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The relationship between natural resources and armed conflict onset: "It's complicated"

A quantitative analysis of how natural resources affect internal armed conflict onset during the period 1950-2003.

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Abstract

The thesis examines how natural resources affect internal armed conflict onset through a quantitative analysis of data on 167 countries covering the period 1950-2003.

Previous research on the relationship between natural resources and armed conflict has often not focused thoroughly on explanations. This thesis seeks to rectify this by focusing on classifying natural resources, and by focusing on the purported mechanisms that are argued to link natural resources and armed conflict onset, namely those focusing on the state, and those focusing on rebels and their motivations and opportunities. This is done through a random-effects panel data model, as well as a "novel hybrid approach" combining some of the previously aspects of the previous dominant fixed –and random effects models.

The thesis' central findings are that classifying natural resources is vital in understanding how they affect armed conflict onset. Among the included natural resource measures, oil, drugs and diamonds, drugs and diamonds are in part found to affect armed conflict onset. Furthermore, the thesis gives support to the notion of natural resources mainly affecting armed conflict onset through their effect on the state and its institutions.

The thesis implies that research on natural resources and internal armed conflict onset, as well as policies directed at hindering armed conflict onset, perhaps should focus more on state institutions than have previously been the case.

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1.0 Introduction

"If you wish for peace, understand war."

\- B. H. Liddell Hart in *Strategy* (1967)

1.1 Conflict over resources?

The last decades have seen conflicts moving away from being international conflicts, pitting states against states, towards internal armed conflicts, pitting states against their inhabitants, and inhabitants against each other. Internal armed conflict is today the dominant form of conflict, bringing detriment wherever they occur, to humans as well as their environment. In addition to the direct loss of life and limbs, internal armed conflicts have been linked to poverty, environmental degradation, and severe human rights violations (Hanlon and Yanacopulos 2006). Understanding where and why internal armed conflict conflicts occur is therefore of huge interest and importance. Indeed, the richness of the academic research on peace and conflict is a testament to this. Research on peace and conflict encompass works from scholars of a wide variety of disciplines, from anthropology to economy.

This richness also poses problems, as scholars from different disciplines often do not speak the same language. There are disagreements of what constitutes a conflict, and even more so on what causes them. It is becoming increasingly apparent that there is no single predominant cause of conflict. Instead, conflict is better understood as being caused by an array of factors (Hanlon and Yanacopulos 2006). Among these factors, natural resources have risen to prominence during the past ten years, largely due to the seminal work of Collier and Hoeffler (1998, 2004).

Collier and Hoeffler found primary commodities to be an important factor in causing internal armed conflict, and argued that this is largely due to the high value attached to them, causing them to be an attractive target for "greedy rebels". Collier and Hoeffler's finding sparked a lot of attention from the academic community, as well as international actors invested in peacekeeping. As a result, much literature on the relationship between natural resources and armed conflict onset has been produced in the past decade. In spite of this, no clear answers on the relationship have emerged. Some argue that only oil, and not natural resources in general, affect armed conflict onset (Ross 2004). Others claim that what matters is how *dependent* a country is on natural resources (Basedau and Lay 2009, Le Billion 2008). There is even more disagreement on the mechanisms linking natural resources to armed conflict onset (Humphreys 2005, Ross 2004a, Ross 2004b, Lujala 2010). Some argue that natural resources lead to conflict through their effects on the state (Fearon and Laitin 2003, Di John 2007, Basedau and Lay 2009), while others argue that they work through their effect on rebels' motivations and opportunities (Collier and Hoeffler 2004;2009, Ross 2004a).

This thesis seeks to clarify the relationship between natural resources and armed conflict onset, and in doing so, provide a clearer understanding of internal armed conflict in general. Hence, the thesis examines the following research question:

"How do natural resources affect internal armed conflict onset[1]?"

1.2 Why study the relationship between natural resources and armed conflict onset?

Studying the relationship between natural resources and armed conflict onset is interesting both from an academic perspective, as there are still a lot of unanswered questions, as well as from a policy perspective. Understanding how natural resources affect armed conflict onset can contribute to understanding why resources in some cases go hand in hand with a healthy and wealthy democracy, as has arguably been the case in Norway and Botswana, while in other cases appear to coexist with permeating conflict, as in the Republic of Congo and Burma.

Understanding how states can manage their resources in a healthy and sustainable manner can contribute to creating policy initiatives that can help build and maintain peace. In line with King, Verba and Keohane (1994), studying the relationship between natural resources and armed conflict onset can make an important "real world" contribution, as well as a scholarly contribution by increasing our ability to understand a relationship that is not yet sufficiently understood.

