the machinations of conflict entrepreneurs who organize men to fight each other; see Tilly (1978) and Gurr (2000) on this."

However, the scholarly community is far from reaching a consensus on this issue yet and there has been a big debate on the greed versus grievances theory. Several authors have criticized firmly Collier´s and Hoeffler´s work emphasizing their flaws but also providing empirical evidence for the grievance argument (see for example; Bensted, 2011; Cederman et al., 2011; Keen, 2012; Koubi & Böhmelt, 2014)

Even though the use of the greed theory and its support with quantitative studies has gain space in this debate (Koubi & Böhmelt, 2014), the use of this economic approach might result in misleading interpretations, often simplistic that don´t add up to the deep understanding of the determinants of violent conflict. The aim of this research paper is not to contrast the greed and grievances theories but instead to extract the learnings from both strands of thought in order to build a conflict explanatory model. For such a complex social phenomena as violent conflict, to assume that only one theory or model can simplify its inherent causes and effects is too simplistic. It is necessary to account for factors that might explain conflict such as those greed and grievances but also their interactions with other inherent factors (such as institutional development, political stability, population or other triggering variables). Part of this challenge is to understand the relationship between this greed and grievances factors that contribute to conflict with other environmental phenomena such as climate change. The following section reviews the existent literature in this field.

2.2 Climate change and conflict

The nexus between climate change and conflict has been widely discussed by scholars during the past two decades. However, the scholarly community is far from reaching a consensus on this matter yet (see the conclusions by Saleyahn, 2008; Bernauer et al. 2012, Scheffran et al. 2012; Theisen et al. 2013; Buhuaug et al. 2014). While many quantitative cross-country studies have found a significative relationship between climate variations and conflict (see, among others, Miguel & Satyanath, 2004; Hsiang et al. 2013; Hsiang & Burke, 2014; Dinar et al. 2015), many scholars have also argued the contrary and that the strength of this relationship is highly conditional on other variables such as economic development, political stability, quality of their institutions or population size (see, for example, Hauge & Ellingsen, 1998; Gleditsch & Urdal, 2002; Urdal, 2005; Hendrix & Glaser, 2007; Ide, 2015; Hislope and Gottlieb, 2017; Owain and Maslin, 2018; Koubi, 2019).

From the group of authors that argue in favor of a relationship between climate change and violent conflict, one of the most cited publications is the one by Miguel et al. (2004:746)

"Economic shocks and civil conflict: An instrumental variables approach", in which they conclude:

> "Using rainfall shocks as instrumental variables for economic growth, we find that growth shocks (rainfall shocks) have a dramatic causal impact on the likelihood of civil war: a five-percentage-point negative growth shock increases the likelihood of a civil war the following year by nearly one-half."

From this perspective, abnormal rainfall variations, land degradation, abnormal climatic conditions, and freshwater scarcity are the main mechanisms by which climate change could increase the likelihood of engaging in conflict.

From a complementary and maybe "more complex" point of view, many authors argue that climate-change has an effect on conflict but only conditional on other factors. Many of these authors base their conclusions on in-depth case studies and extensive qualitative studies (see, for example, Nordås & Gleditsch, 2007; Bernauer et al. 2012; Gleditsch, 2012; Salehyan, 2008; Theisen et al. 2013; Buhaug et al. 2014). However, not many quantitative studies have provided empirical support to refute the relationship between climate variations and conflict.

In recent years, more articles that present empirical evidence (both qualitative and quantitative) about the relationship between climate change and conflict have been published (see, among others, Harari, 2018; Crost et al. 2018; Hunsberger et al. 2018; Sovacool, 2018; Van Weezel, 2019; Koubi 2019). With respect to these recent publications is important to acknowledge their specific focus, deepening in regions or countries instead of broader cross-country analysis. An example of these country-specific analyses are for Bangladesh (Sovacool et al. 2018), for the Philippines (Crost et al. 2018), for Cambodia (Hunsberger et al. 2018) and for Ethiopia and Kenya (Van Weezel, 2019). Of these sources is relevant to notice that many of these publications state that even though there is evidence for a relationship between climate change and conflict it is often conditional to other more salient factors in each region or country. These findings are aligned with most of the conclusions of many publications from the beginning of this decade (see, for example, Nordås & Gleditsch, 2007; Bernauer et al. 2012; Gleditsch, 2012; Salehyan, 2008; Theisen et al. 2013; Buhaug et al. 2014) and as Bernauer et al.(2012:1) precisely points out:

> "…environmental changes may, under specific circumstances, increase the risk of violent conflict, but not necessarily in a systematic way and unconditionally."

To wrap up, the relationship between climate change and conflict has been the subject of study of many scholars in the last decades. The argument is that abnormal rainfall variations, land degradation, abnormal climatic conditions, and freshwater scarcity are the main mechanisms by which climate change could affect the likelihood of conflict. This argument can also be used for the understanding of the relationship between disasters and violent conflict. Nonetheless, the contradictory findings of both quantitative and qualitative studies have made it difficult for the academic community to reach consensus. The following section reviews the literature that focuses on the relationship between disasters and conflict.

2.3 Disasters and conflict

The main objective of this research paper is to understand the nature of the relationship between disasters and conflicts. However, both the EM-DAT database (main input for this

research) and the existent literature tend to refer to them as "natural disasters" (Chmutina and Meding, 2019). From an epistemological point of view, it is important to start by acknowledging that the concept of "natural disasters" is built by adding a "natural" component to the "disasters" concept. Nonetheless, this "natural" addition is far from being natural due to the "man-made" characteristics of these events (Redmond 2005). More precisely, the risk of disasters is the result of the interaction between a particular natural hazard and the vulnerability that a certain society has to it. The vulnerability that a group of people or society has with respect to a natural hazard can be diminished by increasing or improving its coping capacity. As Redmond (2005:1259) precisely points out:

> "Disasters are commonly divided into "natural" and "man-made," but such distinctions are generally artificial. All disasters are fundamentally human-made, they are a function of where and how people choose or are forced to live. The trigger may be a natural phenomenon such as an earthquake, but its impact is governed by the prior vulnerability of the affected community".

This research paper has been built from the acknowledgment of this man-made character of disasters. Throughout this document, the concepts of "disasters" and "natural disasters" are used interchangeably, always referring to those hazards that turn into disasters due to the vulnerability of the human settlement exposed to this events.

The co-occurrence of disasters and conflict is not a recent phenomenon and disaster occurrence might have triggered large historical conflicts (Bai & Kung, 2011). In the literature that focuses on the linkages between disasters and conflict, the oldest and most commonly referred publication corresponds to the work by Enrico Quarantelli & Russell Dynes (1976), entitled "Community conflict: Its absence and its presence in disasters". From the 1970´s Enrico Quarantelli has been considered one of the pioneers of the field of disaster sociology. These authors argue that disasters can actually decrease the likelihood for a society to engage in violent conflicts due to higher levels of agreement between people, as a part of the crisis-responding process. Even though the work by Quarantelli & Dynes (1976) is restricted to the non-violent context of the USA, is relevant to acknowledge its influence in the last two decades of publications. As Brancati & Bhavnani (2006:8) point out:

> "[Quarantelli & Dynes] argue that the emergency phase of a disaster is characterized by high levels of agreement over disaster tasks and goals and the means to achieving them. Conflict is not completely absent but occurs less frequently as compared with other time periods and settings".

The second most referred author corresponds to the Canadian political scientist, Thomas Homer-Dixon and any of his publications between 1994 and 2001. From an opposite point of view, Homer-Dixon argues that if disasters create scarcities, then these scarcities might become a significant source of conflict. It is of same relevance to also notice the recent critic to the work of Homer-Dixon done by Slettebak (2012: 166) in which he argues that:

> "Most natural disasters occur relatively abruptly (the main exception is drought), but the after-effects may linger on for a long time, causing or exacerbating scarcities similar to those described by Homer-Dixon. From the perspective of disaster sociology, however, this is where the similarities end. Of the three main theoretical connections between scarcity and conflict risk suggested by Homer-Dixon (1999: 136), two are directly contradicted [relative

deprivation and increased intergroup segmentation] by disaster sociology, while the third [state capacity weakening] is at least partially contradicted."

Fortunately, in the recent decade, a more solid theoretical framework for the understanding of the relationship between disasters and conflict has been developed. One of the most extensive and recent works in this field is the work done by Buhaug et al. (2008). In this paper, the authors identify three processes through which climate change can cause armed conflict:

1. Natural disasters increase
2. Resource scarcity increase
3. Sea-level rise.

The same authors reflect that there are five complementary mechanisms that will lead to the destruction of infrastructure, increased health risk and loss of livelihood and these are:

1. Economic instability
2. political instability
3. Social fragmentation
4. Migration
5. Inappropriate response.

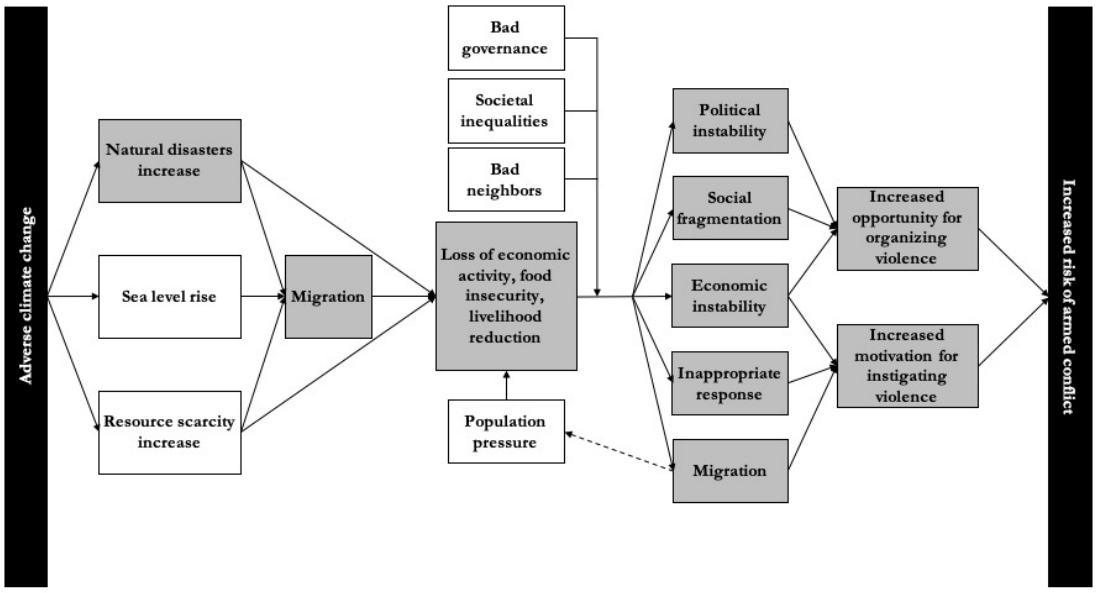
However, their conclusions are far from being deterministic and they strongly point out that the effects of climate change in any society will depend on other contextual factors (Buhaug et al. 2008) and the effects of climate change on resource scarcity will not be the same for each region. For example, Northern Europe is likely to benefit from the rise in the temperature because of increasing crop yields, forest growth, decreased demand for heating and reduced mortality from cold exposure. Nonetheless, regions as south Asia, are likely to be negatively affected by climate change due to change in precipitation patterns and floods risking drop productivity and livelihoods safety. Deepening in the research of a direct link between climate change and conflict through resource scarcity, the authors incorporate an environmental security approach to this problem. According to them, societies that face a dramatic reduction in quality of life due to changes in climate may opt between different coping strategies. Societies can adapt, escape (move) or fight in order to maintain to cope with those resource reductions.

First, societies can adapt by pursuing new and different modes of livelihood or directly substituting those scare resources. Societies can also adapt by reducing consumption in these resources and promoting efficiency. For those societies that cannot adapt, two options remain. Fight for the resources or mobilize. According to Homer Dixon (1999), in some cases, these dramatic reductions in resources availability provide incentives to the emergence of "resource capture", a mechanism in which the elites take control of resources at the cost of the poorest strata's of the society and this can lead to conflict. Nonetheless, whether societies adapt, escape or fight will always depend on other structural country or state-specific characteristics. As quoted by the authors in reference to Homer-Dixon seminal work:

'environmental scarcity is never [emphasis added] a sole or sufficient cause of large migrations, poverty, or violence; it always joins with other economic, political, and social factors to produce its effects.' (Homer-Dixon (1999: 16) in Buhaug et al. 2008:18)

To sum up, disasters may onset or maintain ongoing armed conflicts only under certain conditions and in interaction with several socio-political factors.

Figure 1 – Possible pathways to armed conflict



Source: Buhaug et al. 2008.

Figure 1 summarizes the possible pathways from adverse climate change to conflict. An increase in disasters occurrence (due to adverse climate change) leads to migration or forced displacement (where resources will be compromised and also "poor quality" livelihoods will be set up) but also generates an immediate loss of economic activity, creates food insecurity and reduces livelihood. These immediate losses can be diminished or magnified conditional on the context. The factors that contribute more directly in creating a "favorable environment for conflict" are poor institutions and bad governance, bad neighbors, social inequalities and high population pressure. Finally, The interaction between those immediate losses and this "favorable environment for conflict" may result in an increased risk of armed conflict through political instability, social fragmentation, economic instability, inappropriate response and migration. The mechanisms by which disasters might result in an increase in the risk of armed conflict are many and are highly inter-connected, therefore any model that aims to examine the relationship between these two phenomena, should take into account these conflict preconditions and interactions with the disasters occurrence.

Disasters and conflict, quantitative studies

Due to improvements in technology and data collection, we are now able to better register and understand more precisely these phenomena. Some scholars, already took the challenge and published quantitative studies that focus on the relationship between these two variables. For example, in an early try, Buchanan-Smith & Christoplos (2004) found that at least 140 disasters occurred in countries experiencing complex political emergencies between 1999 and 2003. Another example is the publication by Spiegel et al.(2007) that showed that 14 of the 30 largest epidemics between 1995 and 2004 occurred during at least one complex emergency or conflict, 9 following at least one natural disaster, and 3 after both events. In a more recent publication, Peters & Budimir (2016) found that 50% of the disaster deaths and

30% of the disaster affected people have been in the top 30 fragile and conflict-affected states. However, the literature that links these two events in a statistical manner is still scarce (Nel & Righarts, 2008, Slettebak, 2012), and in the academic debate about the relationship between disasters and conflict, three main strands of thought still stand out.

2.3.1 Disasters as conflict promoters

The first strand of thought argues that disasters act as conflict promoters. This strand of thought argues that disasters cause resource scarcity and this scarcity leads to conflict (see, Drury & Olson, 1998; Dusaillant & Guzman, 2004; Nel & Righarts, 2008; Brancati & Bhavani, 2006; Brancati, 2007; Nelson, 2010; Bai & Kung, 2011; Fleming et al. 2014; Solomon, 2014). From a "Greed theory" perspective the disaster occurrence could be interpreted as a conflict trigger to the extent that these disasters produces scarcities that could lead to a higher competition to extract the rents of natural resources. This is also aligned with Dixon´s "resource capture" theory presented below.

One of the most influential publications that links disasters with conflict corresponds to "Natural disasters and the risk of violent conflict" by Nel & Righarts (2008). Their results show the existence of a statistical relationship between disasters and the onset of conflict after several model specifications and controls. Depending on the model specification, an increase of one standard deviation of the per capita amount of "natural disasters" increases the odds of civil conflict from 17% to 30% (Nel & Righarts 2008:171). The strongest relationship (30%) was found while incorporating a dummy variable that summarizes the general occurrence of disaster regardless of its nature.

2.3.2 Disasters as peace promoters

The second strand of thought argues that there is a negative relationship between disasters and conflict, stating that disasters can bring nations or regions together in order to overcome these crisis (see, Le Billon & Waizenegger, 2007; Slettlebak, 2012; Bergholt, 2012; Dussailland and Guzman, 2014; Toya & Skidmore, 2014; Calo-Blanco et al., 2017). From a "Grievance theory" perspective, this could be interpreted as a reduction in the horizontal inequalities between groups due to the effects of a transversal crisis. However, disasters are the result of the interaction between hazards and vulnerability, therefore if different ethnic groups are grouped in different places and have different coping capacities this theory does not hold true.

