CIVIL WAR AND NATURAL RESOURCES:
A QUANTITATIVE APPROACH


by


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# Abstract

This study is an effort to shed some light on the causes of civil war. The literature on civil war onset has been framed under three main perspectives: cultural, political and economic approaches. Recent studies, however, tend to narrow the debate and posit explanations for civil war as either greed-motivated or grievance-motivated. This study replicates one of the most prominent econometric models on civil war, the Collier and Hoeffler model (CH), and further validated their economic interpretation of civil war as greed-motivated. Their argument is that greed-led behavior is motivated by an abundance of valuable resources. However, Collier and Hoeffler overlooked one critical element: scarce resources also contribute to discontent and violent protests. This study suggests that the CH model should include resource scarcity to avoid omitting variable bias.

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# Dedication

This thesis is dedicated to my dearest mother and father, who have supported me from the very first moment. Thank you for all your incentives; you are my Guardian Angels!

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# CHAPTER 1 - Introduction

Between 1989 and 2003, the 116 wars that happened in 78 countries, only seven were inter-state conflicts. There is no doubt that civil wars have become increasingly frequent. But why do civil wars occur? What motivates civil war, and what does the literature has to offer? Why should we study it? The end of the Cold War and the decline of superpowers' influence in the Third World did not provoke a decrease in the number of civil wars. Certainly, some armed conflicts were strongly influenced by the logic of the Cold War: civil wars in Cambodia, El Salvador, Guatemala and Mozambique come to mind. However, the conflicts in Afghanistan, Angola, Somalia and D.R. Congo occurred in the post-Cold War era. Moreover, we should carefully examine civil war because: "civil war is widespread; it causes tremendous suffering; it almost always affects and involves neighboring states, thereby undermining regional stability; it often engages the interests of distant powers and international organizations; and efforts to deal with the problems posed by internal conflict are in the process of being reassessed by policy makers at the national level and in regional and international organizations" (Brown, 1996, p.3).

Since the study of war and modern warfare became an important issue of research within the social sciences, different theories and schools of thought have tried to encompass plausible explanations of civil war. Two popular approaches have been framing what scholars consider as factors leading to civil war. A number of scholars argue that civil conflicts are a product of present and past *grievances* (Avruck, 1995; Appleby, 2000; Cliffe and Luckham, 1999; Reynal-Querol, 20002; Richardson et al, 1960; Young, 1976). Others see rebellion as *greed*-oriented (Eldabawi and Sambanis, 2002; Keen, 1998; Klare, 2001; Leite and Weidmann, 1999). The former argue that the prevalence of weak political rights, religious or ethnic differences, and

inequality, produce grievances – thus stimulating violent strife. The latter emphasize the role of available opportunities as a crucial factor in rebel group formation; hence the outbreak of civil war is viewed as caused by economic opportunities. Some others contend that civil wars can occur when *resources are abundant, thus increasing opportunities for loot and greed over its control* (Auty, 2001; Richards, P. 1996; Sachs and Warner, 1995, 2001).

A common trend in both these approaches is that natural resources produce grievances, undermine internal stability, thus paving the way for armed conflict episodes. Yet, some have argued that the *scarcity and deprivation of natural resources have been fomenting grievances*, thus increasing the likelihood of civil war (Binningso et al, 2006; Gleditsch, 2001; Homer-Dixon, 1991; Myers, 1993; Renner, 1996). Their findings show that the causes of civil war lie in a permanent struggle for equal access and distribution of scarce renewable resources.

In recent years, the greed approach has been advocated to explain civil war occurrence, and much of it is due to an influential study by Collier and Hoeffler (1998). The authors argue that the economic interpretation of rebellion as greed-oriented has more explanatory power when analyzing the causes behind civil war occurrences. Furthermore, they contend that motivations for rebellion and civil war occurrence are not based on grievances, as much political scientists have been arguing, but rather, on economic *opportunities* available to rebels. According to Collier and Hoeffler (1998), natural resources stand as profitable opportunities for greed-based behaviors, thus the control over such valuable natural resources is not only what leads rebel groups to form and act violently against governments and elites, but also a determinant in financing rebellions.

The inference from the literature on the topic referenced here is that no consensus exist on the causal mechanisms that natural resources are claimed to have on civil war. Therefore,

with such contrasting views and disparate results, it is essential to clarify what constitutes explanations for civil war. This study attempts to accomplish such goal. In order to do so, this study replicates a prominent econometric model on the literature, the Collier-Hoeffler model on civil war. Their model encompasses a great number of factors (e.g. political repression, economic growth, ethnicity, primary commodity exports, to name a few) reported in the literature as explanations for civil war. The authors main conclusion is that primary commodity exports have a significant role in explaining civil war occurrence and that this relationship is non-linear, which further increases its relevance. In particular, Collier and Hoeffler (1998) advocate that the risk of conflict reaches its peak when primary commodity exports constitute 32 percent of Gross Domestic Product.

Notwithstanding, we argue that the authors overlooked one critical element: in some cases, civil war occurrence is not caused by the abundance of resources, rather by the scarcity of valuable natural resources, meaning that its unequal distribution generates grievances and gives rise to violent civil strife. Hence, our objective is to show that a model on civil war has to include environmental scarcity in order to fully explain the causes of civil conflict. Due to the fact that environmental scarcity data has only recently been collected, our dataset comprises 33 civil war episodes from 1980 to 1995, in 126 countries.

This paper is structured as follows. After a brief introduction to the topic, chapter 2 reviews the main cultural, political and economic theories on civil war. It is also presented the most popular study on the topic, the Collier-Hoeffler Model on Civil War – henceforth CH model – along with its theoretical argument and findings. Chapter 3 presents a new model on Civil War and the theory that supports it. The following chapter explains the operationalization of the new model proposed here and its research design. Chapter 5 presents the replication of the

CH model and it will be argued that the model's support for the greed approach led the authors to neglect the fact that many civilians depend on scarce natural resources. Chapter 6 provides the model's statistical findings, and, finally, chapter 7, concludes.

# CHAPTER 2 - Review of the Literature on Civil War

The study of war has been vastly researched and documented. From Thucydides' *Peloponnesian War* and Machiavelli's *The Art of War*, to Clausewitz's *Principles of War* and more recently, Huntington's *The Soldier and the State: the Theory and Politics of Civil-Military Relations*. Important questions have been raised and many answers still debated. This study does not deal with issues directly linked to the *winning* or *losing of* wars, such as leadership, external intervention or military coalitions. Rather, it focuses exclusively on the theoretical arguments put forth by academics on what constitutes explanations for civil war, a specific type of armed conflict. For that, this study reviews the main cultural, political, and economic theoretical perspectives on civil war onset. Before examining these three main approaches, let us define the concept of Civil War. According to Small and Singer (1982, p.210), a civil war is any "armed conflict that involves a military action internal to the metropole, the active participation of the national government, and effective resistance by both sides." In an effort to further distinguish civil war from other internal conflicts, Singer and Small (1994) added that the violence observed in such internal conflict must exceed the threshold of 1,000 battle-related deaths, often in the same year the war episode started. Let us turn now to the cultural, political and economic theories of war.

## Cultural approach to civil war

Marshall and Gurr (2005) identified fifteen out of twenty armed conflicts ongoing in 2005 as motivated by ethnic concerns. It is relevant to the study of civil war as there are several cultural interpretations of ethnic confrontations. In general, these approaches tend to focus on the

role of culture and identity in ethnic rivalry. More specifically, these approaches contend that at the heart of ethnic conflict and civil wars lie a set of cultural differences and social cleavages – racial, religious or class cleavages – between competing ethnic groups.