1.3 The contributions of the thesis

While the data on, and the study of, the relationship between natural resources and armed conflict has developed rapidly in the last ten years, no clear results have

[1] The denotation "Armed conflict" is also used throughout the thesis to refer to *internal* armed conflict.

emerged. In spite of this, there has arguably been a shift from viewing natural resources as having a more direct effect on armed conflicts, to viewing them as mainly affecting armed conflicts indirectly through enabling unstable environments that can facilitate conflict.

Accordingly this thesis provides three main scientific contributions. Firstly, the thesis aims to put attention to, and further the classification of natural resources. While there is a large literature on the relationship between natural resources and armed conflict onset, there is comparatively little work on classifying, and thereby understanding, natural resources. Secondly, by focusing on the mechanisms that have been argued to link natural resources to armed conflict onset, the thesis aims to contribute to understanding not only *if*, but *how* natural resources relate to armed conflict. Thirdly, by utilizing a relatively novel method of approach, the thesis seeks to provide a clear methodological framework, utilizing a reliable dataset that can contribute to clarify some of the differencing conclusions that have been reached on the relationship under study.

Firstly, there has been a tendency to view natural resources as comprising a unified set of items, while in reality natural resources inherently differ in their physical and social characteristics. This thesis therefore aims to provide a more complete and transparent classification of resources by evaluating resources in terms of their *lootability*, *legality*, and *obstructability*. Lootability refers to how easily a resource is to acquire by an unskilled worker, and obstructability to how easily a resource's transportation can be hindered. Legality signifies a resource´s legal status as an international commodity. In other words, how easily a commodity can be sold on international markets.

Secondly, by focusing on the purported mechanisms that are argued to link natural resources to armed conflict onset, the thesis aims to clarify why resources in some cases appear to be related to prosperity, while in other cases seem to hinder it. This is also done in order to take into account the widespread criticism of too much focus on correlations rather than explanations in studies of the relationship between natural resources and armed conflict onset. Hence, the thesis presents and evaluates the arguably two main dimensions of mechanisms purportedly linking natural resources to armed conflict onset, the state and its institutions and rebel's motivations and opportunities respectively.

Thirdly, by employing a relatively novel methodological approach the thesis contributes to enlighten some of the methodological inconsistencies of previous research. The method of approach denoted as a hybrid –or unified model, combines some of the benefits of both fixed –and random effects models, which have previously been widely used in studies of armed conflict onset.

1.4 The structure of the thesis

Chapter two contains four main sections. The chapter starts by providing an overview of the literature on the relationship between natural resources. Here oil, diamonds, and drugs are found to be the most relevant resources for the thesis' research question. The second part of the chapter gives an account of why classifying natural resources is imperative, identifying lootability, legality, and obstructability as central dimensions of classification. The third part of the chapter examines the purported mechanisms linking natural resources to armed conflict onset. Here two main categories are identified, those who focus on the state and its institutions, and those who focus on rebels and their motivations and opportunities. The chapter ends with an overview of the other factors that have been identified as being the most important predictors of armed conflict onset: economic growth and development, level of democracy, instability, ethnic diversity, size of population, neighboring conflict, and the percentage of mountainous area in a country.

Chapter three provides an overview of the thesis' data. Chapter three starts with a presentation of the data utilized in the thesis' analysis, opening with a discussion of the UPSALA-PRIO armed conflict dataset (Gleditsch et al. 2002). This is followed by an overview of the data on the natural resources, oil, drugs, and diamonds respectively. This is followed by a presentation of the control variables.

Chapter four presents the thesis' methodological framework. The presentation starts by giving an account of logistic regression analysis of dichotomous dependent variables. This is followed by a discussion of the benefits and issues involved in utilizing panel data, where the same units are studied over time. A discussion of the hybrid model, combining some of the benefits of the previously widely applied fixed and random-effects models, is given next as a solution to some of the issues involved in analyzing panel data. The chapter ends with a discussion of accounting for time and inclusion of interaction effects in statistical models.

The fifth chapter presents the thesis' empirical analysis and results. The chapter starts by providing an overview of the pertinent descriptive statistics on the relationship between natural resources and armed conflict onset. This is followed by a presentation of the estimated hybrid model, which indicates that the assumptions of the random-effects model are upheld, and that the random-effects model is therefore more efficient and applicable. Subsequently, the explanatory models are presented. This section presents two sets of models, one based upon dummy variable measures of resource production, and the other on continuous measures of resource production. The models indicate that of the included resource measures only primary and secondary diamonds significantly affect armed conflict onset. Furthermore, primary and secondary diamonds are found to work in opposite directions, with secondary diamonds increasing the likelihood of experiencing armed conflict onset, and primary diamonds reducing it. Additionally, an interaction between natural resources, in form of secondary diamonds and drugs, and state capacity is found to significantly affect armed conflict onset, although it is noted that this requires further investigation. The sixth, and final, chapter concludes.