One of the most influential publications that argues that disasters might act as social cohesion promoters is the one by Slettebak (2012) titled "Don´t blame the weather!, Climate-related natural disasters, and civil conflict". Even though the datasets used by this author are the same than the ones used by Nel & Righarts (2008) the empirical strategy is different and leads to complete different results. For the panel data analysis with year fixed effects of Slettebak, the results are completely opposite to the ones found by the previous authors. When incorporating a dummy variable for the general occurrence of natural disasters, the results throw a negative relationship between disasters and conflict of 1.1%. This means that countries that experience disasters in the current or previous period are 1.1 percentage points less prone to experience conflict. The author sustains his findings in the work of the French sociologist Durkheim by stating that he found that:

> "great social disturbances and wars tend to increase social integration, thereby reducing the risk of anti-social behavior." (Durkheim (1952[1897]) in Slettebak, 2012:164)

The research by Slettebak (2012) criticizes the work by Nel & Righarts (2008) and builds his model by taking into account these critics. The major improvement is the inclusion of new and more "robust" control variables and the separation of disasters in sub-groups.

2.3.3 Disasters and conflict, two separate processes

The third strand of thought argues that there is no statistical relationship between these two variables (see, for example, Omelicheva, 2011; Bergholt & Lujala, 2012; Schelussner et al. 2012) and making direct statistical inference about this relationship is just not appropriate. The most quoted publication corresponds to the work of Berghold & Lujala (2012), named "Climate-related natural disasters, economic growth, and armed civil conflict". Bergholt & Lujala (unlike Nel and Righarts, 2008 and Sletteback, 2012) put major attention to the mechanisms by which climate-related disasters might trigger conflict. More precisely the authors focus on the impacts of disasters on economic growth and how economic growth shocks promote the onset of conflict. The results show that an increase of one standard deviation in the number of people affected by disasters reduces income growth by 0.5%. In addition to that, the authors find that income growth may not be an important determinant of conflict. Even though the authors reflect that their results don´t find any relationship in the short term context, they also state that:

> "Hence, our insignificant 2SLS estimates might be an indication that the linkage between economic conditions and conflict risk is far more complex or heterogeneous than suggested by earlier country-year analyses" (Bergholt & Lujala 2012:160)

The results of this research paper can be associated with this third strand of thought. As presented in the following section, it is necessary to differentiate between two types of variables when analyzing the relationship between disasters and conflict. The idea is that disasters might act as conflict promotes but only under the interaction with certain conflict preconditions, such as low economic development, lower democracy levels or unstable political environments and high natural resources exploitation. More on this is explained in the following chapters.

To wrap up, previous research on the relationship between disasters and conflict has been approached by qualitative and quantitative studies. However, not many articles that study the statistical relationship between these two variables have been published. In this ¡academic debate, three main strands of thought stand out and their contradictory arguments have made it difficult for the scholar community to reach a consensus. These contradictory findings and arguments rise naturally the interest of this research paper. The next section deepens in the determinants of conflict and how those interact with the occurrence of disasters.

2.4 Explanatory models for conflict

One of the most extensive and recent literature reviews with respect to the relationship between disasters and conflict is "Climate Change and Conflict" by Vally Koubi. Koubi (2019) argues that the scholarly community has not detected a robust and general effect

linking climate to conflict onset. However the author also reflects that there is common agreement that climate change can contribute to conflict onset under certain conditions. These conditions are: low economic development and political instability (Koubi 2019:354). As the author precisely points out (Koubi 2019:354):

> "Studies interact and/or combine climatic variables with socioeconomic and political factors to examine when and where conflict occurs. Overall, (contextual factors of conflict) studies reveal that adverse climatic conditions are more likely to lead to conflict in places that already experience conflict, and where institutions are ineffective, essential services are difficult to obtain, and people are vulnerable to these climatic conditions."

Thus, as previously mentioned, any conflict explanatory model should start by comprising at least two groups of variables that contain information with respect to economic development but also about the political stability of the countries. These variables will be referred from now on as "precondition variables".

2.4.1 Precondition variables – Economic development: Economic growth, development and poverty, greed preconditions

Several studies have presented empirical evidence to state that the more developed (the less poor) is a country, the less likely is to experience conflict (Miguel et al., 2004; Hegre and Sambanis, 2006; Dixon, 2009; Collier et al., 2009; Murshed & Tadjoeddin, 2009; Hoeffler, 2011; Gleditsch, 2012; Slettebak, 2012; Ide et al., 2014; Ide, 2015; Owain & Maslin, 2018). This relation is based in several arguments. The first argument, is that higher economic development translates in to higher earns in the conventional economic activities with respect to the earns of engaging in conflict. Second, the more developed a country the less it suffers from resource scarcities. Third, countries with lower levels of economic development and high dependence on renewable resources, for example agriculture, are more vulnerable to disasters and complex economic conditions and this might increase the likelihood of conflict (Ide, 2015). Fourth, and most important, the less developed a country is, the less resilient is to disasters. As Urdal (2005) correctly points out, a significant number of previous quantitative studies have found that level of development is strongly associated with conflict and, therefore, should be included in any conflict explanatory model.

One of the most important reasons to include economic development variables in a model that links disasters with conflict is related to the concepts of vulnerability, resilience and adaptive capacity. In general terms, the idea is that the more developed a country, the more resilient due to is higher capacity to adapt. Even though, poverty is not the same than vulnerability (Adger, 2006), existent literature has found a strong correlation between adaptive capacity and economic development (Cutter and Hewitt, 1984; Watts and Bohle 1993; Adger, 2006). Cutter and Hewitt (1984) particularly emphasize that disasters are the result of a combination of extreme events (hazards) and failures on "human systems".

2.4.2 Precondition variables - Political Stability and grievances preconditions

Quality of institutions and political stability are two variables that have been largely examined as conflict determinants (Koubi, 2019). There are many mechanisms by which this variables could promote or stop a the effects of disasters to onset conflict. The first one is that the

better institutions of a country the more prepared it is to cope with hazards, this count both for avoiding hazards to turn into disasters and also to provide better responses. The second one is that the more stable is a country in political terms the more likely it is to resolve resource shortages in a peaceful manner (Linke et al. 2017 in Koubi, 2019). As the same author also points out (Koubi, 2019:348):

> "For instance, regions or countries with high administrative capacity and low levels of corruption as well as inclusive political institutions experience less violent conflict because leaders have the incentive to provide economic support, infrastructure, and social services to their citizenry for alleviating climatic hardship in order to stay in power (Bueno de Mesquita & Smith 2017)."

These two sets of variables (economic development and political stability) are those that explain or compose what has been defined before as a favorable or non-favorable environments for conflict.

2.4.3 Precondition variables - Population

A must-have control variable in any conflict explanatory model is population. As it will be presented in the next chapter of this document, both the occurrence of disasters as the occurrence of armed conflict might be affected by the increase in the country´s population. Since the datasets for conflict and disasters used for this research consider the occurrence of this events from a humans affected perspective, it is strictly necessary to control the results by population size of each country. In order to control for this, the following econometric model controls for the population per country per year in its logarithm form. Other reasons to include this variable as a control have been discussed by other authors. Urdal (2005) for example reflects that where land scarcity is combined high population growth rates, the likelihood of violent conflict increases. Hendrix & Glasser (2007:697) argue with respect to the foundations of the relation between environmental scarcities and conflict:

> "This discourse has its roots in neo-Malthusian notions of carrying capacity. Neo Malthusians argue that human population growth, coinciding with increases in affluence and per capita rates of consumption, will cause exponentially increasing demands on natural resources, leading inevitably to shortages, land and water degradation, and distributional conflicts (Ehrlich, 1969; Ehrlich & Ehrlich, 1990; Goldstone, 1991, 2002; Homer-Dixon, 1999)."

And as also Bernauer et al(2012:1) introduce:

> "Ever since Thomas Malthus published his 'Essay on the Principle of Population' (1798), many policy makers and scholars have claimed that environmental degradation can cause violent conflict at the sub-national level and between states (e.g. Ban 2007, Homer-Dixon 1994)."

Therefore, it was decided to include a population variable in the econometric model built for this research.

2.4.4 Triggering variables

Another relevant aspect when building a conflict explanatory model is to differentiate between the "precondition" variables (economic development, political stability and population) and the "triggering variables" (such as changes in rainfall, climate change and the occurrence of natural disasters). This reflection is quite recent and as presented by Ide (2015) one of the two main triggers for conflicts to turn violent is the resource external appropriation.

Triggering variables - Natural resources rents

The first triggering condition included in his study is external resource appropriation, which is inspired by the political ecology literature. As Ide (2015:63) argues:

> "Some authors argue that commercialization, understood as the increasing exchange of natural resources on markets rather than within local systems of reciprocity and subsistence, is an important factor for the violent escalation of conflicts over scarce renewable resources (Assies, 2003; Yeh, 2000). Other scholars highlight the relevance of privatization, defined as the transformation of a resource from an open access or common pool to a private good, for the violent escalation of resource conflicts (Jewitt, 2008; Simmonset al., 2007)."

As the author reflects, the higher level of resource appropriation then the higher the likelihood of conflict onset. This triggering variable has also a theoretical ground on the work by Homer-Dixon and the theory of resource capture under environmental changes. Another publication that reflects on the need of differencing between the structural conditions and the triggers of conflict corresponds to Hendrix and Glasser (2007:699) and as they point out:

> "The preceding interpretations ignore the fact that land degradation and climate change occur over long time spans, and, as such, represent trends to which human beings have proven remarkably adaptive. Conflict is one possible outcome of increased resource scarcity, but it is hardly the only conceivable one."

The authors suggest that a better identification strategy should focus on short term changes. While they focus on higher levels of rainfall relative to previous years and how it will be associated with higher returns to agriculture, and therefore lower likelihood of conflict, this research considers as short term changes the occurrence of natural disasters. In other words, this research considers as second triggering condition the total occurrence of natural disasters per period of time.

Triggering variables - Disasters occurrence

The second trigger is disaster occurrence and corresponds to the main scope of this research. The idea is that disaster occurrence can act as a conflict trigger or intensifier under certain preconditions (such as low development, less democratic regimes or politically instable countries, and high or highly variant population growth). The theoretical grounds of this have been already largely exposed in this Chapter and the effects that disasters can have on conflict are conditional on both the conflict preconditions but also on the government response.

To sum up, the econometric model estimated in this research contains 2 types of variables. First, the precondition variables that describe the level of economic development, political stability, institutional quality and the population size that built the basis of the conflict explanatory model. Second, the triggering conditions which are external resource appropriation and natural disasters occurrence.

Chapter 3

Hypothesis, methodology and empirical strategy

Hypothesis

The main goal of this research is to understand the nature of the relationship between disasters and conflict. After a critical review of the existent literature about the relationship between disasters and conflict, this research doesn´t start with a pre-established idea of this relation. Thus, the aim of this research is to understand if there is a statically significant relationship between disasters occurrence and armed conflict. More precisely whether disasters increase or decrease the likelihood of a certain country to engage in armed conflict. The interests of this research can be summarized in the following research questions and sub-questions.

Main research questions:

1. Can disasters trigger conflicts?
2. Do disasters contribute to maintain or to reduce ongoing conflicts?

Sub questions:

1. Do disasters have a different effect in different conflict settings (minor conflicts and wars)?
2. Can different types of disasters (such as those climate-related or those non climate-related), trigger or intensify conflict in different forms?

In order to answer this questions the following methodology was followed.

Research Methodology

As stated in Chapter 2, due to improvements in technology and data collection in the last decades, we are now able to better register and understand the occurrence of both disasters and conflict. In addition to that, the availability of information with respect to economic development, political stability and population size by country since 1960 allows to build an econometric model to estimate the likelihood of a certain country to experience conflict.

Being said the above, this research paper is of quantitative nature. This research uses a quantitative methodology in order to understand which are the quantitative effects of disasters on triggering or intensifying conflict. More precisely, this work consists mainly to a correlational analysis that explores the statistical relationship between conflict, development, political stability variables (democracy level and ethnic fractionalization), population, natural resources exploitation and disasters. In order to come with a general reflection with respect to the main question of this research it was decided to do a cross-country analysis along a long period of time. This allowed to capture the differences between countries but also their change in time. Due to the nature of this, I argue that the most suitable methodology to

compare the information of economic development, political stability, population, disasters and conflicts is quantitative. The main reasons for this are: first, a quantitative analysis is the most synthetic way to resume this large amount of information, second, it allows to estimate a probability of any country to experience conflict conditional to their economic, political, population and disaster exposed characteristics. Third, since the main goal of this research is to understand whether disasters as an exogenous phenomenon can trigger or intensify conflicts in the short term, it is necessary to conduct a large comparative study, therefore a qualitative approach wouldn´t allow to make such conclusions.

Even though it has been argued that the most suitable methodology for this research is an econometric estimation, it is also important to acknowledge that other methodologies could lead to similar and useful conclusions but not with the same depth. More precisely, exercises as the one by Ide (2015) in which the author bases his conclusion on a fuzzy-set qualitative comparative analysis provide useful insights but don´t allow to make general conclusions as this research does.

Empirical strategy

Since the dependent variables used in these estimations corresponds mainly to dummy variables of ongoing armed conflict, ongoing wars, ongoing minor conflicts and conflict onset, it was decided to estimate the likelihood of probability of a country to engage in armed conflict conditional on the precondition and triggering variables previously presented. It was also of interest of this research to estimate which is the marginal contribution of each conflict-explanatory variable to ongoing armed conflict. This led to choose a logistic regression for the estimations. In the same manner, it was decided to estimate the marginal effects of each of the variables included in the model in order to assess instantaneous rate of change of the conflict dependent variable produced by a 1 unit change in the explanatory variables. The correct interpretation of each of these variables is presented in Chapter 7.

Once the models were estimated, a Haussmann test was run and it suggested to estimate the regression with random effects and robust standard errors. As it will be presented later in Chapter 7, it was decided to incorporate region effects (dummy variables for regions of interest) and several interactions terms between the precondition variables and disasters. The following chapter explains the model specifications that were designed to estimate the relationship between disasters and conflict.

Chapter 4

Model specification

The idea is to, first, build a reliable armed conflict explanatory model, then test whether disasters enter the model significantly and after interpret the signs and magnitudes of the coefficients using the theoretical framework previously exposed. This Chapter starts by presenting the armed conflict explanatory model and then introduces how the disasters variables were tested.

4.1 Armed conflict explanatory model – Parsimonious specification

This model starts by considering the most simple version of an ongoing armed conflict explanatory model, this is that the likelihood of a country "i" of experiencing armed conflict on year "t" depends on having experienced conflict on the previous year "t-1". As described by equation (1):

$$AC_{i,t} = AC_{i,t-1} + u_{it} \text{ (1), where}$$

$AC_{i,t}$, stands for a dummy variable that takes the value of 1 if the country "i" experienced an armed conflict in year "t" and 0 if don´t.

However, as it will be later introduced in figure 14 (see Chapter 6, figure 14), the median duration of an armed conflict is of three years, therefore it was expected that an ongoing conflict could be explained by the presence of conflict in the last 3 years, a simple logistic regression was estimated to understand the explanatory power of each lag of the armed conflict dummy variable, as described by the following equation:

$$AC_{i,t} = AC_{i,t-1} + AC_{i,t-2} + AC_{i,t-3} + AC_{i,t-4} + u_{it} \text{ (2)}$$

And its respective results:

Table 1 - Probability of armed conflict on year "t" , marginal effects of armed conflict in the previous years, after logit (std. error)

Variable	Coefficient	Std. Error	p - value
Armed conflict dummy, lag1	2.859	0.122	0.000
Armed conflict dummy, lag2	1.128	0.145	0.000
Armed conflict dummy, lag3	0.627	0.162	0.000
Armed conflict dummy, lag4	0.018	0.158	0.910

As it can see from this table armed conflict can be explained with the existence of conflict in the last three periods. The third year marks a threshold of what could be defined as long-lasting conflict (considering the available dataset, see figure 12 in Chapter 6). Due to this findings it was decided to include in the armed conflict explanatory model two variables: the lagged value of the dummy variable of ongoing armed conflict and a new dummy variable called "Long Lasting Armed Conflict" (LLAC) that takes the value of 1 if a country "i" has

experienced conflict for the last 3 consecutive years and 0 if don´t. This led to the following model specification:

$$AC_{i,t} = AC_{i,t-1} + LLAC_{i,t} + u_{it} \quad (3)$$

And its respective results:

Table 2 - Probability of armed conflict on year t , marginal effects of armed conflict in the previous years, after logit (std. error)

Variable	Coefficient	Std. Error	p - value
Armed conflict dummy, lag1	3.388	0.111	0.000
Long lasting armed conflict dummy	0.747	0.122	0.000

As it can see from this table if a country experienced conflict in the last period is 3.38 times more likely to experience conflict in the current year and 74.7% even more if it has been a long lasting conflict.