Primordialists view ethnicity as primordial, emotive affiliation; that is, people who belong to a certain ethnic group have a strong sense of community, a collective self-consciousness, an emotive connection with their background (Geertz, 1963; Shils, 1957, 1995). This 'natural', emotive connection of ethnic affiliations is highly ethnocentric, leading primordialists to assert that when communities with strong ethnic identities become aware of other communities, inter-ethnic interactions may lead to violent confrontation. From a primordial perspective on ethnic behavior, we can infer that while ethnic similarity leads to cooperative behavior, ethnic differences lead to conflict. On one hand, ethnicity creates an intra-group consciousness capable of supportive and peaceful coexistence, and on the other, an inter-group destructive and violent relationship (Connor, 1993, 1994; Isaacs, 1975). In fact, ethnic groups are defined "by ascriptive differences, whether the indicum is color, appearance, language, religion, some other indicator of common origin, or some combination thereof" (Horrowitz, 1985).

Similarly, believers in ancient group hatreds contend that causes for ethnic conflict can be found in antecedent hostility and past atrocities (Furnivall, 1948; Isaacs, 1975; Posen, 1993; Fearon, 1994; Figueiredo and Weingast, 1997). This theory certainly can explain the observed hostility between Cambodians and Vietnamese in Cambodia however, this theory cannot explain why ethnic conflict occurred between ethnic groups that had no past historical interactions. Moreover, it has been proven that identities can vary and change over time (Young, 1976).

Ethnic conflict has also been said to be caused by a clash of civilizations or cultures. Culture can bind and distinguish an ethnic group from another. Fundamental cultural differences

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and conflictual values cause fear and violent friction between contending ethnic groups (Huntington, 1996; Inglehart and Baker, 2000; Norris and Ingleharst, 2004). However, it is possible that discrimination and inequality, or even cultural change may bring together different ethnic groups (or their members). As Horrowitz (1998) points out, "longstanding ethnic divisions of labor are usually shields, rather than swords, in conflict".

A group of scholars argue that modernization paves the way for violent conflict between ethnic groups (Melson and Wolpe, 1970; Olzak and Nagel, 1986; Newman, 1991; Tellis, Szayna, and Winnefeld, 1998). The idea behind modernization theory is that modernization produces rapid economic and social change. These forces may result in an increased group competition over scarce resources, which in turn solidifies group identities and promotes conflict (Connor, 1994).

Others like Figueiredo and Weingast (1996), Brass (1997), Vail (1991), favor an 'instrumentalist' view of ethnic war. They argue that conflict is product of elite mobilization of ethnic groups. In the quest for personal interests and power, predatory elites incite acts of violence, revive old hatreds and create group myths. The elite mobilization of ethnic groups is possible through manipulation and stereotyping of ethnic identities, constant chauvinist appeals to group behaviors and low costs in both mobilization and recruitment. Intergroup conflict is, thus, engineered by predatory elites.

In clear contrast with primordialism, constructivism does not consider identity as inherently conflictual, and its main focus is to "identify the social origins of identity and establish patterns of evolution of identity as a result of social interactions, linking specific social systems and pathological patterns of identity evolution to the outbreak of civil violence" (Sambanis, 2003). For constructivists like Wendt (1992) identity is socially constructed, meaning

that it is subject to changes and evolution, e.g. old enemies can become new friends. Others like Fearon and Laitin (2000) are skeptical about primordialist arguments as it shows limited evidence to be related with ethnic violence, hence, the authors favor the social constructivist and rationalist approaches to ethnic conflict which consider identities as something that changes through time and that its meaning is affected by those who see themselves as belonging to such identity. Fearon and Laitin (2000, p.847) contend that there are three categories of explanations of how conflictual identities are formed: "those based on discursive logics, those based on the strategic actions of elites, and those based on the strategic actions of the masses".

Nevertheless, and according to Avruck (1995), we should include culture in our assessments of conflicts, particularly, on its resolution and peacemaking. A simple way on how to include culture would be by acknowledging that culture shapes our view of the world's social, political, religious, economic, and psychological context.

An example of how culture can produce roots for civil war may be on how identity is shaped and manipulated by elites. Whether such agendas include the control of public resources or overthrow those in power, ethnic or religious leaders have the power to manipulate groups into violent conflict. It seems reasonable to argue that culture is always present in our daily lives, and the fact that we have different cultural backgrounds, conflict will always exist. Whether it is a conflict of interest or a violent conflict, and that it has a direct influence on the conflict or not, culture will always be present in the way we shape the world and how we cope with problems and solve conflicts.

## Political approach to civil war

Political theories of civil war focus on political oppression, collapsing institutions, system transition, or informational problems as sources for conflict. Key in political theories of civil war

is the idea of (relative) deprivation (Gurr, 1970; Tilly, 1978). When members of a collectivity feel deprived of their expectations (e.g. political rights), a sense of violation or injustice arises among them. Such feelings of injustice or resentments generate opportunities to justify violent action. The occurrence of such violent acts is directly dependent on the costs associated with it, i.e. expected deaths, and the possible gains that may result from it, e.g. overthrow oppressive government. Hence, the probability of rebel group formation and episodes of violent confrontation is directly linked to the opportunities available.

When analyzing civil wars, scholars have tended to deal with these issues by analyzing questions related to state legitimacy, weak institutions, regime transition, political oppression and lack of political rights, state's inefficient control of its territory and incapacity to provide protection to its population (Przeworksi, 1991). Although there may be other factors behind rebellion or protests, emphasis is placed on the existing political system (rulers, parties, institutions, policies, or even the state) as a condition that nurtures grievances, which justifies rebellion. For instance, Cliffe and Luckham (1999), stemming from the seminal theoretical predicaments of Gurr (1970) and Tilly (1978), observed the importance of state building and state failure in the occurrence of collective violence and rebel groups' formation in Africa. Cliffe and Luckam (1999) concluded that rebellion, violence and public discontent occurred in countries that: (a) lacked power to protect private property (and defend from rebellion); (b) lack of political legitimacy, i.e. popular/competitors rejection of the existent regime (or constitution/law) as an authority; and, intimately related (c) weak political institutions, e.g. general belief that institutions are unrepresentative and corrupt. When these conditions (opportunities) occur, the government can no longer have stability to rule, hence state failure – the collapse of the existing political structure.

Similarly, Hegre *et al* (2001) contend that political instability and regime transition create opportunities for violence and political protest and further exacerbates grievances. They have found that intermediate regimes (in a democracy-autocracy index) are more prone to conflict than democracies or autocracies. As the authors argued, such conflict-prone condition is due to the fact that such intermediate regimes (or semidemocracies) do not possess either enough control over its population, thus unable to prevent violence, or democratically inclusive and stable so as to keep feelings of resentment and injustice from occurring. In addition, the likelihood that a country faces conflict and violence is directly linked with the level of political/state repression (Lichbach, 1987). Gupta, Singh and Sprague (1993) concluded that high and low levels of political repression tend to reduce violent protests in nondemocracies[1], while having the inverse effect in democratic regimes[2]. In contrast, Rasler (1996) contend that political repression prevents conflict in the short-run, while encouraging it in the long-run. Moreover, Moore (1998) tested the above three theories of violent protest and corroborates Lichbach's (1987) theory. These results seem to concur with the previous political theories on civil war and empirical data, that is, violent protest and civil war occur in semidemocracies, states that are neither able to authoritatively subdue its population under the rule of law or to be inclusive enough to constitutionally enforce equal share of political and human rights (Hegre *et al*, 2001).

Kalyvas (2006) study of the Greek civil war contends that the distribution of information is critical in explaining the dynamics between insurgents and government. He contends that "the

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[1] The costs of protest, i.e. deaths, under an autocratic regime are high as such regimes disregard human rights and will respond to such acts with high level of coercion (Gupta, Singh and Sprague 1993).