2.0 The obfuscated relationship between natural resources and armed conflict

Previous studies have found natural resources to be linked to armed conflict onset. This thesis seeks to expand upon previous research by not only examining *if*, but also *how*, natural resources affect armed conflict onset. In order to do this three main considerations are central. Firstly, it's not readily apparent what constitutes a natural resource and why. In order to examine the relationship thoroughly then, a greater understanding of natural resources is desirable. Secondly, if natural resources affect armed conflict onset, why is this the case? In other words, which mechanisms are at place linking natural resources to armed conflict? In order to understand how natural resources affect armed conflict onset, focusing on mechanisms is therefore fruitful. Lastly, it is unlikely that natural resources are the only factors to affect armed conflict. A satisfactory examination of the relationship therefore also needs to identify, and control for other factors that might explain the relationship. This chapter sets out to explore how these considerations can be taken into account within a quantitative analysis of the relationship between natural resources and armed conflict onset.

2.1 Overview

The relationship between natural resources and armed conflict has garnered attention in the past ten years partly due to better and more available data, and partly as a result of more refined theory on the "resource curse" (Collier and Hoeffler 2004, Di John 2007, Fearon and Laitin 2003, Ross 2004b, Snyder and Bhavnani 2005, Brunnschweiler and Bulte 2009, Fearon 2005, Le Billon 2001). There is however no consensus on how this relationship transpires or which mechanisms are in place. My focus in this section will hence be threefold.

Firstly, I will give an overview of previous research on the relationship between natural resources and armed conflict and their empirical results focusing on oil, diamonds, and drugs respectively. Secondly I will look at the classification of natural resources. Many previous studies on the relationship between natural resources and armed conflict have neglected classification of resources, which risks diluting analytical results. Thirdly, in order to take into account the lack of clear results, and oft-mentioned criticism regarding the lack of focus on *explanations*, I will focus on mechanisms. Lastly, the chapter presents an overview of the most pertinent factors that have previously been found to be linked to armed conflict onset, and which will serve as the foundation for the thesis' control variables.

2.2 Oil, drugs, and diamonds. The evidence to date.

Several types of resources have been examined in connection with conflict. Most have been rejected as insignificant. Some are difficult to study due to the unavailability of data. The effects of oil, diamonds, and drugs, however, are still actively debated. In this section I will therefore give an overview of the empirical findings on the effects of the respective resources. I will start by giving an account of the effect of oil, which has mostly been found to increase the likelihood of conflict, followed by an overview of diamonds and drugs, where the effects have been found to be more uncertain.

2.2.1 Oil

Arguably one of the more robust results in the armed conflict literature is that oil wealth -or abundance is linked with the onset of armed conflict. Fearon and Laitin (2003), for example, find that a dependence on fossil fuel exports increases the likelihood of civil war onset by 10 percent (Fearon and Laitin 2003:85-86). This result is significant in all of their models, even while controlling for the disproportionate Middle-Eastern oil producers (Fearon and Laitin 2003:86). In a follow up paper, expanding on and testing the previous results, Fearon (2005) reaches the same conclusion. He finds oil to increases the risk of armed conflict by a substantial amount.

Fearon and Laitin are not alone in their conclusions on the role of fossil fuels in conflict. In a series of papers regarding the role of natural resources in politics, Ross (2001, 2004a, 2004b, 2006) finds that oil wealth is one of the more robust predictors of armed conflict. This is supported by several other studies using different data and measurements of oil wealth (Besley and Persson 2008, Lujala 2010, de Soysa and Neumayer 2007, Theisen 2008, Dube and Vargas 2007, Buhaug and Rod 2006, Buhaug 2006). It has therefore been argued that oil wealth is one of the more robust predictors of armed conflict. While oil thus seems to be an important predictor of conflict there has been increasing calls for reconsideration of this link.

Hegre and Sambanis (2006) find oil to be linked to conflict, but point out that in their analysis this only holds true for smaller armed conflicts and hence question the robustness of the oil-conflict link. They do however note that this might be a result of unsatisfactory proxy variables. Buhaug (2006) also finds the size of a conflict to moderate the effect of oil on conflict.