4.2 Armed conflict explanatory model – Extended specification, preconditions

The next step is to include the precondition variables. As derived from the literature review, it was decided to include economic development, political stability and population size as precondition variables. This corresponds to groups of variable that will account of the level of development, the greed and grievances as well as the population of each country. This led to the following model specification:

$$AC_{i,t} = AC_{i,t-1} + LLAC_{i,t} + ECODEV_{i,t} + POLSTA_{i,t} + POP_{i,t} + u_{it} \quad (4), \text{ where:}$$

$ECODEV_{i,t}$, stands for the level of economic development for a country "i" in a year "t".
$POLSTA_{i,t}$, represents the political stability for a country "i" in a year "t". The Polity IV Index and the Polity fragmentation variables were included in the estimations. However only the Polity IV variable enter the model significantly systematically (for more see Chapter 5)
$\mathrm{POP}_{i,t}$, stands for the population size for a country "i" in a year "t", this variable was included in its logarithm form.

4.3 Armed conflict explanatory model – Extended specification, triggering variables: natural resources rents and disasters occurrence

As triggering variable it was decided to include the rents that come from the extraction of natural resources and the occurrence of disasters in several forms. In order to understand whether the disasters trigger or intensify conflict several model specifications were estimated. This lead to the following model specification:

$$AC_{i,t} = AC_{i,t-1} + LLAC_{i,t} + ECODEV_{i,t} + POLSTA_{i,t} + POP_{i,t} + NRGDP_{i,t} + DIS_{i,t} + u_{it} \quad (5), \text{ where:}$$

$NRGDP_{i,t}$, stands for the natural resources rents as a % of the GDP for a country "i" in a year "t".
$DIS_{i,t}$, relates to a group of different variables related to disasters occurrence for a country "i" in a year "t". The variables tested were: disasters dummy, disasters total per year, climate-related disasters dummy, climate-related disasters total per year, the lagged value of the disasters dummy, interaction terms with all the preconditions variables.

Naturally it was decided to start testing the general hypothesis (disasters trigger conflict) by including a disasters dummy variable and a total number of disasters variable. Then the hypothesis was tested by including dummy variables by each type of disaster separately. The model was also estimated by including disasters divided by climate-related and non-climate-related disasters. Finally interaction terms between the total amount of disasters and the precondition variables (economic development, political stability and population size).Chapter 5 presents the data used and analyzed before estimating the several model specifications.

Chapter 5

Data

This chapter presents all the data sources used in this research. This chapter starts by introducing the data sources and the respective justification for their use. Some summary statistics are presented for the ongoing preconditions variables values. Due to the relevance of the variables of armed conflict and disasters occurrence for this research, Chapter 6 presents the main summary statistics and trends for this variables separately.

Preconditions data – Economic Development and Human Development

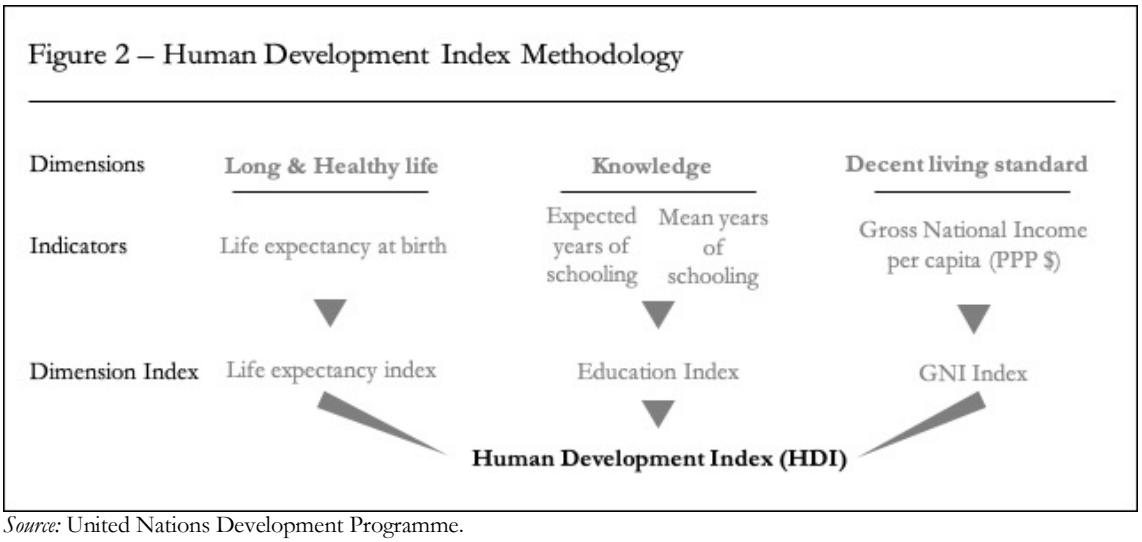
As stated in the literature review of this document, several publications have provided evidence that economic development is negatively related with conflict. For this research a set of 8 different variables were considered as proxies of economic development: GDP, GDP per capita, GDP growth, GDP per capita growth, GINI Index, Infant Mortality rate, Human Development Index and people living below the poverty line (at national poverty lines and at 1.90 USD per day). From this set of variables it was decide to not work with aggregate values of GDP because they don´t really reflect the real livelihood conditions of the people that might affected by the disasters and could engage in conflict. Then, for the per capita economic development variables (GDP per capita, infant mortality rate, and people living below the poverty line) it was expected that they would be highly correlated[4].

GDP per capita and the Human Development Index were the only two variables considered for the estimations. It was decide to use GDP Per Capita in Purchasing Power Parity due to several reasons. GDP per capita based on purchasing power parity (PPP) is the gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. This makes this indicator a good comparative measure to conduct a comparative cross country analysis. Another reason is that this variable has been used in other similar publications and has consistently appeared to be significant in this armed conflict explanatory models. A final reason to choose this variable is because is highly significant in all model specifications and its explanatory power is consistent in all the different specifications tried for this research. The data for this indicator is derived from the World Bank and this dataset contains information between 1960 and 2018. A novel aspect from this research, is that it was also decided to estimate the models considering another proxy for the development: The Human Development index. The reason for this is that this index measures more than only economic development and therefore might be a better proxy for development since it considers "long and healthy life", a "decent standard of living" and "knowledge". Figure 2 presents a diagram of how this index is estimated. This information was extracted from the Human Development Data Program from the United Nations Development Program.

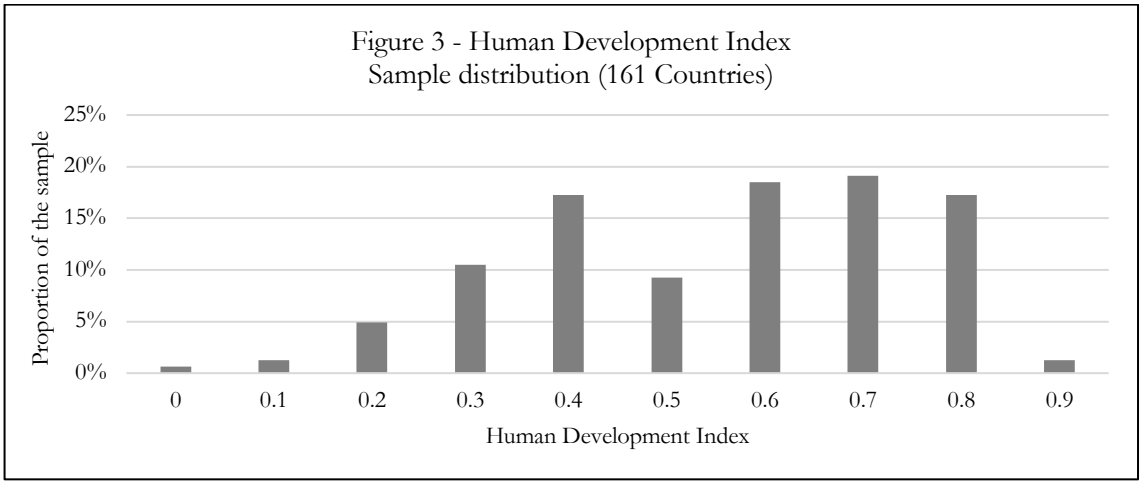
Information for 161 countries between 1990 and 2017 with respect to their HDI was used for the estimations. Figure 3 presents a histogram of the level of human development

[4] A simple correlation matrix was used to corroborate this, to see the results please check Appendix 2 – " Economic Development preconditions variables correlation matrix".

of each country considered in this sample between 1990 and 2017, the mean value is of 0.6 and is slightly skewed towards the right (more developed).



Source: United Nations Development Programme.



Source: Elaborated by the author using United Nations Development Programme data.

Preconditions data – Institutional Quality and Political Stability

As stated in chapter 2, another essential component of any armed conflict explanatory model is a proxy for institutional quality, political stability and regime. The more democratic and stable a country is, the less likely to engage in conflict. This type of variable is a precondition for conflict as previously explained in the literature. To proxy for regime quality and stability it was decided to work with the Polity IV project dataset from the Center for Systemic Peace.

The Polity IV dataset covers all major, independent states in the global system over the period 1800-2017 (i.e., states with a total population of 500,000 or more in the most recent year; currently 167 countries) (Marshall, 2009). The Polity conceptual scheme is unique in that it examines concomitant qualities of democratic and autocratic authority in governing institutions, rather than discreet and mutually exclusive forms of governance (Marshall, 2009).

In this analysis, it was decided to use two variables. Ethnic fractionalization (as a proxy for the grievances theory of conflict) and the "Polity IV Score" which captures the regime authority spectrum between -10 (hereditary monarchy) and +10 (consolidated democracy). After running several estimations it was decided to keep working only with the Polity IV variable because the ethnic fractionalization variable did not enter the model significantly in a systematic manner. In several model specifications the ethnic fractionalization variable was not statistically significant. Also the Polity IV variable has been used in other empirical studies that study conflict and corresponds to a good proxy for institutional quality and political stability. Table 3 presents the mean values for the Polity IV Index by region. The higher the index the more democratic a country, which is a reflect of better institutions in the country and stability.

Preconditions data - Population

In order to control for population size per country it was decided to include population estimates from the World Bank. This information was used in logarithm terms in order to account for large difference between countries. This dataset contains information between 1946 and 2018. Aggregated values for population by region are presented in Table 3.

Table 3 - Summary Statistics (161 countries between 1990 and 2017)

Region	GDP Per Capita (PPP, 2011)		Human Development Index		Polity IV Polity Index		Natural resources rents		Pop. in 2017 (millions)
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
West Africa	$ 1,836	$ 1,254	0.36	0.16	2.10	5.20	12%	9%	371
Central Asia	$ 2,193	$ 3,148	0.39	0.18	1.49	5.54	10%	7%	71
East Europe	$ 3,549	$ 2,316	0.50	0.20	4.40	3.43	14%	12%	293
South Asia	$ 4,602	$ 4,405	0.51	0.18	2.21	5.94	5%	8%	1,873
Melanesia	$ 5,798	$ 8,191	0.41	0.20	-2.08	3.55	26%	16%	10
Central America	$ 5,853	$ 6,166	0.51	0.27	-5.01	4.31	17%	18%	173
South America	$ 7,059	$ 4,020	0.57	0.07	3.78	6.92	4%	2%	390
Central Africa	$ 7,430	$ 4,907	0.64	0.08	7.67	1.90	2%	2%	164
North Africa	$ 7,998	$ 5,907	0.60	0.12	-3.58	3.41	14%	16%	232
Caribbean	$ 9,455	$ 8,816	0.64	0.12	7.00	3.91	4%	6%	26
South-Eastern Asia	$ 9,682	$ 4,856	0.66	0.15	7.18	2.52	9%	8%	648
South Africa	$ 11,906	$ 17,980	0.63	0.12	0.39	6.15	6%	5%	65
East Asia	$ 13,068	$ 8,193	0.74	0.12	6.80	4.60	3%	4%	1,568
East Africa	$ 16,306	$ 12,349	0.74	0.12	4.93	7.07	6%	10%	380
South Europe	$ 17,605	$ 9,659	0.74	0.19	7.97	3.46	1%	1%	150
West Asia	$ 28,497	$ 28,273	0.67	0.24	-1.43	6.92	16%	18%	245
Australia & N. Z	$ 28,797	$9,771	0.89	0.03	10.00	0.00	3%	3%	29
North Europe	$ 29,524	$ 14,535	0.85	0.06	9.63	0.82	2%	2%	104
North America	$ 37,048	$ 10,781	0.89	0.03	9.93	0.37	2%	1%	362
West Europe	$ 39,358	$ 17,967	0.87	0.04	9.74	0.55	0%	0%	196
Total	**$ 13,238**	**$ 16,575**	**0.61**	**0.23**	**3.55**	**6.38**	**8%**	**12%**	**7,350**

Triggering variables data – Natural resources rents

The first triggering variable included in this analysis is the rents from natural resources as a % of GDP per country each year. During crisis, such as the ones generated by the disasters,

there is an incentive for the elite to exploit the natural resources even more and "capture" them, leaving the lower social strata with less access to the economic benefits of the extraction earnings of these resources. This might create an incentive for people to engage in conflict. This variable is not very correlated with GDP per capita (correlation of only 0.02) and therefore is expected that it will add valuable information to the model. Table 3 presents the summary statistics for the variables included in the model of this research. As it can be seen from table 3 those countries with lower GDP per capita tend to have a higher composition of rents of natural resources extraction.

Triggering variables data - Disasters

It was decided to work with the Centre for Research on the Epidemiology of Disasters (CRED) Emergency Events Database (EM-DAT) data on disaster occurrence (CRED, 2019). The main reason why it was decided to work with this dataset is that it corresponds to the most extensive dataset on natural disasters available. This dataset contains information between 1900 and 2019. For this research, several model specifications were estimated considering different disasters variables available from this dataset. Examples of this are disasters dummy variables, the total number of disasters per year, dummies by type of disaster and also by sub-classifications such as climate-related disasters and non-climate-related disasters. Summary statistics and more on this is explained in the following chapter.

Dependent variables data – Armed conflict

It was decided to work with the Uppsala Conflict Data Program (UCDP) data on armed conflict. More precisely, it was decided to work with the UCDP/PRIO[5] Armed Conflict 19.1 dataset because of three reasons (Petterson, 2019). First, it corresponds to one of the largest datasets available on organized violence and armed conflicts. Second, the dataset provides information on the intensity level for every conflict, their battle-related deaths and also the conflict main reasons, these variables were used to estimate the effect of disasters on different "conflict dependent variables". Third, the dataset contains information between 1946 and 2018 and this allows to estimate all the model specifications with the most recent information. Summary statistics and the definition of all the relevant variables from this dataset are presented in the next chapter.

Period of analysis

Due to the availability of information of the variables of the Polity IV dataset and economic development finally the majority of the model specifications were finally estimated between 1990 and 2017.

[5] Peace Research Institute of Oslo. The Armed Conflict dataset is a joint project between UCDP and PRIO.

Chapter 6

Disasters and Armed Conflict – Historical trends

6.1 Disasters – General trends

In 1988, the Centre for Research on the Epidemiology of Disasters (CRED) launched the Emergency Events Database (EM-DAT). The aim of this dataset is to record the occurrence of disasters on a country level per year. By 2019, EM-DAT has become the biggest cross-country disaster dataset, containing essential information on the occurrence (and effects) of over 22,000 mass disasters, from which 14,874 correspond to "natural disasters". For a disaster to be entered into the database at least one of the following criteria must be fulfilled:

- Ten or more people reported killed
- Hundred or more people reported affected
- Declaration of a state of emergency
- Call for international assistance

Table 4 presents EM-DAT´s organization for the different types of "natural disasters" and its total occurrence between 1900 and 2018.