[2] Under a democratic regime and constitutional law, all fundamental human rights must be guaranteed; otherwise protests and/or violent confrontation is expected to occur.

institutions that govern the distribution of information determine the likelihood and severity of retaliations".

Gates (2002) explores how rebel recruitment occurs. He asserts that rebel recruitment is made easier if cultural (ethnic/religious identity), ideological and geographical proximity exists between rebels and leader. But what motivates a person to join a rebel group? Gates contends that, besides the cultural, ideological and geographical proximity, there are a number of benefits to rebels. These will vary according to their activities. As Gates (2002) states, "loot-seeking groups will rely on wages and other pecuniary rewards", such as drugs or alcohol, "distributed from their rent-seeking activities", whereas "ideological groups (…) rely on nonpecuniary rewards of fighting the 'good fight'" (p.114). These include functional (reward's value is associated with task itself) and solidary benefits. His study stands as a bridge between macro-econometric studies of civil war (Collier and Hoeffler, 1998), and the micro-foundations of individual behavior in civil war.

Recent studies (Collier and Hoeffler, 1998; Berdal and Malone, 2001) tested the different motivations for rebel group formation and political violence. They claim that civil conflicts are not due to profound religious divisions, political repression or inequality, but because there is a number of "opportunities for predation". Hence, rebellion is motivated by the expected financial benefits of looting. However, Herbst (2000) notes that in many African wars, pure economic motives are not consistent with the behavior of rebel leaders. In many of these cases there is a persistence of ideological beliefs, political inequality and a constant struggle for power.

Furthermore, Gurr (2000) highlights what he considers to be the main determinants of civil war: "the salience of ethnocultural identity, as it relates to other types of socio-economic identities; the level of grievance (actual or expected); the capacity of ethnopolitical groups to

mobilize (a function of their cohesion); and the available opportunities for political action by each group" (Sambanis, 2002). Gurr (2000) contends that the risk of ethnopolitical action decreases in well-established democracies as they provide opportunities for peaceful conflict resolution. His work on political violence discusses the rational (choice theory) uses of violence, that is, violence is the outcome of a rational pursuit of individual/group self-interest, and the social construction of identity that is often used as a mobilization device.

Political theories on civil war are particularly relevant in the analysis of post-war peacebuilding. Most of the literature on post-war peacebuilding has focused on the political process, e.g. institutional failure, loss of political legitimacy (Doyle et al, 1997; Durch, 1993). Mason and Fett (1996) indicated that negotiation settlement was more likely after long civil war wars and where the government's military was small. Doyle and Sambanis (2000) contented that the "space for post-war peace is determined by the interaction of the root causes of the war, the local capacities for change, and the magnitude and type of international assistance", and while "significant human suffering and a large number of hostile factions reduce the likelihood of successful peacebuilding after civil war, the probability of success increases with the level of economic development and with the deployment of well-prepared and properly mandated UN peace operations" (Sambanis, 2002).

## Economic approach to civil war

Generally, economic explanations for war either emphasize the role of economic growth and modernization, or view war as a rational choice (violence as a strategy to achieve interests). Past historical examples can help us to illustrate these two perspectives. The idea that modernization and economic growth make war more likely, can be seen for instance in the New Imperialism period (c. 1880s-1914). In a move to modernize and become economically superior,

European states scrambled for territory, wealth and scarce resources in Africa. It is commonly stated that the fight/competition between the European states over wealth and scarce resources in Africa led to the First World War (Arendt, 1958). The same reasoning can be applied to civil wars. Newman (1991) argues that ethnic group conflicts are a result of the structural changes that economic growth and modernization create. In other words, the process of growth and modernization generates rapid socio-economic changes, which result in group competition over valuable resources. Newman's (1991) theoretical argument is backed up by the severe group competition over scarce valuable resources in the Middle East region, e.g. water scarcity in the Jordan River basin. Moreover, "the process of modernization explains not only the origins of ethnic conflict but also the form of that conflict, and the success or failure of specific ethnic political movements" (Newman, 1991, p. 452). It is important to mention that although Marxists and Capitalists have different views on the what free trade and economic modernization has achieved in the past – Marxists view modernization and competition under capitalist ideals as the source of war and violence, whereas capitalists argue that free trade and modernization leads to interdependence and peaceful coexistence – both perspectives seem to agree that the end result, particularly in Africa, was an increase in group competition and civil strife[3] (Jackson and Sorensen, 2006)

However, as Newman (1991) and Horowitz (1985) point out, although the modernization and development paradigms argued that growing interethnic social and economic activity increases the likelihood of conflict between ethnic groups, it fails to explain why such ethnic

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[3] From a Marxist perspective, capitalism is like an economic war, where different groups compete to have access to valuable resources, making war more likely. In contrast, Capitalists argue that violence and conflicts in the Middle East and Africa are a result of state borders and protectionism, a consequence of not having free trade (Jackson and Sorensen, 2006).

conflict occur in countries with low economic modernization, such as Chad or Sudan. Clearly, not all violent confrontation between ethnic groups can be explained by the modernization theory.

Scholars like Grossman (1995) and Hirschleifer (1995) have used rational choice theory and economic theories of criminal behavior in order to explain why ethnic conflict and civil wars persist even with the emergence of modern societies. Particularly, their studies attempt to shed some light on the interactions between the parties involved (tradeoffs), its impact on economic growth, and ultimately, what constitutes explanations for the outbreak of civil conflict. Grossman (1995), sought to theorize what a state (or incumbent ruler) would do in an insurrection scenario and its probable outcome. He concluded that the "state's decision on how much to tax or appropriate from its subjects, given an expectation that insurrection may result from too much taxation and resources will then have to be shifted to the protection of the state (reducing the net value of these rents to the state)" (Sambanis, 2002, p. 221). Hirschleifer (1995), went beyond the claim that modernization increases the likelihood of conflict between ethnic groups, and sought to explain why war/conflict can in fact be a rational alternative for the parties' involved. His model of conflict concluded that preferences, opportunities, and perceptions determine the choice between conflict and settlement. He argues that "the parties' divergent preferences and capabilities develop opportunities for conflict (…) [and] the perception of the likelihood of a successful outcome in a conflict enters the calculation of net expected benefits from conflict and can result in a party choosing to use violence as a strategy to satisfy its preferences" (Hirschleifer, 1995, p. 172).

### *The Collier and Hoeffler Model*

The natural resource-civil war relationship has gained much attention since the publication of a study by Collier and Hoeffler (1998). Their study challenges what scholars within the political science field have been arguing as motives for rebellion. Collier and Hoeffler (1998) advocate that civil wars are motivated by greed, meaning that rebellion is possible due to a group of opportunities. Clearly stated, greed-based behaviors for rebellion and, consequently, civil strife, are caused due to the availability of economic opportunities. The authors consider three main proxies for opportunities: finance availability, cost of recruitment, and cost of weaponry. Behind this logic, lies the argument that for rebellion to occur it is needed some sort of finance, and natural resources extortion stand as a profitable opportunity for rebellion. However, for rebel groups to work and function it is also needed manpower. Collier and Hoeffler (1998) advocate that in many countries, rebel organizations can operate due to the low cost of recruitment. A third critical element in their analysis is the cost of weapons. They argue that the cost of weapons should increase in countries that have experienced higher periods of peace.