Table 4- Total occurrence of disasters types between 1900 and 2018

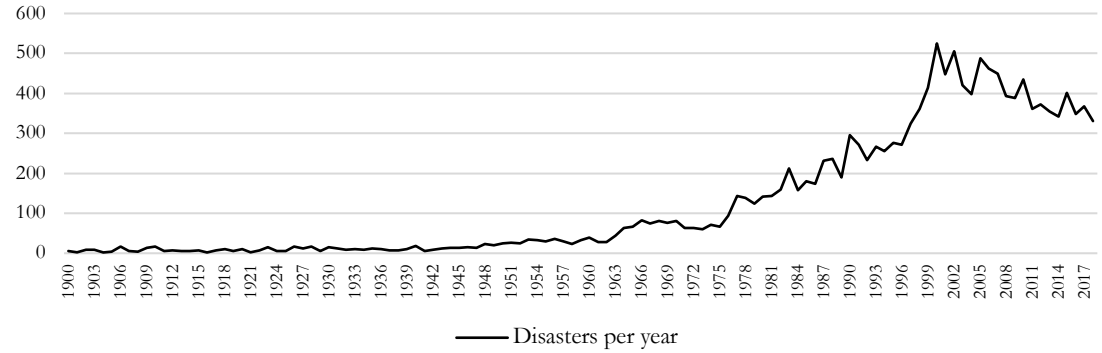
Group of disaster	Sub group of "natural disaster"	Type of "natural disaster"	Occurrence	Relative Weight
Natural	Biological	Epidemic	1,454	10%
		Insect infestation	86	1%
		Animal accident	1	0%
	Climatological	Drought	730	5%
		Wildfire	432	3%
	Geophysical	Volcanic activity	250	2%
		Earthquake	1,374	9%
		Mass movement (dry)	48	0%
	Meteorological	Storm	4,189	28%
		Extreme temperature	574	4%
		Fog	1	0%
	Hydrological	Flood	4,992	34%
		Landslide	722	5%
	Extra-terrestrial	Impact	1	0%
Total			14,854	100%

Note: Definitions according to CRED EM-DAT dataset.

As it can be seen from table 4, not all types of disasters happen with the same frequency and only epidemics, earthquakes, storms and floods account for 80% of all the disasters occurred since 1900. What also stands out is that some types of disasters almost never occur and some of them have only occurred once. Fogs, impacts and animal accidents have result in human losses only once, and those specific cases were: the Great Smog of the United Kingdom that lasted for 5 days in December of 1952 and killed more than 12,000 people; the impact of the Chelyabinsk meteor in Russia in 2013 and last, the animal accident is the one caused by one Hippopotamus that attacked and killed 12 children in Niger (the) in 2014. The small occurrence of some disasters might be due to the criteria established by CRED EM-DAT to define a disaster or also the capabilities of some countries to self-report these incidents. This criteria is of course consider one of the biggest limitations of this research.

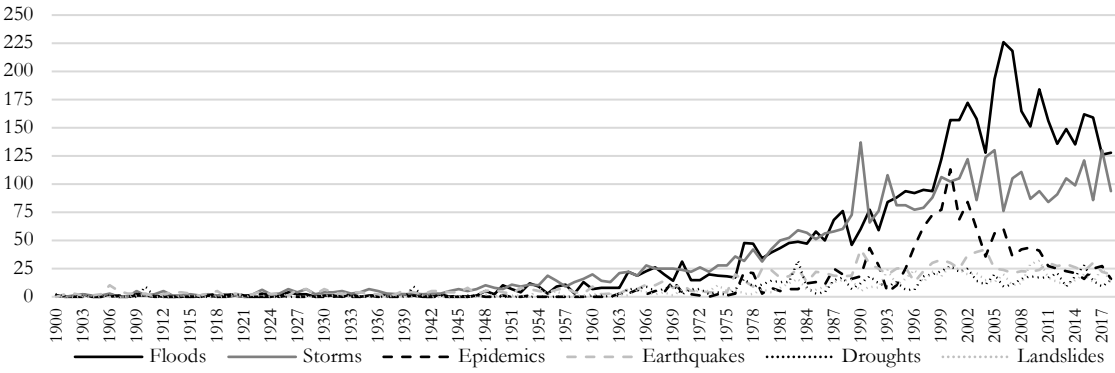
While some types of disasters almost never occur, the general trend has been increasing historically and some disasters are occurring every year more often. Figure 4 show the general occurrence of "natural disasters" (as classified by CRED EM-DAT) per year since 1900. Figures 5 & 6 show the occurrence of disasters by type, dividing them in high-occurrence and low-occurrence disasters.

Figure 4 - Natural Disasters Occurrence
1900-2018



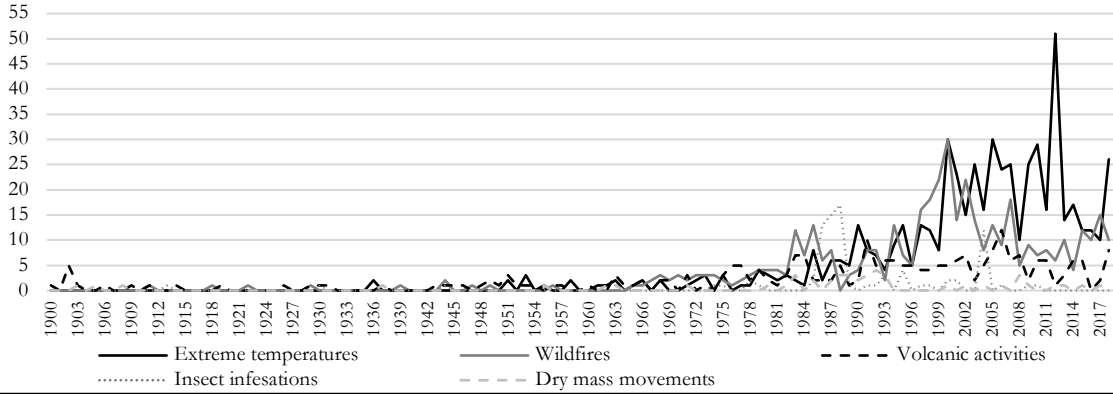
Source: Elaborated by the author using EM-DAT data.

Figure 5 - High-occurrence disasters trends
1900-2018



Source: Elaborated by the author using EM-DAT data.

Figure 6 - Low-occurrence disasters trends
1900-2018

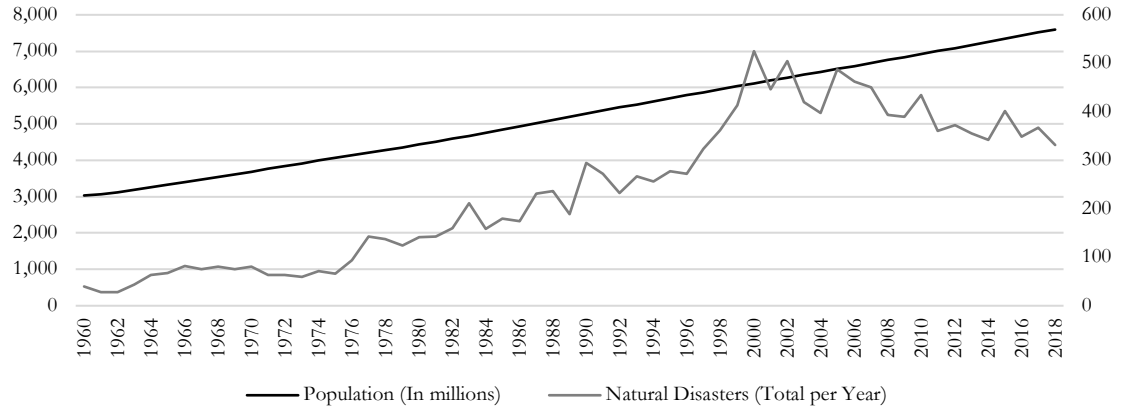


Source: Elaborated by the author using EM-DAT data.

In the last 118 years, the amount of recorded "natural disasters" has increased dramatically, showing only a slow decrease over the last 20 years. This, of course, corresponds to a general trend and as figure 5 and depicts, different types of disasters have followed different trends.

This dataset is highly anthropocentric by definition because it considers as a disaster only those events that have a negative impact on societies. This definition raises at least two major concerns for this research paper. The first one is that it does not take into account major natural catastrophes that don´t have direct effect in societies in the short run. These big natural catastrophes can indirectly generate tensions within and between nations in the medium-run. A good example of this limitation is the Amazon wildfire crisis in 2019. Even though 75.000 wildfires were recorded in Brazil[6] between January and August of 2019, EM-DAT has not a single record of them. As it has already been seen in the media during 2019, these natural events have been a major source of tension in the international political arena[7] but also between local communities and the government[8][9]. A second concern is that the information might be affected by the exponential increase in the world population. As Figure 7 depicts, the world population and the natural disasters occurrence per year have been constantly increasing. Thus, the increase in the reported natural disasters might be due to the increase in population, and therefore in the number of people potentially affected by disasters, and not due to a real increase in the natural hazards occurrence. As a matter of fact, between 1900 and 2018, the ten disasters that left more human losses occurred in four of the ten most populated countries of the world: China, India, Bangladesh, and Russia (for more, see table 2). This concern makes it necessary to control for country population in order to estimate the real effects of disasters on conflict. Even though the model presented in the previous chapters controls for the population of each country each year, it does not compress any proxy for those other hazards without direct effects on societies that might trigger social tensions. The indirect effects of natural hazards on conflict is definitely an interesting topic for future research.

Figure 7 - World Population and Natural Disasters Occurrence
Year Values between 1960 and 2018



Source: Elaborated by the author using World Bank and EM-DAT data.

[6] British Broadcasting Corporation (BBC) News - https://www.bbc.com/news/world-latin-america-49433767
[7] The Guardian Newspaper - https://www.theguardian.com/world/2019/aug/27/amazon-fires-brazil-to-reject-20m-pledged-by-g7
[8] Independent Print Limited - https://www.independent.co.uk/news/world/americas/amazon-crisis-brazil-tribes-bolsonaro-rainforest-xiangu-river-a9089716.html
[9] British Broadcasting Corporation (BBC) News Brazil https://www.bbc.com/portuguese/brasil-49528317

Being said the above, the EM-DAT dataset is to the most extensive disaster dataset available and it was decided to use it due to its large country extension but also do its rich historical information.

This dataset provides also estimations on the number of people affected, injured and death as well as the economic losses produced by each disaster. The following section summarizes some of these trends.

6.1.1 Effects of natural disasters - trends and summary statistics

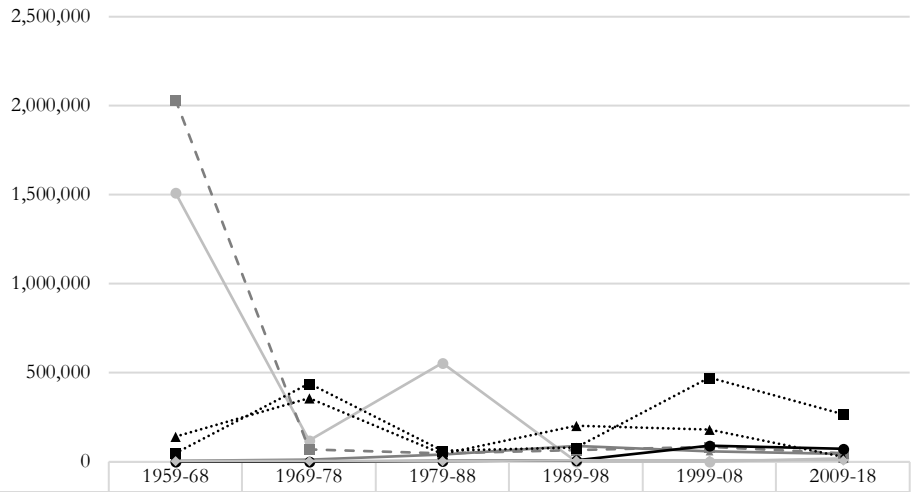
Human losses due to disasters

The biggest concern related to the effects of disasters is the one related to the human losses produced by them. Even though, the occurrence of natural disasters has increased in time, the human losses have not. Figure 8 depicts the total deaths per disaster type since 1900. Figure 8 can be summarized in three key ideas. First, the total human losses per decade have decreased significantly with time. Second, disasters as droughts, epidemics, and floods that used to kill many people, killed only half of the people during the last decade than earthquakes (113.250 deaths in comparison to 269.314 deaths between 2009 and 2018). Earthquakes remain as a critical type of disaster and the deaths they leave do not show a clear decreasing trend. Third and final, a relevant portion of all deaths that disasters left during the last decade (2009-2018) corresponds to the deaths produce by extreme temperature events. The losses produced by these extreme temperature events only decreased by 20% in the last 2 decades and in the last 20 years the total deaths due to this type of disaster amounts to 163.606 people. Table 5 presents the most harmful disasters recorded in the EM-DAT dataset. From this table, another three main insights emerge. First of all, droughts have historically been a major cause of deaths. Second, all of them occurred before 1970. Third, the most affected countries are also the most populated ones, showing once again the need to control for population size while estimating models that consider disasters as explanatory variables.

Table 5 - The 10 worst disasters (in death terms) between 1900 and 2018.

Country	Year	Type	Occurrence	Total deaths
China	1931	Flood	1	3,700,000
China	1928	Drought	1	3,000,000
India	1920	Epidemic	2	2,500,000
Russia	1917	Epidemic	1	2,500,000
China	1959	Flood	2	2,000,187
Bangladesh	1943	Drought	1	1,900,000
India	1965	Drought	1	1,500,000
China	1909	Epidemic	1	1,500,000
India	1942	Drought	1	1,500,000
India	1907	Epidemic	1	1,300,000

Figure 8 - Total deaths per decade by disaster type
Decade values between 1959 and 2018



	1959-68	1969-78	1979-88	1989-98	1999-08	2009-18
Drought	1,510,650	119,063	557,049	2,989	1,508	20,035
Epidemic	5,947	12,947	42,523	89,510	60,016	44,084
Flood	2,034,246	71,281	47,875	65,396	85,185	49,131
Earthquake	49,108	441,475	61,604	82,359	473,611	269,314
Storm	140,374	357,968	44,437	203,134	181,113	28,350
Extreme temperature	1,127	1,083	5,424	8,933	90,964	72,642
Landslide	5,098	7,102	6,142	8,529	7,439	10,109

Source: Elaborated by the author using EM-DAT data. *Note:* Human losses due to volcanic disasters are excluded because of its relative low value, 30,287 deaths in the last 60 years.

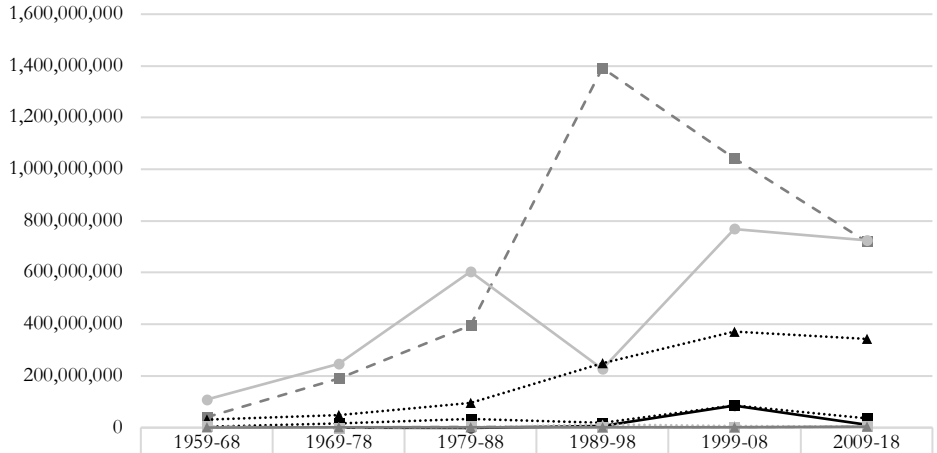
People affected by disasters

Another interesting metric provided by EM-DAT is the number of people affected by each type of disaster on a year. This number is an estimation by EM-DAT of the number of people who was injured (physical injuries, trauma or an illness requiring immediate medical assistance), homeless (people whose house is destroyed or heavily damaged and therefore need shelter) and or affected (people requiring basic survival needs such as food, water, shelter, sanitation, and immediate medical assistance) by a disaster. Figure 9 depicts the number of people affected (injured, homeless and/or affected) per decade by disaster type. Unlike the deaths due to disasters (see figure 8), the number of people affected has been constantly increasing in time. The peak of people affected by decade was reached between 1999 and 2008 with more than 2.3 billion people affected.