In a special issue published by the *Journal of Conflict Resolution* in December 2000, several scholars conducted their studies in an attempt to refine the economic theories of civil war. As Sandler (2000, p. 723) summarizes, the essays presented in the special issue analyze violent conflict as the result of appropriative/rational rent-seeking behavior. As we shall see, such studies marked a new avenue for research. From this collection of essays, we highlight the one of Garfinkel and Skaperdas (2000), where the authors claim that the popular idea that conflict and war are the outcome of misperceptions, incomplete information or irrationality may not necessarily be true. As presented in the authors' model, despite the fact that a peace settlement could be achieved in the short-run, ethnic and national conflicts do not necessarily result from irrationality or misunderstandings, in fact such conflicts "can be considered the

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outcome of calculated gambles as a consequence of the adversaries' concern for the future", e.g. warlord warfare can be the outcome of plans to that project domination and elimination of other competitors or the weakening of their resources (p.794). From these perspectives, we can observe that there is no credible commitment to peaceful settlement in an insurrection scenario, between rebels and government, or as the above example, between a warlord and his competitors. As Collier (2000a) showed, when "rebels are predatory on natural resources, the government responds by attempting to defend them, and this gives rise to violent conflict" (p.852).

Collier and Hoeffler (1998) and Fearon and Laitin (2003) contend that civil conflicts are not due to ethnic or religious differences, but because there is a number of "opportunities for predation" (in Collier and Hoeffler, 1998), or as Fearon and Laitin (2003) put it, a group of "conditions that favor insurgency". Here, rebellion/insurgency is seen as a rational decision (and much frequent), as countries experiencing civil war have high levels of poverty (which favors rebel recruitment), weak political institutions (which increase opposition and reduces legitimacy) and large populations (the higher the population size, the higher the amount of opportunities and grievances). The dilemma that states face is that in order to protect its population and private property, the state must tax its citizens in order to invest in security and defend itself. On one hand, the state must not tax "too" much from its subjects as it may incur in discontent and lower economic growth rates (decrease private sector investments). On the other, the greater the tax revenue, the higher the risk the state faces from rebel predation, as it constitutes higher rewards from capturing the state. It is important to mention that although the benefits for rebels to organize and act violently are proportional to the available opportunities for rebellion, the costs for rebellion to organize, recruit members and fight also increase. Moreover, both studies expect

that countries with high levels of GDP per capita are less prone to rebellion, as costs for rebel recruitment become higher. In sum, these perspectives place less emphasis on ethnic/religious hatreds and differences, and see rebellion as economically motivated.

# CHAPTER 3 - Proposed Model

This essay's attempt to create a new model stems from the necessity to clarify the causal mechanisms that natural resources are said to have on civil war. Although the CH model clearly supports the greed approach, some of the economic variables used in the model also account for some of the observed grievances. Hence, they could not fully reject the grievance model. Nonetheless, the authors fail to account why in cases where the availability of resources is scarce, rebellion and civil war still occurs. This is will be our contribution to the model and literature on the topic.

Let us briefly explain what is at stance in this debate and reasoning behind the new model. The CH model represents the neoclassical idea of greed-resource abundance in explaining civil wars. Supporters of this 'honey pot' hypothesis contend that explanations for rebellions reside in the abundance of mineral resources, such as oil, diamonds, copper, timber, exemplified by the violent conflicts in Congo, Sierra Leonne, Nigeria and Russia, or the contraband of coca, coffee and tobacco in Africa and Latin America (Englebert and Ron, 2004; de Soysa, 2002; Fearon, 2005; Reynal-Queirol, 2002; Ross, 2006; Sachs and Warner, 2001). They contend that natural resources are a curse and that they have a decisive role in the existence and prevalence of violent civil conflicts. In order to test these claims, the following hypothesis was formed:

$H_1$= *Resource scarcity does not lead to civil wars*

Hence, $H_1$ implies that all the coefficients of the natural resources' variables are simultaneously equal to zero.

However, as pointed in this essay, there is another group of scholars, often called Neo-Malthusians that suggest just the opposite (Dasgupta, 1995; Homer-Dixon, 1999; Renner, 1996; Reuveny, 2002). They argue that resource scarcity leads to economic decline, erosion in government support, institutional crisis and exacerbates ethnic or religious tensions. All of the enumerated consequences increase grievances leading people to rebel and engage in violent protests (Diamond, 2005; Gleditsch, 2001; Hauge and Elligsen, 1998). Their argument becomes even more pertinent when we are dealing with renewable resources, such as arable land and water. Such renewables not only are important to human's survival, particularly in developing countries, but also a major source of employment. Thus, deprivation of such important resources leads to rebellion and civil war. For example, when water becomes scarce and land becomes infertile, economic declined is observed and people no longer can depend on the local environment to extract possible gains and therefore tend to migrate in search of better place to live. However, such 'better place to live' can be an ethnic or religiously different region from theirs and tensions over the share of the 'shrinking pie' may arise. (Homer-Dixon, 1999; Kahl, 2004; Klare, 2001). As a result of such possible scenario, governments may adopt policies to solve the problem, but those may be unpopular further exacerbating grievances.

*$H_2$= Resource scarcity is likely to lead to civil wars*

Hence, $H_2$ implies that the coefficients of the natural resources' variables are not simultaneously equal to zero.

Using two most popular arguments on the topic – greed and grievance – this essay will produce a combined model with variables that portray both arguments. In order to do so, it will use one of the most popular models on the topic, the CH model, and test it with new variables that can better portray the debate between the two contrasting views. The new variables

introduced to the CH model are water resources per capita, and total soil degradation in a country. These variables are included in the new model because they have been widely used in the literature and are said to portray the grievance-resource scarcity approach. Water per capita is expected to be negatively correlated with civil war. On the other hand, soil degradation is expected to be positively correlated with civil war. Following this logic, resource abundance is expected to decrease the likelihood of war, instead of increasing it as Collier and Hoeffler argued. Let us turn now to the research design.

# CHAPTER 4 - Research Design and Methods

To examine civil war occurrence, I have used Collier and Hoeffler (1998) dataset and a similar limited dependent variable model – Logit. Their war data includes civil war occurrence and nonoccurrence from the period of 1960 to 1999, collected by Small and Singer (1992) and updated for 1992-99. The variables introduced to the CH model - water per capita and soil erosion - were collected from Hauge and Ellingsen (1998), another major study on the causes of war. Their data on the environment-related variables were collected as part of the 'Causes and Dynamics of Conflict-Escalation', a joint research project between the International Peace Research Institute in Oslo, and the Department of Peace and Conflict Research, Uppsala University. Due to the fact that the two datasets have different time periods, and that environmental resources data is only available from 1980 onwards, I have decided to frame my replication dataset in 5-year periods, for 126 countries, from 1980 to 1995, assuming, in some cases, 1992 observations as 1995 values.

## Dependent variable

The dependent variable indicates whether episodes of civil war occurred during each 5-year period. It is coded 1 if civil war occurred and 0 if there was no civil war. Using Singer and Small's (1994) definition, it is considered to be a civil war episode any internal conflict that has at least 1,000 combat-related deaths per year.

# Independent variables

The independent variables used in this model are: primary commodity exports, secondary school enrollment, economic growth, time since previous conflict (peace duration), geographic dispersion, population size, social fractionalization, ethnic fractionalization, ethnic dominance, democracy, water resources per capita, and soil degradation.

Collier and Hoeffler (1998) argue that motives *per se* cannot account for rebel group formation. For a rebel group to form and pursue their agenda, they must have some sort of finance. But how do rebel organizations finance their rebellion? The authors consider two types of sources: resource extortion, and donations from diasporas[4]. Collier and Hoeffler (1998) operationalized resource predation as the share of *primary commodity exports* in GDP. These included the major commodities produced by each country, ranging from oil or diamonds extraction to agricultural goods[5].

According to Collier and Hoeffler (1998) the share of *primary commodity exports* to its GDP proxies the abundance of natural resources, meaning that it should positively correlated with civil war occurrence. However, with the inclusion of environmentally-related variables, we expect its influence on civil war to decrease, or even to have a negative coefficient.