Historically the type of disasters that affects more people are floods. However, during the last 3 decades the people affected by floods has been constantly decreasing (even though they have been occurring more often) while the number of people affected by droughts keeps increasing from decade to decade. In addition to that, from this information three major insights emerge. First, the most harmful disaster type were the floods between 1989 and 1998 that affected the livelihoods of almost 1.4 billion people. Nonetheless, the worst three disasters ever recorded correspond to the droughts that occurred in India in the years 1987, 2002 and 2015 (almost every 13 years a drought that affected 300.000.000 people occurred in this country). Second, the number of people affected by extreme temperature disasters has increased constantly in time with only a decrease for the last decade. If during the 1960´s the number of people affected by extreme temperature events was only 600 people, by the last

decade the total of people affected by this same type of disasters corresponded to almost 12 million people. Third and last, the number of people affected by storms has been increasing rapidly in the last decades, between 2009 and 2018 the total number of people affect by storms corresponded to 342,579,700, this is ten times bigger than the total for the 1960´s decade.

Figure 9 - Total people affected per decade by disaster type
Decade values between 1959 and 2018



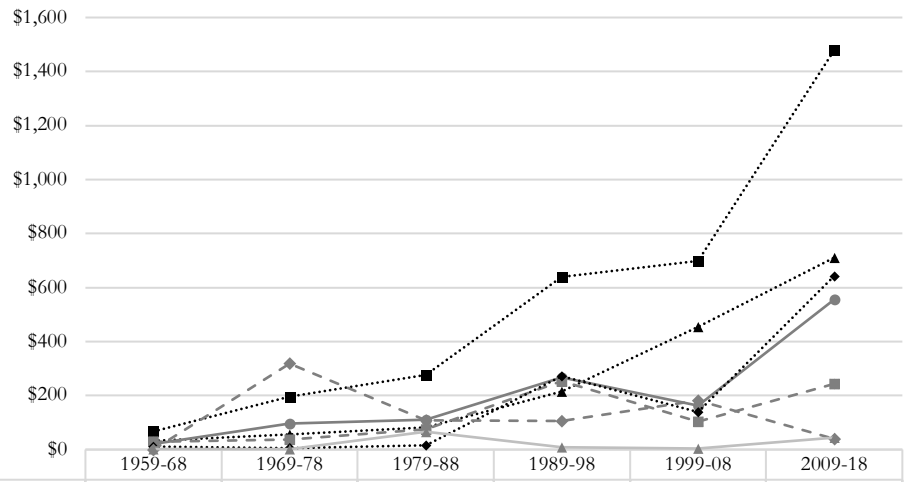
	1959-68	1969-78	1979-88	1989-98	1999-08	2009-18
Floods	40,566,652	190,115,681	394,657,902	1,391,844,342	1,040,875,470	719,128,175
Droughts	108,928,100	246,686,489	602,478,376	227,935,978	768,358,758	725,522,556
Storms	31,038,039	49,193,954	94,633,985	249,791,139	371,752,484	342,579,700
Earthquakes	3,588,845	16,629,195	33,080,006	18,119,050	86,179,217	36,988,369
Extreme temperature		600	40,202	6,409,438	85,273,319	11,720,602
Epidemic	348,055	2,367,352	1,664,788	12,477,568	5,578,311	3,904,592
Landslide	4,001,587	90,877	3,432,391	2,120,929	1,533,106	3,085,489
Volcanic activity	259,716	572,013	698,014	2,010,721	1,437,702	3,560,041

Source: Elaborated by the author using EM-DAT data.

Economic effects – damage in US$ millions

Consistent information of the economic damage produced by disasters is only available starting from the 1960´s. To understand which is the real trend in the economic damages produced by these disasters is necessary to observe the average economic damage by event type. Figure 10 depicts this analysis. Almost all types of disaster have increased their average economic damage since the 1960´s but the increase of the effect of earthquakes is significantly higher. By 2018, the type of disaster that produces the biggest economic damage on average is the earthquake with an average of 1.500 million US$ per time. Storms, wildfires and droughts are also high intensity disasters in terms of the economic damage they produce, leaving losses of 711 US$ millions, 643 US$ millions and 556 US$ millions per disaster. If the hypothesis that disasters trigger conflict through resource scarcities holds true, then disasters like earthquakes, storms, wildfires and droughts might be more likely to create conflict than other types of disasters due to their economic impact but also due to their significant impact in time. It is also worth noticing that even though the occurrence of extreme temperature related disasters has increased in the last years, it´s economic impacts hasn´t.

Figure 10 - Average economic damage per decade by disaster type
Average values in millions of US$ per decade between 1959 and 2018



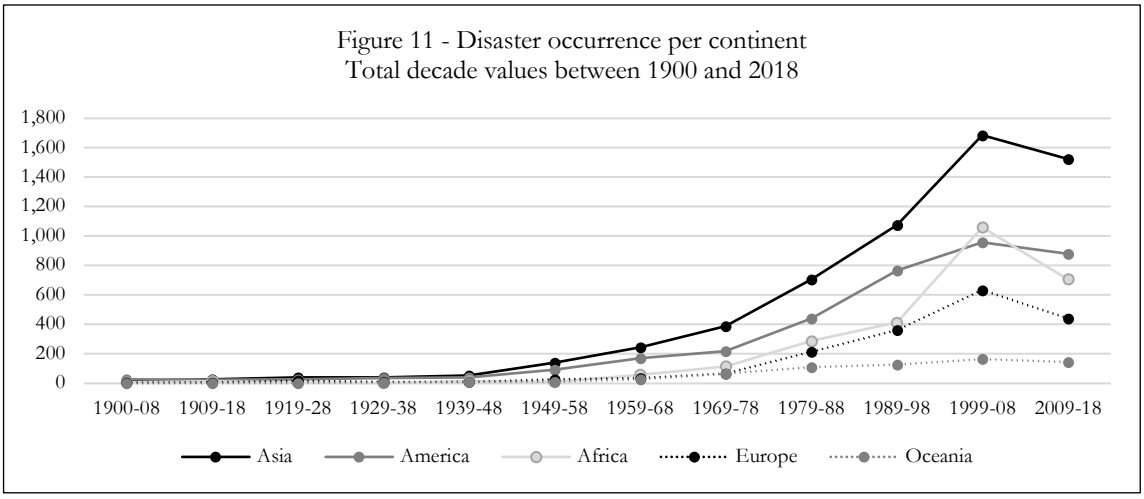
	1959-68	1969-78	1979-88	1989-98	1999-08	2009-18
Storm	$32	$57	$82	$215	$454	$711
Earthquake	$67	$195	$277	$638	$699	$1,479
Flood	$29	$37	$76	$253	$103	$244
Drought	$21	$95	$109	$266	$164	$556
Wildfire	$10	$5	$17	$273	$138	$643
Extreme temperature	$0	$318	$107	$107	$182	$39
Volcanic activity	$2	$2	$66	$8	$3	$44

Source: Elaborated by the author using EM-DAT data.

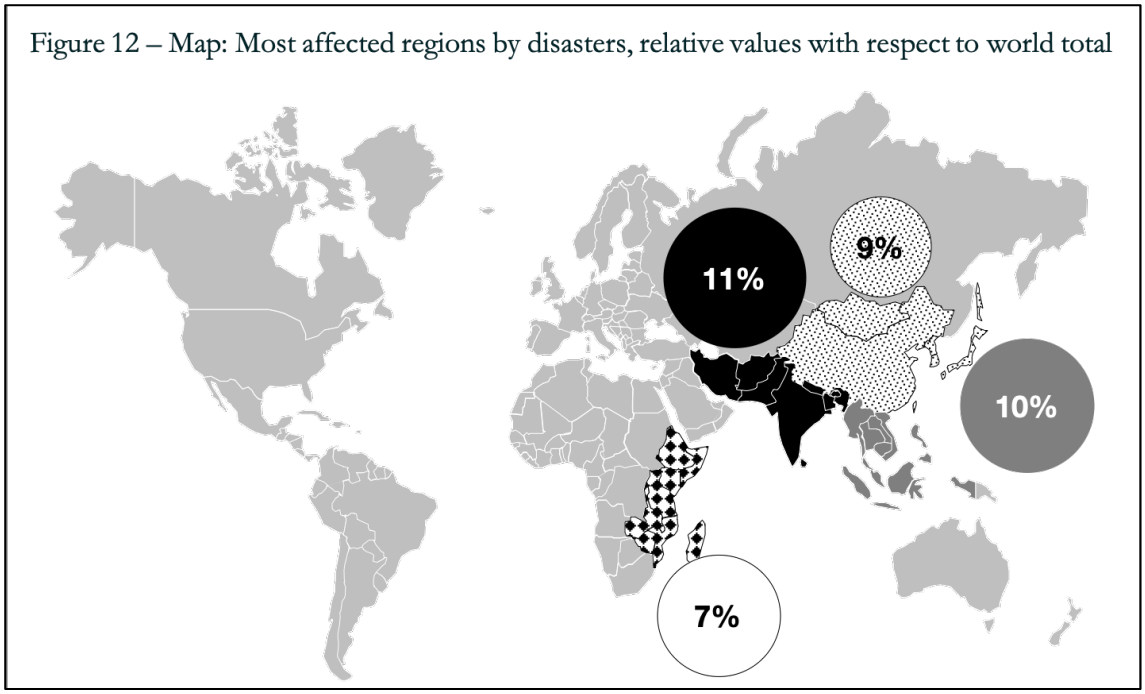
6.1.2 Disasters - a spatial representation

This section aims to understand the regional distribution of the occurrence of disasters since 1900. Figure 11 shows the occurrence of natural disasters by continent. All continents have experienced a constant increase in the occurrence of natural disasters. The biggest increase has been in Asia, continent that accounts for 40% of all "natural disasters" ever occurred (14,854). It is also worth noticing the big increase in Africa between the 1990´s and 2000´s, as well as the increase in Europe that almost duplicated its occurrence in the same decade. The high occurrence in Asia might be explained due to its big population (59.76% of the world population).

The vast majority (83%) of the disasters occur only in Asia, Africa and America. Figure 12 presents the distribution of the disasters per region for these continents. Only South Asia, South-east Asia and East Asia account for 30% of the disasters occurred in the last three decades. This regional distribution has not changed in the last decades and its understanding is highly important for this research. As discussed later in this document, South Asia, South East Asia, East Asia and East Africa are the four regions that have experienced more disasters in history but also the regions that experienced more minor conflicts in the last three decades. Due to the concentration of natural disasters in few regions it was necessary to account for regional specific effects when building an econometric model.



Source: Elaborated by the author using EM-DAT data.



Source: Elaborated by the author using EM-DAT data.

To sum up, disasters have been constantly increasing in time. However, climate-related disasters have been increasing in time more dramatically. The economic losses by disasters have also been increasing systematically in contrast to the deaths related to these events. It is of special concern the increase in occurrence and in effects of those extreme temperature events that were converted into disasters. Most of the disasters occur in Asia. It is of special interest to understand more precisely what is the connection between disasters and conflict for those highly affected by disasters regions like South Asia, South East Asia, and East Asia.

6.2 Armed Conflict – General trends

The Uppsala Conflict Data Program (UCDP) is one of the largest datasets available with data on organized violence and armed conflicts. This institution defines a state-based armed conflict as (Petterson 2019:1):

"a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths in a calendar year."

Not all armed conflicts have the same intensity and, obviously, the same reason. UCDP classifies them in two levels; minor conflicts (between 25 and 999 battle-related deaths) in a given year and wars that have at least 1,000 battle-related deaths in a given year. For the incompatibilities, UCDP differentiates whether a conflict correspond to an incompatibility in terms of the government, territory or both. The following section focuses on the description of the occurrence of armed conflict by the level of intensity, , region, and countries for the last seven decades.

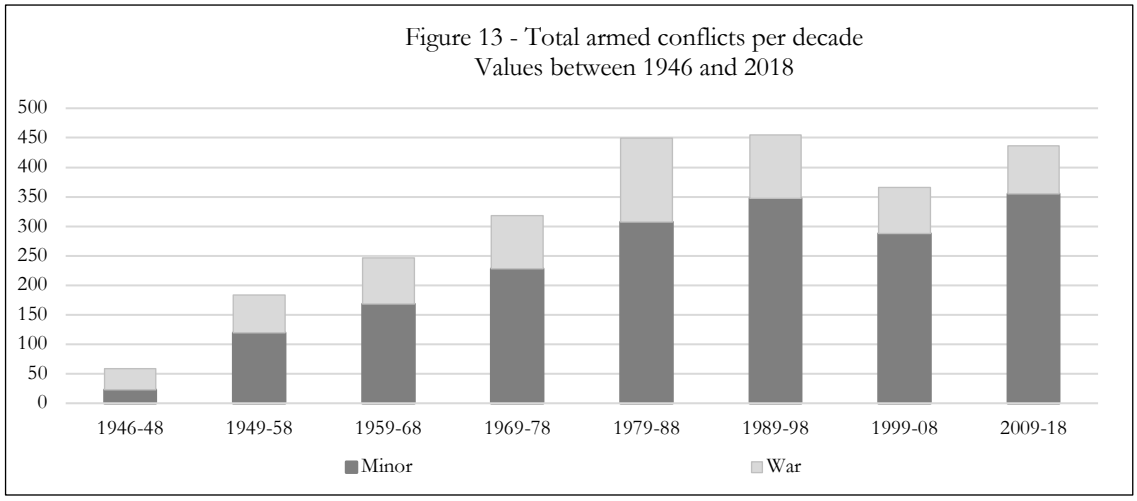
Since 1946 a total of 2,385 ongoing conflicts have already been recorded. This 2,385 ongoing registered armed conflicts correspond to 286 unique conflicts that have repeatedly occurred since 1946. A relevant aspect of these 286 armed conflicts is its location. Out of the 286 unique conflicts previously mentioned, 43 correspond to inter-state armed conflicts that happened in more than one location. In order to do a proper matching between countries affected by disasters and conflicts every year it was necessary to consider those "unique conflicts per year" between two different countries as two conflicts that affected two different locations (countries). This precision makes it possible to estimate the relation between disasters for both countries that engaged in an armed conflict in the past. From the original dataset that contains 2,385 "unique conflicts per year", the total amount of conflicts per location (country) increases to 2,512 (which corresponds only to 5% of the original total) when accounting for each country that was involved as a unique geographic territory that might have been affected by a disaster.

Figure 13 presents the general trend of total armed conflicts by decades and by type (minor conflict or war) following UCDP´s classification. In the last 7 decades, the amount of armed ongoing conflicts has increased persistently besides the period between 1999 and 2008. Nonetheless, the biggest increase has occurred in terms of minor conflicts and not in wars and the general trend for war occurrences has decreased over time.

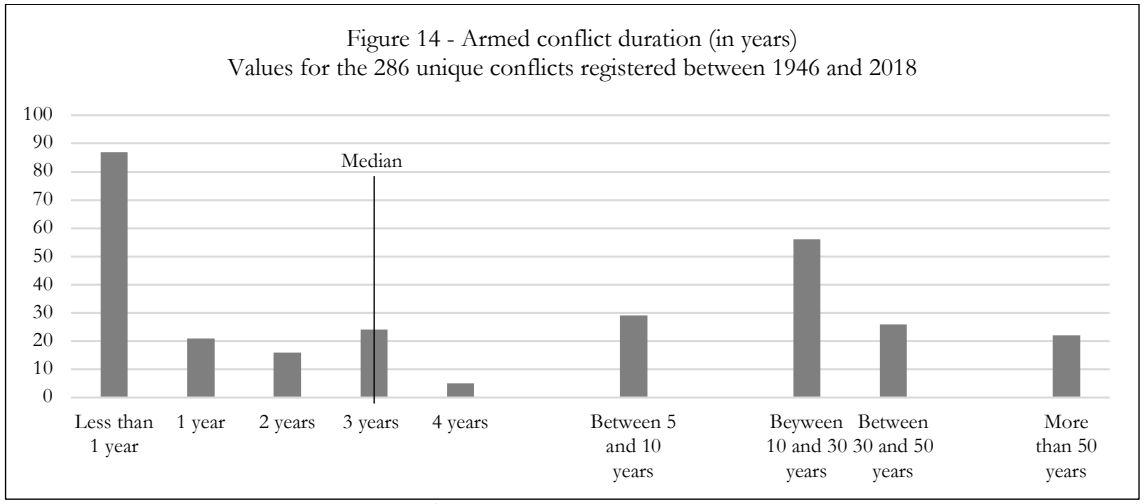
As stated before, these 2,385 armed conflicts correspond to 286 unique conflicts. These 286 unique conflicts have lasted on average 13 years and the two longest ones are the CPP-NPA-NDF rebellion (armed conflict between the government of The Philippines and the coalition between the Communist Party, the New People´s Army and the National Democratic Front) and the conflict between the Iranian Government and the Kurdish Democratic Party of Iran. The histogram on figure 14 depicts the duration of all the armed conflicts registered in the dataset. As it can be seen from this figure the duration is highly concentrated in conflicts that have lasted less than one year and the median is situated in 3 years[10][11]. Historically minor conflicts lasted 4 more years than wars with average of 13 years and 9 years respectively. The general median value of 3 years can be used as a reference point to differentiate between short and long-term conflicts. Figure 14 is particularly relevant for this research and for the construction of any armed conflict explanatory model. With a

[10] The mean and median duration of these conflicts were estimated by calculating the difference between the year of the latest incident (as registered by UCDP/PRIO) and the year of the first incident for each unique conflict.
[11] This duration is estimated with the input of UCPD/PRIO dataset that defines a conflict on "casualty" basis. This means that as long as one conflict leaves less than 25 battle-related death it won´t be part of the dataset and therefore of this analysis.

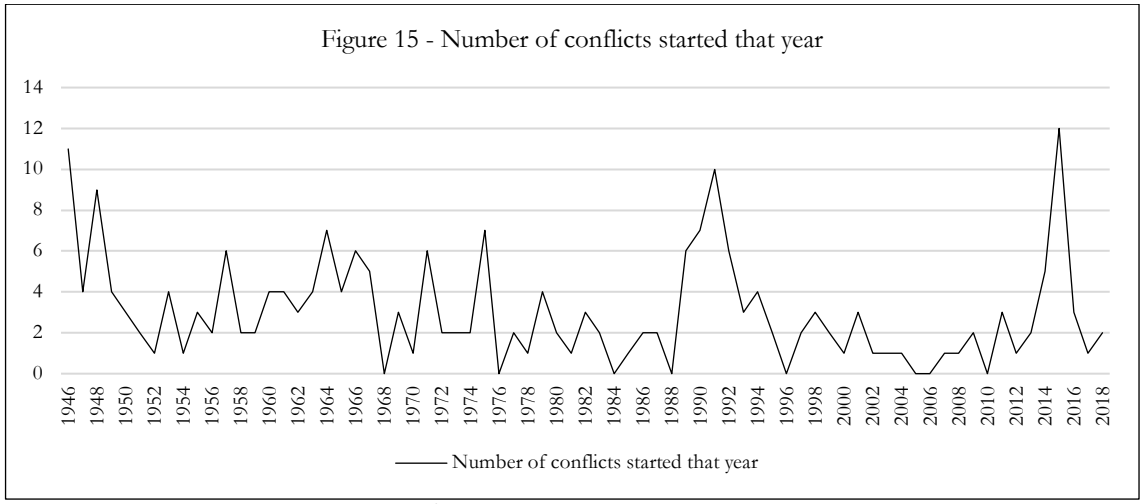
median duration of 3 years and an average duration of 12 years, the likelihood of having conflict on one year depends highly on experiencing armed conflict in the previous year.



Source: Elaborated by the author using UCDP/PRIO data. *Note:* The first decade only considers the values between 1946 and 1948 due to information availability.



Source: Elaborated by the author using UCDP/PRIO data.



Source: Elaborated by the author using UCDP/PRIO data.

Onset of Armed Conflict

Figure 15 depicts the onset of armed conflicts per year between 1946 and 2018. As it can been seen from this figure, no clear trend has emerged in terms of the onset of conflict. Even though both the ongoing conflicts and natural disasters occurrence has been constantly increasing in time, the onset has not.

Types of incompatibility

UCDP collects information on conflicts and their type of incompatibility. Table 6 presents the distribution of the 286 unique conflicts registered in the dataset by incompatibility but also with their respective average and median duration in years. Most of the incompatibilities have been with respect to the government and these conflicts last on average 10 years but and their median value is 3 years. Those incompatibilities related with territories last 9 years more on average and its median value is also consistent with that. Incompatibilities with respect to the government are more prompt to trigger minor conflicts (81%) instead of wars (19%). Incompatibilities related with territories are also more prompt to generate minor conflicts (65%) but in relative terms to those government incompatibilities are more prompt to generate wars (35%). Since incompatibilities with both concerns have occurred very few times in history, the data does not serve to do some conclusions with respect their likelihood or triggering minor conflicts or wars.

Table 6 - Average and median duration by type of incompatibility

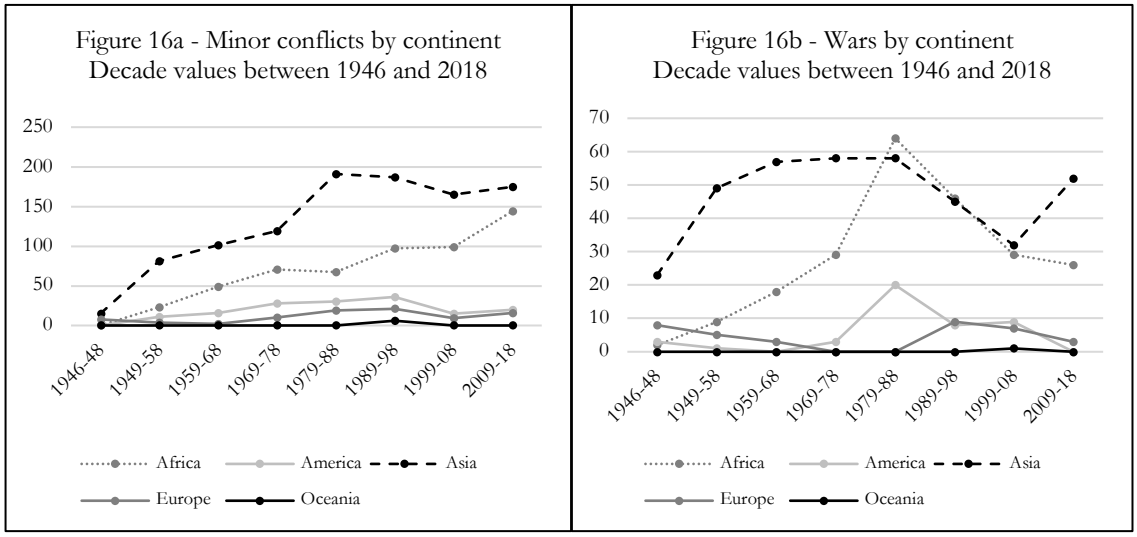
	Incompatibility about government	Incompatibility about territory	Incompatibility about government and territory
Frequency	180	102	4
Median	3	9	7
Average	10	19	8

6.2.1 Armed Conflict – a spatial representation

The conflict occurrence differs dramatically by continent. Out of the 2.512 armed conflicts consider in this analysis, 56% occurred only in Asia. The other continent that has experienced the second largest number of armed conflicts is Africa, accounting for 31% of the conflicts registered. In sum, Asia and Africa account for 87% of all the conflicts ever occurred. Asia, is the continent most affected by natural disasters and with more registered armed conflicts in the world.

Figure 16a and 16b present the evolution in the number of conflicts by type and by continent over the last seven decades. Minor conflicts have been continuously increasing in Asia and Africa. The war trends are less clear. In general, the number of wars have been decreasing in Asia but only until the last decade. For the case of Africa, there was a constant increase in the number of wars between 1946 and 1988 but then it started to decrease. For the rest of the continents, the amount of wars registered by decade is relatively low and the only difference that stands out is the period between 1979 and 1988 in America, more precisely Central and South America. These incidents correspond to El Salvador between 1981 and 1987 (Civil War of El Salvador), Nicaragua between 1978 and 1987 (Nicaraguan

Revolution or Sandinist Revolution or "Revolución Sandinista" in Spanish) and Perú between 1983 and 1985 (War against the "Shining Path" or "Sendero Luminoso" in Spanish).



Source: Elaborated by the author using UCDP/PRIO dataset

Figure 17 shows the location of the majority of minor armed conflicts that occurred during the last 3 decades (1,015 in total). The resemblance with Figure 12 that shows the distribution of disasters occurrence is shocking. South Asia, South East Asia, West Asia and East Africa are the four regions that have experienced more disasters in history but also four of the regions that experienced more minor conflicts in the last three decades. In order to see how strong has been this relationship during the last three decades, figure 18 shows a scatterplot with the number of "natural disasters" for the 80% of the most affected regions and its respective number of minor armed conflicts. By looking at figure 18 it seems that the occurrence of both incidents is positively and strongly correlated for those highly exposed to disasters regions. This finding naturally raises interest in deeply researching the co-occurrence of these two variables and their reasons. This is the aim of the following section.

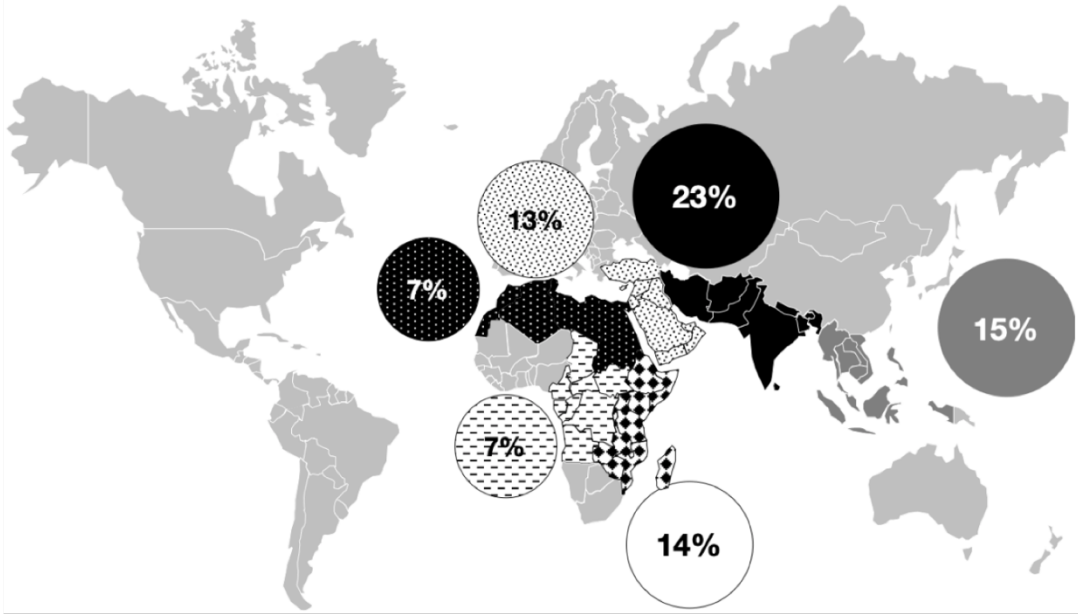
6.3 Co-occurrence of Armed Conflicts and Disasters

Historically, regions highly affected by disasters did also engage more in conflicts. However, the co-occurrence of these events (in the same country and in the same year) is a different phenomena. The research of the co-occurrence of these events is the main concern of this paper because it will allow understanding whether disasters can act as conflict intensifiers or triggers. The following chapter´s aim is to show that the co-occurrence of armed conflicts and disasters exist, with more intensity in some regions than others, and that has been constantly increasing in the last decades. This chapter starts with the key facts and figures with respect to the co-occurrence of these events, then digs deeper into the characterization of these co-occurrences and finishes by stating the relevance of the research of this subject.

The majority of the 230 countries considered for this research didn´t experience disasters, armed conflicts or both in the same year between 1960 and 2018. As a matter of fact, 63% of the sample (country-year pairs) didn´t experience disasters, 88% didn´t experience armed conflicts and 92% didn´t experience both events in the same year.

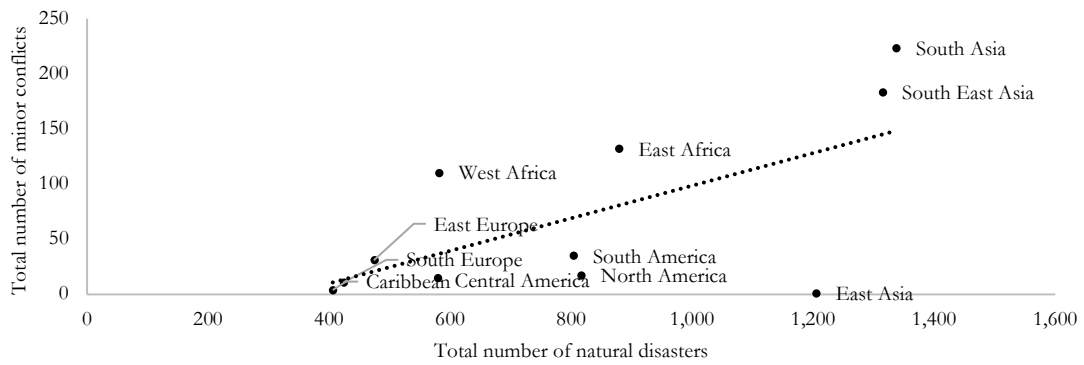
However, those countries that engaged in one armed conflict are very likely to be affected by disasters in the same periods of time (67%)[12].

Figure 17 – Map: Most affected regions by conflicts, relative values with respect to world total



Source: Elaborated by the author using UCDP/PRIO data. *Note:* Majority (80%) of the minor armed conflict affected regions in the World.

Figure 18 - Minor conflicts for the most disasters-affected regions
Values between 1989 and 2018



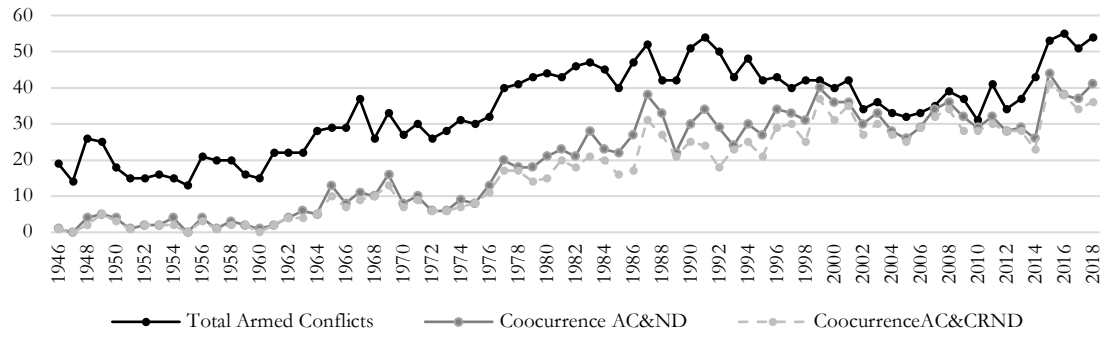
Source: Elaborated by the author using EM-DAT and UCDP/PRIO data.

The co-occurrence of these events in the same locations is high and has been constantly increasing in time. During 2018, from the armed conflicts that occurred, 41 co-occurred with a total of 106 disasters. On average all the countries that experienced the co-occurrence of both events, had 1.5 conflicts and 3.8 disasters The highest value for last´s year co-occurrence was in India, with 23 registered disasters and 4 armed conflicts. The last two figures of this section present the co-occurrence per country of any type of armed conflicts and disasters in absolute and relative terms. The values of figure 20 are shockingly high. During the last 7 decades the co-occurrence has been increasing systematically to the point of reaching a peak

[12] To see the amount of disasters, conflicts and co-occurrences per country per year please see Annex 3 – "Disasters, armed conflict and co-occurrence for country - year pairs (1960-2018)".