Donations from diasporas, that is, emigrant support for rebel groups, is another source of finance, as donations constitute funds for rebel movements. This argument found support, for instance, in the case of the Tamil Tigers that were being funded by the Tamils in North America

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[4] In the later versions of their paper (2004; 2005), Collier and Hoeffler have also considered subventions from hostile governments as a critical element in the financing for rebellion. However, this not pertains to the original CH model, and therefore, it will not be analyzed here.

[5] As many have argued (Englebert and Ron, 2004; Fearon, 2005; Ross, 2004) not every commodity is related to civil war, however, the purpose of the CH model was to investigate if the countries' primary commodities are correlated with civil war initiation, whether they include drugs or live stock.

(Angoustures and Pascal, 1996). As previously mentioned, the second proxy for opportunities is the low cost of recruitment. But how do rebels recruit members and why do they follow? Almost every civil war considered in the study occurs in developing countries. The living standard in many these countries is well below a dollar per day, making desirable any situation of possible profit, thus making mobilization almost costless. The low cost of recruitment is controlled for secondary school enrollment, economic growth, GDP per capita and ethnic fractionalization. These quantitative indicators are argued to low the cost of recruiting. The first two, secondary school enrollment and GDP per capita, are highly correlated, thus the avoidance of including them together in the same model. The reasoning behind the inclusion of these variables is obvious, as they stand as indicators of development.

*School enrollment* is argued to be synonym of development and obviously, better qualifications. Low levels of school enrollment promote low cost rebel recruitment. We expect it to be negatively correlated with civil war, and positively correlated with economic growth. Using data from the World Bank Development Indicators, 1998, the authors measured male school enrolment rates as "the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown".

*Economic growth* was based on GDP per capita, highly correlated with secondary school enrollment, to calculate the average annual growth rate over the previous five years. We expect it to be negatively correlated with civil war.

*Social fractionalization*, as opposed to social cohesion, hinders a rebel group to function, especially if their "listing" process works on an ethnic or religious basis, as it reduces the recruitment pool. We expect social fractionalization to be negatively correlated with civil war. The fractionalization indices range from zero to 100, where a value of "zero indicates that the

society is completely homogenous whereas a value of 100 would characterize a completely heterogeneous society."

The fifth independent variable is *peace duration.* Collier and Hoeffler (1998) argue that the low cost of weapons facilitate rebellion. They operationalize the cost of weapons with the percentage of previous war episodes and peace duration, measured in months since the last conflict. The argument is that greater number of war episodes tends to reduce the cost of weapons, thus, it is expected that greater peace periods increase the cost of weapons. We expect it to have a negative relationship with civil war. In addition, we interpret longer periods of peace as decay in grievances. This variable is measured in months since the end of the previous civil war, and for countries which never experienced a civil war, since the end of World War II.

Both the grievance and greed approach see high levels of *geographic dispersion* as an inhibitor in the effective state control of its population. These approaches contend that a highly dispersed population limits the power of a state to uphold the law, thus civilians are subjected to the rule of local militias and rebel groups. Hence, we expect it to negatively correlated with civil war, as higher the population concentration, lower the likelihood of war – easier for the military to control the population. The authors constructed a dispersion index of the population for each country. A value of 0 indicates that there is a evenly distributed population, whereas 1 indicates that the total population is agglomerated in one major area. The data used was collected from the Center for International Earth Science Information Network, International Food Policy Research Institute, and World Resources Institute, 2000.

Risk of conflict is said to be proportional to population size, (*Ln population*). We expect it to be positively correlated with civil war. Using the same logic of Collier and Hoeffler on proportionality, we also interpret this as a proxy for grievance, as it is expected that the higher

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the number of civilians, the greater the grievances. The data source for total population is the World Bank Development Indicators 1998.

However, hatreds and tensions between ethnic or religious groups increase in highly fractionalized societies, thus lowering the cost of mobilization. The argument behind ethnic fractionalization in favoring low cost recruitment is that ethnic fractionalization enables greater elite mobilization through manipulation and stereotyping, thus increasing greater hatreds and resentments among the populace. Therefore, we expect *ethnic fractionalization* to be positively correlated with civil war, and negatively correlated with economic growth. Ethnic fractionalization is "measured by the ethno-linguistic fractionalization index: it measures the probability that two randomly drawn individuals from a given country do not speak the same language".

*Ethnic dominance* is expected to be positively correlated with civil war. Thus, the risk of conflict increases if a society becomes ethnically dominated. The CH model reported that in some cases both ethnic dominance and social fractionalization might be correlated with war. They interpret this as initial levels of social fractionalization, or diversity, in a ethnically dominated society will be present, but only have an effective role in civil war occurrence if diversity increases, decreasing ethnic dominance. The authors have calculated an indicator of ethnic dominance, using the ethno-linguistic data from the Atlas Narodov Mira, Department of Geodesy and Cartography of the State Geological Committee of the USSR, 1964. Ethnic dominance "takes the value of one if one single ethno-linguistic group makes up 45 to 90% of the total population and zero otherwise".

Political repression (*democracy)* was included in our regressions as it is prime in the grievance approach, as it is said to be object of many grievances and at the heart of civil wars

(Jaggers and Gurr, 1995; Esteban and Ray, 1994). This measure of political rights was used in the CH model but it was insignificant in the models that it was tested and therefore not included previously in our analysis and replication. Although it is not our primary goal to assess the role of political rights in civil war occurrence, rather to study how the scarcity of vital resources affects civil war occurrence, we decided to include it because of its wide use in the literature. We expect Political repression to be negatively correlated with civil war.

*Water*, particularly in developing countries, is of utmost necessity. Several accounts of civilians fighting for such valuable resource, for instance in the Middle East, leads to include it here. We expect it to be negatively correlated with civil war. This variable measures the average annual internal renewable water resources per capita, where high levels of availability are coded 0 (over 20.1 thousand cubic meters), average as 1 (between 5.1 and 20 thousand cubic meters), and low as 2 (1.1 to 5 thousand cubic meters). Data source: World Resources Institute, 1994.

*Soil degradation* is interpreted as a reduction in both arable land and water availability. In addition, soil degradation is of no use, leading people to look for other places and better conditions, possibly in different ethnic regions or with different religious beliefs, thus increasing grievances. We expect it to be positively correlated with civil war. Data source: Global Assessment of Soil Degradation, 1992.

## Methods

We collected data for all country 5-year periods in our data set (comprising data between 1980 and 1995, for 126 countries) and present descriptive statistics for all variables in table 1.1. Note that most of them have relatively high standard deviations, hence the dataset used on this study as a high degree of statistical dispersion. Succinctly, this leads to the conclusion that we

cannot make significant inferences about the mean of each variable because the data indicates that each observation is not necessarily clustered around the mean. It is noteworthy that Geographic Dispersion of the Population is the variable with the lowest relative level of standard deviation (soil degradation is the second lowest) for the overall sample and sub-samples, i.e., all countries, countries in "no civil war", countries in "civil war": 31%, 31%, and 24% of the mean, respectively. Note that the standard deviation is lower in the "civil war" scenario. Soil degradation is the second lowest relative level of standard deviation. For the variable peace duration the standard deviation is much higher in the "civil war" sub sample (96% of the mean) than in any other scenario. This is also true for the GDP *per capita* variable.

**Table 1.1 Descriptive Statistics**

| Variable | Sample (*n*=450) | Std. Deviation | No Civil War (*n*=417) | Std. Deviation | Civil War (*n*=33) | Std. Deviation |
|---|---|---|---|---|---|---|
| War starts | 0.073 | 0.260 | 0 | 0 | 1 | 1 |
| Primary commodity exports/GDP | 0.150 | 0.141 | 0.149 | 0.143 | 0.136 | 0.116 |
| Male secondary schooling | 53.71 | 31.61 | 54.68 | 31.70 | 39.14 | 24.60 |
| GDP *per capita* (average growth for previous 5 years) | 0.754 | 3.45 | 0.89 | 3.33 | -0.442 | 3.79 |
| Peace duration (months since last conflict) | 408.3 | 172.8 | 423.64 | 160.43 | 214.60 | 206.87 |
| Geographic dispersion of the population (Gini) | 0.610 | 0.187 | 0.605 | 0.187 | 0.617 | 0.147 |
| Religious fractionalization (index, 0-100) | 37.04 | 24.6 | 36.66 | 24.67 | 36.68 | 24.68 |
| Ethnic fractionalization (index, 0-100) | 41.85 | 29.1 | 40.86 | 28.78 | 52.86 | 28.33 |
| Ethnic dominance (% with main ethnic group 45-90%) | 0.464 | 0.499 | 0.468 | 0.499 | 0.482 | 0.502 |
| Water *per capita* | 1.28 | 0.860 | 1.29 | 0.85 | 1.32 | 0.84 |
| Soil degradation | 2.10 | 0.765 | 2.08 | 0.76 | 2.35 | 0.73 |

In order to assess the role of these explanatory variables on the likelihood of civil war, 3 different logit regressions will be presented. The first is the baseline model from Collier and Hoeffler (1998) plus political repression (*democracy*). As already stated, themain reason to include it in our analysis is due to the fact that weak political rights are said to promote

grievances. Moreover, we expect it to further validate our resource scarcity hypothesis as deprivation of vital natural resources may foster civilian discontent over government's social and economic policies. Then, in our second regression we will introduce the variables we argue to portray the resource scarcity argument, water per capita and soil degradation to the CH baseline model. The third regression will test the variables on greed, primary commodity exports and its square (to account for nonlinear relationship), male secondary school enrollment, economic growth, peace duration, geographic dispersion, population size and social fractionalization with those we argue to represent the scarcity argument. Our fourth regression will test grievance-related variables, peace duration, geographic dispersion, population size, social fractionalization, ethnic fractionalization, ethnic dominance, and democracy with those on the scarcity argument.

# CHAPTER 5 - Replication of the CH Model

In order to test their theoretical argument, Collier and Hoeffler (1998) constructed two brief models that included the economic variables said to account the greed-led motivations, and those often enumerated by the grievance approach. The results obtained by the opportunity model are greatly tuned with the 'greed' hypothesis. Although mountainous terrain (safe haven for rebels), previous war episodes (since 1945), and donations from diasporas are insignificant, all other variables that portray the greed approach - primary commodities, secondary school enrollment, economic growth, GDP per capita, and peace years - are highly significant and with the expected sign. Prime in Collier and Hoeffler (1998) explanation for rebellion is that primary commodity exports has a significant role in explaining civil war occurrence and that this relationship is non-linear, which further increases its relevance. In particular, Collier and Hoeffler (1998) advocate that the risk of conflict reaches its peak when primary commodity exports constitute 32 percent of Gross Domestic Product. It is noteworthy that if a country is experiencing such ratio then it is highly dependent on international trade, as 32 percent of its Gross Domestic Product comes from selling those commodities to foreign countries.

It is also important to mention that the authors introduced an 'oil versus nonoil scenario' in order to assess if a change in oil versus nonoil dependence could alter the probability of a war. They concluded that oil has the same effects as other commodities, but a low level of oil dependence has fewer risks than high levels of dependence. Other critical indicators for rebellion, school enrollment and economic growth, are also significant at the 95% level and with the expected sign.

From the coefficients on 'grievance' only ethnic dominance and ethnic fractionalization are significantly correlated with civil war. Ethnic fractionalization does facilitate recruitment but high levels of social fractionalization (religious and ethnic fractionalization added together) may hinder the rebel organization to function. An attempt to create a homogenous and cohesive group in a highly fractionalized society may be difficult as social fractionalization reduces the recruitment pool. Nevertheless, the authors interpreted high levels of ethnic fractionalization as proxy for hatred and resentment between elites and populace, thus facilitating rebel recruitment. Ethnic dominance wears a nonlinear character, i.e. a homogeneous society is likely to become ethnically dominated, but higher levels of diversity have a reversed effect on the occurrence of civil war[6]. Therefore, the probability of war starts in an ethnically dominated society is high. Other proclaimed variables on grievances - inequality, political rights, ethnic polarization, and religious fractionalization - were insignificant.

It is also important to mention that the risk of conflict is proportional to population size. Its use throughout the models proved it to be important, as it is significant and supports the theoretical argument that the higher population, the higher the risk of conflicts. This idea is coherent with both 'resource abundance' and 'resource scarcity' arguments. The higher the population size, the higher the amount of opportunities and grievances. Nevertheless, the authors have suggested that the likelihood of population size to intervene in the risk of civil war is higher in a 'resource abundance' scenario.

Let us turn now to the replication[7] of the study by Collier and Hoeffler (1998). Of the seven potential models presented by Collier and Hoeffler, I selected those 3 models with the

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[6] Diversity has positive effect in the reduction of dominance but at a certain amount.

[7] The dataset for replication was available through Anke Hoeffler's web page, at
http://users.ox.ac.uk/~ball0144/g&g.zip

highest number of statistically significant coefficients. Then, I proceed by assessing the significance of those variables on a new dataset (comprising data between 1980 and 1995, for 126 countries), and ultimately, test if the model fails to explain civil war, i.e., if we fail to reject the null hypothesis: all coefficients of the CH model are equal to zero.

The results of the logit regressions are reported in Table 2.1. As shown in the first model (column 1), every variable, except GDP growth and peace duration, failed to have significance. This may be due to the fact that both $N$ and number of wars have been reduced, from 665 (CH) to 354 (new dataset). However, models 2 and 3 suggest that that might not be relevant in our case. Peace duration significance at 5 percent level and expected sign may be interpreted as a reduction in conflict-induced grievances, however, it also supports the opportunity argument.

**Table 2.1 Combined opportunity and grievance model**

| Variable | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Primary commodity exports/GDP | 8.4693 | 41.07*** | 27.938** |
|  | (6.975) | (17.89) | (15.583) |
| (Primary commodity exports/GDP)$^2$ | -10.470 | -94.816** | -66.380* |
|  | (13.16) | (47.73) | (45.943) |
| Male secondary school enrollment | -0.015 | -0.030** | -0.023* |
|  | (0.012) | (0.017) | (0.012) |
| (GDP Growth) t-1 | -0.126** | -0.069 | -0.147** |
|  | (0.066) | (0.093) | (0.067) |
| Peace duration | -0.004** | -0.002 | -0.004*** |
|  | (0.002) | (0.0018) | (0.001) |
| Geographic dispersion | -0.930 | -1.7572 | -1.349 |
|  | (1.426) | (2.032) | (1.546) |
| Ln population | 0.293 | 0.672** | 0.642** |
|  | (0.252) | (0.322) | (0.296) |
| Social fractionalization | -0.00009 | -0.0004 | -0.0002** |
|  | (0.0001) | (0.0005) | (0.0001) |
| Ethnic fractionalization |  | 0.009 |  |
|  |  | (0.028) |  |
| Ethnic dominace (45-90%) |  | 2.10* | 0.038 |
|  |  | (1.32) | (0.531) |
| Primary commodity exports/GDP x oil dummy |  |  | -18.011* |
|  |  |  | (11.779) |
| (Primary commodity exports/GDP x oil dummy)$^2$ |  |  | 58.702* |
|  |  |  | (42.974) |
| N | 354 | 257 | 330 |
| No. of wars | 33 | 33 | 33 |
| Chi$^2$ test | 0.0000 | 0.0187 | 0.0000 |
| Log-likelihood | -66.07 | -44.98 | -59.38 |

*Note:* All regressions include a constant. Standard errors are in parentheses.
***, **, * indicate significance at the 1, 5, 10 percent level, respectively, in one-tailed test.