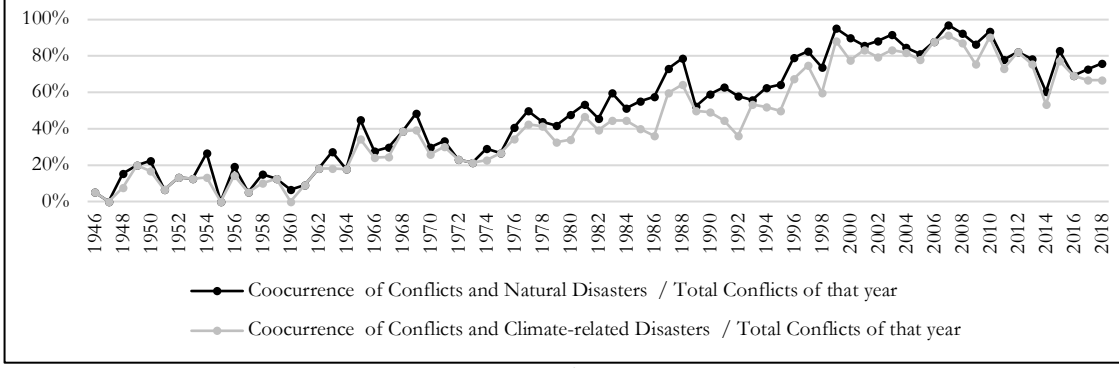
of 97% in 2007. This means that out of the 35 conflicts that happened that year, 34 were in countries affected by at least one disaster. Of the same concern is that for the last decade (2009-2018) the average relative co-occurrence has been of 78%. This means that of the average of 44 armed conflicts that happen every year, 34 occur in disaster affected countries.

Figure 19 - Armed conflicts and total cooccurrence with disasters and climate-related disasters



Source: Elaborated by the author using EM-DAT and UCDP/PRIO data.

Figure 20 - Armed conflicts and total cooccurrence with disasters and climate-related disasters as a share of total armed conflicts per year



Source: Elaborated by the author using EM-DAT and UCDP/PRIO data.

The results of this simple co-occurrence analysis raise many questions. Is this co-occurrence increase only a coincidence? is there a relationship between disasters and armed conflict beyond its only coincidence? Is this relationship "strong enough" to be statistically significant? Why such a specific group of regions (South Asia, South-east Asia, East Asia and East Africa) stands out in the co-occurrence of these two events? In order to answer this question, the following chapter of this document presents the results of the estimations of the ongoing armed conflict explanatory model and its relationship with the disasters occurrence.

Chapter 7

Results & Discussion

The following Chapter presents the results for the estimations of the model described in Chapter 4.

7.1 Results – Armed Conflict explanatory model

Table 7 presents the results for the ongoing armed conflict explanatory model. The first 7 specifications add variable by variable in order to estimate how they contribute to the explanatory power of the model and to test whether they enter the model significantly. Two proxies for development are included: GDP per capita and the Human Development Index. The two development proxies are included to show their substitutability and to evidence why further it was decided to work with the HDI instead of the GDP per capita as a development proxy. One novel aspect of this research is the use of the HDI as development proxy in the ongoing conflict explanatory model.

Table 7 - Marginal effects after logit regression on armed conflict per country per year dummy.

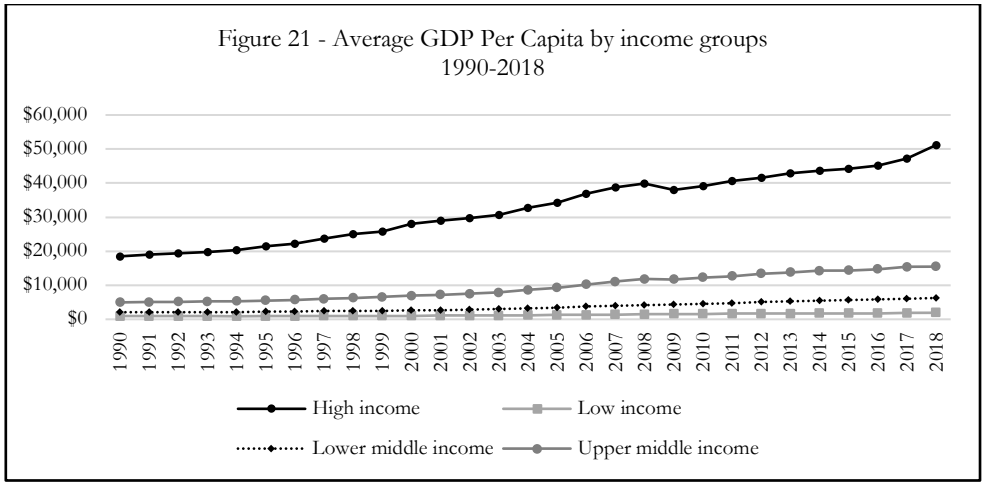
Dependent Variable:	(1) Ongoing Conflict	(2) Ongoing Conflict	(3) Ongoing Conflict	(4) Ongoing Conflict	(5) Ongoing Conflict	(6) Ongoing Conflict	(7) Ongoing Conflict
Armed conflict dummy, lag1	3.18	2.80	2.90	2.72	2.74	2.79	2.80
	(0.14)***	(0.25)***	(0.26)***	(0.24)***	(0.24)***	(0.25)***	(0.26)***
Long lasting armed conflict dummy	1.14	1.05	1.05	1.05	1.05	1.09	1.04
	(0.11)***	(0.18)***	(0.19)***	(0.18)***	(0.18)***	(0.19)***	(0.20)***
GDP Per Capita (in US thousands)		-0.06		-0.05	-0.05	-0.05	
		(0.02)***		(0.02)***	(0.02)***	(0.02)***	
Human Development Index			-1.33				-2.43
			(0.45)**				(0.62)**
Polity IV Democracy Index				-0.04	-0.05	-0.07	-0.05
				(0.02)***	(0.02)***	(0.02)***	(0.02)**
Log of Population					0.67	0.65	0.70
					(0.11)***	(0.11)***	(0.12)***
Natural Resources rents (as a % of GDP)						1.31	1.08
						(1.01)	(0.92)
Total observations	12,880	5,382	5,236	4,415	4,415	4,234	4,328
Number of countries	230	196	187	161	161	161	163
Average observations per country	56	28	28	27	27	26	27
Pseudo R2	0.35	0.68	0.68	0.69	0.70	0.72	0.71

Note: Robust standard errors in parenthesis below coefficients, ***p-value < 0.01; ** p-value < 0.05: *p - value < 0.1

Overall, all the specifications make sense (in direction and magnitude). As expected all the variables (besides the Natural Resources Rents) enter the model significantly and contribute to explain conflict. The overall explaining capacity of the model (specification 7) is 0.71 and all the variables added explanatory capacity. The direction and magnitude of the coefficients can be interpreted as it follows:

- Experiencing conflict in the last period increases the likelihood of engaging in conflict by 2.8 times.
- If a country has experienced a long-lasting conflict then is also more likely to engage in conflict, a 109% more likely.
- The more developed a country the less likely to engage in conflict. These interpretation is valid for both GDP Per Capita and the HDI:

    - An increase of 1.000 US dollars in the GDP per capita (in PPP at 2011), decreases the likelihood of experiencing conflict by 5%. The effect of an increase in GDP Per Capita is high and significant but not very likely to happen in those low income countries that are more prone to conflicts. Meanwhile an increase of 1.000 US dollars in the GDP per capita might happen every 4 months in the group of high-income countries, it has taken almost 20 years to the low-income countries to experience this increases *(see figure 21*).



Source: Elaborated by the author using World Bank data.

    - An increase of 0.1 points in the HDI decreases the likelihood by 23%. The effect of HDI is naturally bigger because it compresses both economic development indicators but also health and education information.

- The more democratic a country the less likely it is to experience conflict. An increase of 1 point in the Polity IV Index (it ranges from -10 to +10) can decrease up to a 5% the likelihood of experiencing conflict.[13]

- Aligned with previous findings (see Chapter 2), the population control variable also contributes to the armed conflict persistence. An increase of 1% of the population increases 0.69% (when controlling for HDI) the likelihood of experiencing conflict.

These results are satisfactory and allow to control for the disasters variables. As robustness check it was decided to predict the values of this estimations for the latest year possible, 2017. The results are quite accurate and for the presence of armed conflicts of 2017, the model predicts 92% of the cases correctly when controlling with GDP and 93% of the

[13] All the model specifications were estimated also including the GINI Index in order to account for vertical inequalities, however this variable doesn´t enter the model significantly in all estimations.

cases correctly when controlling with HDI. However, both model specifications are "better" estimating non-conflict cases than conflicts. Both specifications predicted correctly 126 of the 128 countries from the sample that did not experience conflict during 2017 but predicted correctly only 20 of those 29 countries that did actually experienced conflict. The specification accuracy when controlling for GDP or HDI is almost the same and for the estimations for the year 2017 specification 6 and specification 7 predicted almost the same results with only one difference (HDI predicted one more conflict correctly). Before conducting the tests of interests with respect the disasters variables it was decided to estimate the effects of this model on different types of conflict. Table 8 presents the results for the different dependent variables of interest for this research: wars, minor conflicts and conflict onset.

Table 8 - Marginal effects after logit regression on armed conflict per country per year dummy.

Dependent Variable:	(8) War	(9) War	(10) Minor Conflict	(11) Minor Conflict	(12) Onset	(13) Onset
Armed conflict dummy, lag1	3.03 (0.38)***	3.07 (0.39)***	2.29 (0.26)***	2.29 (0.26)***		
Long lasting armed conflict dummy	0.63 (0.28)**	0.57 (0.30)**	0.80 (0.18)***	0.76 (0.17)***		
GDP Per Capita (in US thousands)	-0.09 (0.03)***		-0.03 (0.02)**		-0.04 (0.01)**	
Human Development Index		-3.62 (0.98)***		-1.84 (0.53)***		-2.29 (0.53)***
Polity IV Democracy Index	-0.05 (0.04)*	-0.04 (0.03)	-0.04 (0.02)*	-0.03 (0.02)	-0.03 (0.02)	-0.01 (0.02)
Log of Population	0.34 (0.14)**	0.45 (0.15)***	0.61 (0.11)***	0.65 (0.11)***	0.34 (0.07)***	0.36 (0.07)***
Natural Resources rents as a % of GDP	-0.24 (1.33)	-0.15 (1.29)	1.65 (1.01)	1.43 (0.98)	1.25 (0.96)	0.60 (1.03)
Total observations	4,234	4,328	4,234	4,328	4,234	4,328
Number of countries	161	163	161	163	161	163
Average observations per country	26	27	26	27	26	27
Pseudo R2	0.84	0.84	0.68	0.67	0.86	0.86

Note: Robust standard errors in parenthesis below coefficients, ***p-value < 0.01; ** p-value < 0.05: *p - value < 0.1

Specifications 8 and 9 present the results for the estimations of ongoing wars instead of any kind of conflict as in Table 7. The goodness of fit of both specifications is 0.84 which is higher than for the general model presented in specification 7. This means until some extent that this model is "better" predicting wars than minor armed conflicts. However it works for the prediction of both scenarios and as the results for specification 10 and 11 show that the goodness of fit is still high (0.67). However, it is of high relevance to note that the variable that measures the democracy level does not appear to be statistically significant when HDI is used as a proxy for development to try to estimate both ongoing wars and ongoing minor conflicts. For Wars, the presence of conflict in the previous period has 0.7 more effect than for the case of minor conflicts, and population seems to play a more relevant role in explaining minor conflicts than when explaining wars.

Finally, specifications 12 and 13 presents the results of estimating the onset of conflict dependent variable. Naturally it was decided to not include the presence of conflict in the previous period and the long lasting conflict dummy. Out of the 4 renaming explanatory variables only 2 appear to be significant, development and population. Even though the

values for the development variables GDP and HDI don´t change too much with respect to specification 6 and 7, population seems to play a less relevant role, it decrease from 0.65 to 0.34 when controlling for GDP per capita and from 0.69 to 0.59 when controlling for HDI. Other specifications were also estimated. One of them was taking as dependent variable the total amount of armed conflicts per country per year that varies from 0 to 7 and has an average of 0.17. The results of this ordered logit estimation are very similar to the ones of specification 7.

7.2 Results – Testing the disasters variables in all forms and interactions

After estimating several specifications and analyzing the overall contribution to the model and its predictive capacity it was decided to estimate the following model specifications with the Human Development Index as a proxy for development. Table 9 presents the results when including several types of disasters variables. In addition to that it was decided to include region fixed effects for those six highly affected regions by both events presented in figure 16 (Chapter 6): South Asia, South-east Asia, West Africa, East Africa, Central Africa and West Asia. For all model specifications disasters don´t enter the model significantly. A disasters dummy variable, the total amount of disasters in a year, the total of climate related disasters, the total of non-climate related disasters and also the lagged value of the total number of disasters were tested. One reason for this "no significance" is theoretical. Disasters variables are only triggering variables that contribute to conflict under certain preconditions (low development, high instability, large population and high dependence on natural resources extraction). In order to account for this, it was decided to estimate the same model specification as number 15 (which is the same than model specification 7 but adding the total disasters variable) but now including interaction terms for every variable of relevance one by one and all of them together. None of the specifications led to statistically significant coefficients[14]. The results of all of this model specifications mean that disasters don´t intensify or promote ongoing conflicts. This answers the second research question.

In order to answer the first question of this research which is whether disasters trigger conflict, the same previous model specifications were estimated but this time using as the dependent variable, not the ongoing armed conflict dummy variable but the onset of conflict. After estimating the 5 variations of the model with disasters (dummy, total, both, climate-related and non-climate-related) the results show that there is not enough information to state that disasters are statistically related to the onset of conflicts.

Finally, in order to assess whether natural disasters can contribute to intensify the conflict or the number of conflict in each country each year, an ordered logit on the total number of armed conflicts was estimated following specification 14. The effects on the total number of armed conflict per country per year were estimated for the disasters dummy and total per year. No significant effects were found.

These results are encouraging. These results are encouraging to the extent that they present that armed conflict is a complex social phenomena that can be explained by certain specific conditions (development, political stability and population) instead of by the occurrence of environmental shocks such as disasters. These results are not new and similar

[14] The results of this estimations are available in Appendix 4.

findings have also been presented by previous researchers (Omelicheva, 2011; Bergholt & Lujala, 2012; Schelussner et al. 2012). However, if the common agreement with respect to the relationship between disasters and conflict is that this relation depends on certain preconditions then it would be expected that the interaction terms tested in the previous chapter entered the model significantly, unfortunately this is not the case. Even though many forms were estimated and the robustness's checks indicate that these findings are consistent, this analysis is highly limitated by the datasets that were used. The following chapter discuss these results and present the main limitations of this research.