Model 2 has fewer observations, and still, the variables presented have become significant. The indicator for the financing of rebellion, primary commodity exports, and its squared are significant at the 5 percent level. CH advocates that the risk of conflict reaches its peak when primary commodity exports constitute 32 percent of Gross Domestic Product. However, our model 2 suggest that it may reach its peak when primary commodity constitute 22 percent of GDP, meaning that if a country experiences such ratio then it is highly dependent on international trade, as 22% of its GDP comes from selling those commodities to foreign countries. Surprisingly, indicators for low cost recruitment, male secondary school enrollment, economic growth and ethnic dominance, are all only marginally significant. Similarly to what was reported by the CH model, ethnic fractionalization is insignificant. As suggested by the authors and reported in Table 2.1, the greed approach finds reasoning in such results, i.e., we fail to reject the null hypothesis mentioned above, namely for model 2. Surprisingly, geographic dispersion is insignificant. Widely cited as a major inhibitor of state action, it was expected it to be significant and positively correlated with civil war. Population size is significant at the 5 percent level and with the expected sign. Social fractionalization was significant in all 3 selected models from Collier and Hoeffler, here, however, is only at the 10 percent level in model 3. Although, the chi-square test suggests a strong explanatory power for model 2, its log-likelihood suggests otherwise. There was an increase in the number of significant variables from model 1 to model 2, however, based on its log-likelihood we cannot say that there was significant improvement as model 2 has a lower log-likelihood.

Model 3, on the other hand, has a higher explanatory power (log-likelihood) than model 2. In line with the greed approach, primary commodity and its square are significant at the 5 and 10 percent level, respectively. This model suggests that the risk of conflict reaches its peak when

primary commodity exports constitute 30 percent of GDP, which is close to the 32 percent reported in CH. Of all indicators for low cost recruitment, only male secondary school enrollment and economic growth are significant at the 10 percent level. Ethnic dominance and geographic dispersion are insignificant. Favoring both 'greed' and 'grievance' arguments, peace duration was significant in 4 out 7 models reported in their study. Here it is significant at the 1 percent level in column 3. Population size is significant at the 5 percent level and with the expected sign. Social fractionalization is significant in all 3 selected models from Collier and Hoeffler, here, however, is only at the 10 percent level in column 3. It is important to note that ethnic fractionalization was originally excluded by CH in order to increase the number of observations. The authors introduced an 'oil versus nonoil scenario' in order to assess if a change in oil versus nonoil dependence could alter the probability of a war. They concluded that oil as the same effects as other commodities, but a low level of oil dependence has less risks than high levels of dependence. Its significance in model 3, further validates their argument. The chi-square test suggests a strong explanatory power of the models used.

The CH model stands as a major critic to the grievance argument widely supported within the field of political science. However, in order to fully reject the grievance approach we need to go beyond variables such as ethnic and religious fractionalization to incorporate other widely used grievance-related variables. Certainly, social fractionalization (ethnic and religious fractionalization), geographic dispersion and ethnic dominance cover a great amount of the argument, but it is not exhaustive. From the wide literature on civil wars, it is this essay's argument that the authors overlooked one critical element: in some cases, civil war occurrence is not caused by the abundance of resources; rather at heart of many civil wars we find that grievances provoked by resource scarcity increase the likelihood of civil war. It is true that oil

and diamonds are abundant in Africa and that such resources have been cursing those peoples to fight against each other. However, it is also true that water and arable land is major issue in the Middle East, having originated rebellion and violent civil strife.

As suggested earlier, the 'resource scarcity' argument founds theoretical support in the grievance approach because in a resource scarcity scenario, renewables such as arable land and water become oddly distributed among the population or at least leads to greater deprivation. Thus, such deprivation is object of grievances, which can be increased if other relevant factors such as inter-group tensions or political repression exist. Such specific conditions are said to lead to civil war. Another reason for us to somewhat merge resource scarcity and grievance approaches lies on the fact that, according to Collier and Hoeffler (1998), civil war occurrence is motivated by greed. Thus, it is hard to speculate that scarce resources such as arable land and water would motivate greed behaviors as does the abundance of oil or diamonds. Moreover, it is not feasible to *export* arable land or water, as other primary commodities are. It should be pointed out that we are not trying to discredit the greed approach. In fact, our results in Table 1.1 show that the greed approach has more explanatory power. We propose ourselves to see the role of scarce resources, particularly, water and arable land, in the occurrence of civil war. Since, evidence supports our claims (Hauge and Ellingsen, 1998; Homer-Dixon, 1994; Gleditsch, 2001) that the deprivation of scarce resources might induce civil war occurrence, and also due to the fact that our variables were not included in the CH model, it becomes pertinent to test them under the CH model on civil war. We now turn to a new model proposed in this essay.

The next section tests our two hypotheses:

$H_1$= *Resource scarcity does not lead to civil wars*

$H_2$= *Resource scarcity is likely to lead to civil wars*

# CHAPTER 6 - Environmental Scarcity and the CH Model

As we have hypothesized, resource scarcity may impact the likelihood of civil war, thus $H_1$ is rejected, as at least one of the coefficients for the resource scarcity variables is statistically significantly different from zero in the logit regressions number 2, 3 and 4, shown in Table 3.1 - note that the number of observations varies for each regression because some were dropped due to the lack of data. Although we do confirm that the greed argument has more explanatory power, we cannot, nor Collier and Hoeffler, fully reject the grievance argument. Furthermore, results in Table 3.1 suggest that we should not exclude soil degradation and water resources variables from a model on civil war. We have used multicollinnearity detection methods in all models as suggested by Farrar and Glauber (1967). The diagnostics results show a Variation Inflation Factor below 10, which as rule of thumb indicates no harmful collinearity.

**Table 3.1 Proposed Model**

| Variable | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Primary commodity exports/GDP | 28.231** | 41.869** | 4.390 | |
| | (15.571) | (21.393) | (6.089) | |
| (Primary commodity exports/GDP)$^2$ | -66.95* | -121.8* | -5.155 | |
| | (45.83) | (76.85) | (11.22) | |
| Primary commodity exports/GDP x oil dummy | -18.46* | -29.417** | | |
| | (11.834) | (16.364) | | |
| (Primary commodity exports/GDP x oil dummy)$^2$ | 59.335* | 112.61* | | |
| | (42.985) | (72.971) | | |
| Male secondary school enrollment | -0.022** | -0.022* | -0.014 | |
| | (0.013) | (0.015) | (0.012) | |
| (GDP growth) t-1 | -0.142** | -0.151** | -0.111* | |
| | (0.068) | (0.070) | (0.063) | |
| Peace duration | -0.004*** | -0.003*** | -0.005*** | -0.004*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Geographic dispersion | -1.310 | -1.960 | -1.135 | 0.078 |
| | (1.544) | (1.738) | (1.550) | (1.310) |
| Ln population | 0.653** | 0.834*** | 0.281* | 0.203* |
| | (0.299) | (0.323) | (0.194) | (0.150) |
| Democracy | -0.030 | -0.077 | -0.046 | -0.101* |
| | (0.083) | (0.090) | (0.078) | (0.067) |
| Social fractionalization | -0.0002** | -0.0002** | | 0.00005 |
| | (0.0001) | (0.0001) | | (0.0001) |
| Ethnic dominance (45-90%) | 0.034 | 0.404 | | 0.294 |
| | (0.532) | (0.585) | | (0.462) |
| Ethnic fractionalization | | | | -0.00006 |
| | | | | (0.122) |
| Water per capita | | -0.456 | -0.360 | -0.519** |
| | | (0.359) | (340) | (0.290) |
| Soil degradation | | 0.809** | 0.690** | 0.562** |
| | | (0.424) | (0.378) | (0.324) |
| N | 330 | 323 | 351 | 401 |
| No. of wars | 33 | 33 | 33 | 33 |
| Chi$^2$ test | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Log-likelihood | -59.31 | -54.72 | -64.41 | -83.14 |

*Note:* All regressions include a constant. Standard errors are in parentheses.
***, **, * indicate significance at the 1, 5, 10 percent level, respectively, in one-tailed test.

In our baseline model, model 1, primary commodity exports and its square are significant at the 5 and 10 percent level, respectively, with the expected sign. This suggests that we can be 95% confident that primary commodity exports have a significant effect on the outbreak for rebellion. It also shows that the risk of conflict reaches its peak when primary commodity exports constitute only 30 percent of GDP. However, we were not able to assess the role of oil[8] in the outbreak of civil war, as it was insignificant (not reported here). Male secondary school enrollment is significant at the 5 percent level and with the expected sign. As suggested by Collier and Hoeffler (1998) low levels of education tend to reduce the cost of rebel recruitment. With the expected sign, economic growth was significant at the 5 percent level in column 1. Its negative relationship with civil war, once again, proved that high levels of development tend to increase welfare, thus, making war costly and imprudent. Similarly to Collier and Hoeffler's (1998) findings, peace duration was significant at the 1 percent level. As suggested by the authors, time heals. Its negative sign confirms the theory behind it, that is, not only peace promotes fewer tendencies for conflict and tensions, but also it discourages people to fight violently (including the use of weapons). Surprisingly, geographic dispersion was insignificant in all models. Population growth was significant at the 5 percent level. This lends support for both the greed and grievance approach, that is, conflict risk is proportional to population size. Social fractionalization is significant at the 5 percent level and with the expected sign, proving that high levels of social fractionalization hinder a rebel group to function and reduces the recruitment pool. Ethnic dominance and democracy were both insignificant but with the expected sign. The chi-square test suggests a strong explanatory power.

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[8] We have created a dummy variable for oil and test it in our regressions. We have found that it was insignificant in all models tested.

The second model adds our variables to test the two proposed hypotheses. Although the number of wars (33) was the same, our number of observation was reduced to 323. In model 2, primary commodity exports is significant at the 5 percent level, and the role of oil in civil war occurrence is significant at the 5 percent level. Secondary school enrollment is significant at the 10 percent level, and both economic growth and social fractionalization were significant at the 5 percent level. Peace and population size are significant at the 1 percent level. Finally, water per capita is insignificant but with the expected sign, and soil degradation is significant at the 5 percent level. All other variables were insignificant. The chi-square test suggests a strong explanatory power.

In the third model, we dropped the oil dummy due to sample size, and grievance-related variables, social fractionalization, ethnic fractionalization and ethnic dominance. By doing so, we were able to have a small increase in the number of observations. Here, we wanted to test only those variables on greed with the ones on scarcity. From this model, we highlight the high significance of peace duration (1 percent level), economic growth (5 percent level), soil degradation (5 percent level) and population size (10 percent level). CH main argument, that is, primary commodity exports has a significant role in explaining civil war occurrence and that this relationship is non-linear, proved to be flawed in our third model – they lost significance. Male secondary school enrollment, geographic dispersion, social fractionalization, water per capita and democracy are also insignificant. In addition, both chi-square test and its log-likelihood proves this model has strong explanatory power, and that there was a significantly improvement in contrast with all previous models.

Our fourth model tests the effects of the grievance-related variables, peace duration, geographic dispersion, population size, social fractionalization, ethnic fractionalization, ethnic

dominance and democracy with those on the scarcity argument, water per capita and soil degradation on civil war occurrence. Not only there was an improvement of the model, but also our critical variables significant to back up our theory. Peace duration is significant at the 1 percent level, population size and democracy at the 10 percent level, and water per capita and soil degradation significant at the 5 percent level and with the expected signs. As previously mentioned, these variables stand as the basis of the grievance-scarcity argument, that is, high periods of peace and fairly distributed water resources have a positive effect in the reduction of grievances and civil wars. It is also important to mention that we were able to increase the number of observations (401) and that the chi-square test suggests a strong explanatory power. Moreover, the model's high log-likelihood not only shows an improvement to the previous models, but also proves it to be the best model.

Collier and Hoeffler (1998) argued that primary commodity exports have a significant role in explaining civil war occurrence and that this relationship is non-linear, which further increases its relevance. In particular, Collier and Hoeffler (1998) advocate that the risk of conflict reaches its peak when primary commodity exports constitute 32 percent of Gross Domestic Product. Although we were able to replicate and our results back up their theory, our models on greed (model 3) and grievance (model 4) disprove their claims, as the variables used in the CH model, which this thesis was able to replicate, are not significant in my dataset. Even though model 2 has larger number of significant variables, its explanatory ability (log likelihood) is not as powerful as model 4. The results attained in Table 3.1 further validate our claims initial claims. Soil degradation and water per capita significance in our fourth model supports our argument that scarcity of vital resources for human survival increases the likelihood of conflict,

thus its inclusion in a model on civil war seems to be important for the explanation of its frequent

occurrence.

# CHAPTER 7 - Conclusion

We have briefly reviewed the two main approaches on civil war in the literature. Both the greed and grievance theoretical arguments have been supported by a variety of qualitative and quantitative studies. However, the greed approach has gained much of the scholarly attention as it challenges a major approach to civil war - the grievance approach. With an emphasis on opportunities, rather than on demand for rebellion, Collier and Hoeffler (1998) have argued that rebellion can be explained through economic terms. They argue that civil war occurs due to a group of economic opportunities available that rebels, cleverly, use to finance their activities and pursue their agendas. These include the predation of natural resources, low cost in recruiting and mobilizing members, and cheap weaponry. In sum, the authors contend that these economic opportunities seem to be abundant in the countries analyzed, and therefore, they represent explanations for rebellion.

We have also successfully replicated one the most important econometric models on civil war, the CH combined opportunity and grievance model. By doing so, not only were we able to see its 'fit', but also to test two new variables said to portray the resource scarcity approach on civil war occurrence. The inclusion of these variables lies on the fact many observers have been arguing that the scarcity of valuable resources leads to economic decline, weak government support and institutional crisis, which further exacerbates greater grievances, and such grievances are at the heart of many civil wars (Kahl, 2004; Merrick, 2002; Sprinz and Vaahtoranta, 1994; Schawartz and Singh, 1999).

Although the resource scarcity may find support in the grievance argument, we are not suggesting that we should abandon the view of rebellion as motivated by greed, in fact, our

model further validates the CH argument. What we are suggesting, however, is that when vital resources become scarce, civil war is likely to occur. Collier and Hoeffler argue that the existence, or abundance, of natural resources is likely to lead to civil war, but as our results suggest, the same result can occur when arable land and water resources become scarce. Furthermore, our results back up what we initially have suggested, that is the CH model overlooked one critical element: the scarcity of vital resources is a source of discontent and violent protests, and therefore we should include it in any model that attempts to look for explanations on the occurrence of civil war.

Given the results obtained in Table 3.1, it is plausible that both greed and grievance approaches explain civil war, as they constitute reasons for rebellion in different countries. Nonetheless, resource scarcity cannot be neglected by either theory. Unfortunately, we are unable to fully close this debate, and more research must be done. Much of it is due to the fact that environmentally-related variables have only been collected in the last 20 years or so. Should we have more periods to analyze, particularly in developing countries, we might have reached to a different conclusion, and, perhaps, come to an agreement on the factors leading to civil war.

I would like to mention that it is my intention to further research this issue, particularly the threshold on scarcity and abundance of resources. Furthermore, once we delineate such threshold we could investigate if resource scarcity influences human behavior in the same way worldwide, or if some changes occur according to ethnicity or religious beliefs.

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