Table 9 - Marginal effects after logit regression on ongoing armed conflict

Dependent Variable:	(7)* Ongoing Conflict	(14) Ongoing Conflict	(15) Ongoing Conflict	(16) Ongoing Conflict	(17) Ongoing Conflict	(18) Ongoing Conflict	(19) Ongoing Conflict
Armed conflict dummy, lag1	2.80 (0.26)***	2.79 (0.26)***	2.79 (0.26)***	2.79 (0.26)***	2.79 (0.26)***	2.79 (0.26)***	2.79 (0.26)***
Long lasting armed conflict dummy	1.04 (0.20)***	1.03 (0.20)***	1.03 (0.20)***	1.03 (0.20)***	1.03 (0.20)***	1.03 (0.20)***	1.03 (0.20)***
Human Development Index	-2.43 (0.62)**	-2.17 (0.65)***	-2.15 (0.65)***	-2.15 (0.65)***	-2.15 (0.65)***	-2.15 (0.65)***	-2.14 (0.65)***
Polity IV Democracy Index	-0.05 (0.02)**	-0.04 (0.02)***	-0.03 (0.02)	-0.03 (0.02)	-0.03 (0.02)	-0.03 (0.02)	-0.03 (0.02)
Log of Population	0.70 (0.12)***	0.63 (0.11)***	0.66 (0.11)***	0.69 (0.11)***	0.69 (0.11)***	0.69 (0.11)***	0.66 (0.11)***
Natural Resources rents as a % of GDP	1.08 (0.92)	0.67 (1.10)	0.65 (1.04)	0.65 (1.05)	0.66 (1.05)	0.63 (1.05)	0.63 (1.05)
Disasters variables							
Disasters dummy		0.23 (0.17)					
Disasters total			-0.01 (0.02)		0.01 (0.03)		
Disasters total, lag1				-0.02 (0.04)	-0.03 (0.04)		
Climate-related disasters total						-0.01 (0.39)	
Non climate-related disasters total							0.02 (0.06)
Regions							
South Asia		1.47 (0.55)***	1.51 (0.55)***	1.47 (0.55)***	1.52 (0.55)***	1.52 (0.55)***	1.52 (0.55)***
South-east Asia		0.76 (0.65)	0.79 (0.65)	0.76 (0.65)	0.80 (0.65)	0.80 (0.64)	0.78 (0.65)
West Africa		0.51 (0.44)	0.54 (0.44)	0.51 (0.44)	0.54 (0.44)	0.54 (0.44)	0.54 (0.45)
East Africa		0.66 (0.51)	0.69 (0.51)	0.66 (0.51)	0.69 (0.51)	0.69 (0.51)	0.69 (0.51)
Central Africa		1.11 (0.50)**	1.15 (0.49)**	1.11 (0.50)**	1.15 (0.50)**	1.15 (0.50)**	1.15 (0.50)**
West Asia		1.33 (0.51)**	1.28 (0.52)**	1.33 (0.51)**	1.27 (0.51)**	1.29 (0.53)**	1.29 (0.53)**
Total observations	4,328	4,328	4,328	4,328	4,328	4,328	4,328
Number of countries	163	163	163	163	163	163	163
Average observations per country	27	27	27	27	27	27	27
Pseudo R2	0.71	0.71	0.71	0.71	0.71	0.71	0.71

Note: Robust standard errors in parenthesis below coefficients, ***p-value < 0.01; ** p-value < 0.05: *p - value < 0.1

Chapter 8

Limitations

This research paper has many limitations, some of them related with the theory, others with the methodology applied for the analysis and others with the data sources.

From a methodological perspective this research doesn´t explore all the mechanisms by which disasters act as conflict triggers, maintainers or intensifiers. For example, no major research was done with respect to the effects of disasters occurrence on forced displacement and how this reactions could generate conflict. As stated in Chapter 6 one limitation of this research is also that it does not explore the effects of all those hazards that did not turn into disasters as defined by EM-DAT. An illustration of this was the example of the wildfires in Brazil (see Chapter 6). This of course opens a big opportunity for future research. In addition to the above, it is highly suggest to take the results of this research as baseline and complement them with deep case studies when making conclusions with respect to a country-specific context.

From the data available perspective many limitations emerge:

1. This research has been conducted at the country level, aggregating all the dynamics that could happened at the meso-level (regions) or at even more micro levels such as neighborhoods, small human settlements and villages. This of course imitates the research but opens opportunity to use geo-referenced datasets (once available) in order to examine the relationship between disasters and conflict at a lower level of analysis.

2. This research has been done utilizing data that considers only conflicts with casualties, leaving aside all the forms of minor conflict with less than 25 deaths. This of course imitates the scope of the research but also provides an opportunity for a more complete analysis.

3. This research only considers as disasters those hazards that converged in disasters resulting in at least 10 people death, a 100 affected, the declaration of state of emergency or the call for international assistance. This of course has a direct incidence in this analysis because it does not consider the effects of those disasters that don´t fulfilled this criteria but could actually have an effect on conflict, this was explored in Chapter 6 of this documents. Future research that merges hazards, disasters and conflict, might provide rich insights.

4. Most of the information of economic development and political stability is only available from 1990. Therefore this model did not include any information besides this year for the econometric analysis. This means that all the disasters between 1900 and 1990 and all the conflicts between 1946 and 1990 are not part of this analysis and this might be biasing the results. Future research could incorporate reconstructed information for economic development and political stability I order to use a larger dataset.

The results of this research and of many other publications exposed in this document argue that armed conflict might be explained largely by the level of development, political stability (democracy level) and population. Disasters are the results of the interaction between hazards and the vulnerability level of human settlements. The likelihood of a hazard to turn into a disaster depends also (inversely) in the coping capacity of these groups of people. These two reflections suggest that this two processes (armed conflict and disasters) might be cofounded. Since according to this analysis, population, political stability (democracy level) and development determine conflict it is likely that they also affect the likelihood of disasters occurrence. Even though, as a part of this analysis it was estimated how disaster occurrence could be explained by those three variables (the results were statistically insignificant), this remains an issue that future research should address.

Chapter 9

Conclusions

Armed conflict corresponds to a complex social process that has been largely studied in the past. However, its general occurrence keeps increasing over time. Its effects can result, in the worst cases, in deaths which are of course the worst loss for society. Armed conflict can be mainly explained by low economic development, less democratic regimes, political instable environments and bigger populations.

Natural hazards can turn into disasters when levels of vulnerability are high enough to affect people and their settlements. The effects of disasters are a complex social process that is highly dependent on the capacities of human settlements to cope with hazards. In the last century a persistent increase in disasters occurrence has been observed, especially in climate-related disasters. Even though the effects of these events, in terms of deaths, have been decreasing in time, its general occurrence and economic impacts keep rising.

There is a high co-occurrence between disasters and conflicts. Unfortunately this co-occurrence has been constantly increasing over time, and the vast majority of conflict-affected countries also experience disasters during those same years. The understanding of the co-occurrence of these two complex social processes is highly relevant due to their interconnection and their capacity to influence each other.

Even though these two socially complex processes and their co-occurrence have been constantly increasing over time, there is no statistically significant evidence to state that at least disasters can trigger, maintain or intensify armed conflicts. Once controlled for all the "deep determinants" of armed conflict, there is no statistical relationship between disasters and conflict. This is the major finding of the research and also the main conclusion of this document. Taking into account all the limitations that this research may present, the main message is that a complex social process such as armed conflict often responds to specific events in time and other deep determinants such as human development, political stability (democracy level) and population size, instead of the occurrence of disasters. These findings should be used cautiously because they are highly dependent on the definitions and datasets used.

Due to the relevance of the conflict pre-conditions, making conclusions based only in this cross-country analysis might end in misleading interpretations. This research serves as a baseline and general framework, and the effects of disasters on conflict should be studied case by case after taking reviewing the current findings.

In order to better understand the nature of the relationship between disasters and conflicts, it is highly suggested to explore the inverse relation (not covered in this paper) between these two variables, in other words, the effects of armed conflict (ongoing or onset) on disasters. Understanding the nature of this relationship and combining those finding with the present document might lead to a clearer picture to the current academic debate. This is, of course, a proposal for future research.

Appendices

Appendix 1 – Countries and periods analyzed

Continent	Region	Income	Country	Period
Africa	East Africa	Low income	Burundi	1990-17
			Eritrea	1993-11
			Ethiopia	1990-17
			Madagascar	1990-17
			Malawi	1990-17
			Mozambique	1990-17
			Rwanda	1990-17
			Tanzania	1990-17
			Uganda	1990-17
		Lower middle income	Comoros	1990-17
			Djibouti	1990-17
			Kenya	1990-17
			Zambia	1990-17
			Zimbabwe	1990-17
		Upper middle income	Mauritius	1990-17
	Central Africa	Low income	Central African Rep,	1990-17
			Chad	1990-17
			Congo, Dem. Rep.	1990-17
		Lower middle income	Angola	1990-17
			Cameroon	1990-17
			Congo, Rep.	1990-17
		Upper middle income	Equatorial Guinea	1990-17
			Gabon	1990-17
	North Africa	Low income	South Sudan	2011-16
		Lower middle income	Egypt, Arab Rep.	1990-17
			Morocco	1990-17
			Sudan	1990-17
			Tunisia	1990-17
		Upper middle income	Algeria	1990-17
			Libya	1990-17
	South Africa	Lower middle income	Eswatini	1990-17
			Lesotho	1990-17
		Upper middle income	Botswana	1990-17
			Namibia	1990-17
			South Africa	1990-17
	West Africa	Low income	Benin	1990-17
			Burkina Faso	1990-17
			Gambia	1990-17
			Guinea	1990-17
			Guinea-Bissau	1990-17
			Liberia	2000-17
			Mali	1990-17
			Niger	1990-17
Asia	Central Asia	Low income	Tajikistan	1991-17
		Lower middle income	Kyrgyz Republic	1991-17
			Uzbekistan	1991-17
		Upper middle income	Kazakhstan	1991-17
			Turkmenistan	1991-17
		Lower middle income	Mongolia	1990-17
	East Asia	Upper middle income	China	1990-17
		High income	Japan	1990-17
			Korea, Rep.	1990-17
	South East Asia	Lower middle income	Cambodia	1993-17
			Indonesia	1990-17
			Lao PDR	1990-17
			Myanmar	2000-17
			Philippines	1990-17
			Timor-Leste	2016-17
			Vietnam	1990-17
		Upper middle income	Malaysia	1990-17
			Thailand	1990-17
		High income	Singapore	1990-17
	South Asia	Low income	Afghanistan	2002-17
			Nepal	1990-17
		Lower middle income	Bangladesh	1990-17
			Bhutan	1990-17
			India	1990-17
			Pakistan	1990-17
		Upper middle income	Iran, Islamic Rep.	1990-17
			Sri Lanka	1990-17
		Low income	Syria	1990-17
			Yemen, Rep.	1990-17
	West Asia	Upper middle income	Armenia	1991-17
			Azerbaijan	1991-17
			Georgia	1991-17
			Iraq	1990-17
			Jordan	1990-17
			Lebanon	1990-17
			Turkey	1990-17
		High income	Bahrain	1990-17
			Cyprus	1990-17
			Israel	1990-17
			Kuwait	1990-17
			Oman	1990-17
			Qatar	1990-17
			Saudi Arabia	1990-17

			Sierra Leone	1990-17				U. Arab Emirates	1990-17
			Togo	1990-17			**Lower middle income**	Moldova	1995-17
			Cabo Verde	1990-17				Ukraine	1991-17
			Côte d'Ivoire	2016-17				Belarus	1991-17
		Lower middle income	Ghana	1990-17			**Upper middle income**	Bulgaria	1990-17
			Mauritania	1990-17				Romania	1990-17
			Nigeria	1990-17				Russia	1992-17
			Senegal	1990-17		**East Europe**		Czech Republic	1993-17
		Low income	Haiti	1990-17				Hungary	1991-17
		Upper middle income	Cuba	1990-17			**High income**	Poland	1990-17
	Caribbean								
			Dominican Rep.	1990-17				Slovak Republic	1993-17
		High income	Jamaica	1990-17				Denmark	1990-17
			Trinidad and Tob.	1990-17				Estonia	1995-17
		Lower middle income	El Salvador	1990-17				Finland	1990-17
						North Europe	**High income**		
	Central America		Honduras	1990-17				Ireland	1990-17
		Upper middle income	Nicaragua	1990-17				Latvia	1995-17
			Costa Rica	1990-17				Lithuania	1995-17
America			Guatemala	1990-17	**Europe**			Norway	1990-17
			Mexico	1990-17				Sweden	1990-17
		High income	Panama	1990-17				U. K.	1990-17
	Northern America	**High income**	Canada	1990-17				Albania	1990-17
			United States	1990-17				Bosnia and Herz.	1994-17
		Lower middle income	Bolivia	1990-17			**Upper middle income**	Montenegro	2006-17
			Argentina	1990-17		**South Europe**		Macedonia	1991-17
			Brazil	1990-17				Serbia	2003-17
			Colombia	1990-17				Croatia	1995-17
	South America	**Upper middle income**	Ecuador	1990-17				Greece	1990-17
			Guyana	1990-17			**High income**	Italy	1990-17
			Paraguay	1990-17				Portugal	1990-17
			Peru	1990-17				Slovenia	1995-17
			Suriname	1990-17				Spain	1990-17
			Venezuela	1990-14				Austria	1990-17
		High income	Chile	1990-17				Belgium	1990-17
			Uruguay	1990-17				France	1990-17
	Australia and New Zealand	**High income**	Australia	1990-17				Germany	1990-17
			New Zealand	1990-17				Luxembourg	1990-17
		Lower middle income	Papua New Guinea	1990-17		**West Europe**	**High income**		1990-17
Oceania			Solomon Islands	1990-17				Netherlands	1990-17
	Melanesia	**Upper middle income**	Fiji	1990-17				Switzerland	1990-17

Appendix 2 – Economic Development preconditions variables correlation matrix.

Economic Development preconditions variables correlation matrix

	POV - National	POV	GDP PC	IMR	HDI
Poverty headcount ratio at national poverty lines (% of population) – POV National	1.000				
Poverty gap at $1.90 a day (2011 PPP) (%) – POV	0.647	1.000			
GDP per capita, PPP (current international US $) – GDP PC	-0.559	-0.575	1.000		
Mortality rate, infant (per 1,000 live births) - IMR	0.634	0.768	-0.688	1.000	
Human Development Index - HDI	-0.624	-0.783	0.811	-0.902	1.000

Appendix 3 – Disasters, armed conflict and co-occurrence for country - year pairs (1960-2018)

Disasters, armed conflict and co-occurrence for country - year pairs (1960-2018)

Frequencies	Disasters per country per year	Armed conflicts per country per year	Co-occurrence
0	8,623	11,949	12,508
1	2,307	1,280	865
2	1,028	202	139
3	585	56	22
4	330	38	19
5 or more	697	45	17

Appendix 4 – Results for model specifications with interaction terms

Marginal effects after logit regression on ongoing armed conflict

Dependent Variable:	(20) Ongoing Conflict	(21) Ongoing Conflict	(22) Ongoing Conflict	(23) Ongoing Conflict
Armed conflict dummy, lag1	2.79 (0.18)***	2.80 (0.18)***	2.80 (0.18)***	2.78 (0.18)***
Long lasting armed conflict dummy	1.06 (0.19)***	1.06 (0.19)***	1.04 (0.19)***	0.99 (0.19)***
Human Development Index	-2.28 (0.54)***	-2.11 (0.52)***	-2.15 (0.52)***	-2.15 (0.53)***
Polity IV Democracy Index	-0.03 (0.02)***	-0.04 (0.02)***	-0.04 (0.02)***	-0.04 (0.02)***
Log of Population	0.66 (0.12)***	0.66 (0.12)***	0.68 (0.12)***	0.69 (0.12)***
Natural Resources rents as a % of GDP	0.69 (0.92)	0.62 (0.92)	0.62 (0.92)	-0.25 (1.05)
Disasters variable				
Disasters total	-0.09 (0.08)	-0.02 (0.03)	0.25 (0.30)	-0.04 (0.03)
Interaction terms				
Disasters total X HDI	0.11 (0.11)			
Disasters total X Polity IV		0.00 (0.00)		
Disasters total X log(Population)			-0.01 (0.01)	
Disasters total X Natural Resources Rents				0.50 (0.28)*
Regions				
South Asia	1.58 (0.59)***	1.45 (0.59)**	1.45 (0.59)**	1.53 (0.61)**
South-east Asia	0.82 (0.56)	0.72 (0.56)	0.72 (0.56)	0.72 (0.78)
West Africa	0.56 (0.48)	0.53 (0.47)	0.52 (0.47)	0.53 (0.49)
East Africa	0.72 (0.47)	0.66 (0.47)	0.66 (0.47)	0.64 (0.49)
Central Africa	1.18 (0.59)***	1.12 (0.58)***	1.11 (0.59)***	1.10 (0.62)***
West Asia	1.29 (0.47)***	1.24 (0.46)***	1.28 (0.46)***	1.31 (0.49)***
Total observations	4,328	4,328	4,328	4,328
Number of countries	163	163	163	163
Average observations per country	27	27	27	27
Pseudo R2	0.71	0.71	0.71	0.71

Robust standard errors in parenthesis below coefficients, ***p-value < 0.01; ** p-value < 0.05: e < 0.1; ** p-value < 0.05: ***p - value < 0.01

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