Other researchers question the link between oil and conflict altogether (Smith 2004, Di John 2007, Alexeev and Conrad 2009, Watts 2007, Murshed and Tadjoeddin 2007, Basedau and Lay 2009, Dube and Vargas 2007, Obi 2010). It is frequently argued that findings on the link between oil and conflict are due to common methodological errors and inconsistency, and that these findings are a matter of spuriousness rather than robustness (Obi 2010)

The lack of coherent results might, on the other hand, be related to a lack of disaggregation and proper classification of oil. Lujala (2010) argues that it is important to consider the location of production when examining the oil-conflict link. Offshore oil is significantly harder for rebels to access than onshore oil. He finds onshore oil to increase the likelihood of conflict, while offshore oil has no significant effect. Hence, examining oil production as a whole, while it is better understood, as comprising two dissimilar modes of production could prove misleading. In examining the thesis' research question it would therefore be fruitful to disaggregate oil according to its physical and social characteristics. This will be discussed in more detail in this chapter's section on classification of natural resources.

Dependence or abundance?

The lack of coherent results on the oil-conflict link could also be due to a lack of differentiation between oil-dependence and abundance. Several researchers therefore argue that separating between resource abundance –and dependence is necessary. Basedau and Lay (2009), in contrast to most previous studies, find oil to have a negative effect on armed conflict, utilizing control variables based on the concept of the rentier state, in which oil wealth is argued to be utilized to strengthen the state and quell opposition. Basedau and Lay's (2009) main theoretical argument against the oil-conflict link lies in their differentiation of resource *abundance*, and resource *dependence*. They view dependence as relative to other economic activities, while abundance is seen as the absolute amount of resources available per capita (Basedau and Lay 2009:760). Their empirical results do indeed confirm their argument, and show that a state's dependence on oil tends to be associated with a higher risk of civil war onset, while high levels of oil wealth tend to make states less prone to armed conflict (Basedau and Lay 2009:768), contrary to the results usually presented in the conflict literature.

In brief, the literature on the link between oil and conflict has tended to show that oil increases the likelihood of experiencing conflict. This claim has, however, been questioned. It has, for example, been argued that the location of oil production needs to be taken into account. It also seems pertinent to differentiate between oil abundance -and dependence. Previous studies of oil therefore provide two central findings for studying the research question, the need for disaggregation and classification of resources, and the separation between resource abundance –and dependence.

2.2.2 Conflict diamonds?

Since diamonds have a very high value to weight ratio (Gilmore, Gleditsch, Lujala and Rod 2005), it is often expected that these should increase the feasibility of financing both rebellion and the state. They are therefore highly interesting in the study of the role of natural resources in armed conflict. While there has been a large interest in the effect of oil in the quantitative literature on conflict, research on the effect of mineral resources has been lacking. Although there have been case-studies examining the role of diamonds in conflict (e.g Sierra Leone, Liberia, DRC, Angola) there have not been many studies systematically looking at the role of diamonds from a quantitative angle. This is largely due to a previous lack of available data on diamond trade and deposits.

Recent developments have, however, made statistical analysis on the role of diamonds possible. Gilmore et al. (2005) have recently compiled a dataset on "conflict diamonds". The dataset differentiates between *primary diamonds* (kimberlitic), which mostly occur in subsoil deposits, and *secondary diamonds*, which occur mostly around riverbeds (alluvial). This separation allows for the possibility of more systematic investigation of the importance of a resource's physical and social characteristics, as related to armed conflict onset. The main importance in separating between kimberlitic and alluvial diamonds, relate to how easily they can be extracted and obstructed. Alluvial diamonds are more easily extracted than kimberlitic diamonds, which require large amounts of investment in capital and technology (Gilmore et al. 2005, Le Billon 2008:355). The differentiation is not dissimilar to that of onshore and offshore oil. Hence, primary diamonds are therefore arguably more similar to oil than secondary diamonds as far as extractability and obstructability is concerned.

Le Billon (2008) also highlights the importance of examining diamonds' physical and social characteristics. He demonstrates the importance of separating what he considers to be the three main dimensions of diamonds- dependence, abundance, and mode of production-. Dependence, in a similar vein as Basedau and Lay (2009) measure of oil dependence, relates to how large the diamond production in a given country is relative to its GDP. Diamond abundance, as with Basedau and Lay's (2009) concept of oil abundance, considers the total amount of diamond production per capita. Mode of production, on the other hand, is related to the geological aspects of diamonds and is classified in the same manner as Gilmore et al's. (2005) primary and secondary diamonds distinction.

While the "conflict diamonds" dataset has been available for some time, there have not been a lot of quantitative empirical studies on the relationship, and the studies that have been published have produced diverging results. Gilmore et al. (2005) and Lujala, Gleditsch and Gilmore (2005) have done some initial analysis utilizing the dataset, but few have followed. Their analysis shows that diamonds do indeed affect the likelihood of conflict, but mostly for ethnic wars. Furthermore they find that the geological form of the diamond deposits makes a significant difference, as expected. They find a positive effect of secondary diamonds, meaning they make conflict more likely. This is hypothesized to be due to the fact that secondary diamonds more easily can be used to finance rebellion. Primary diamonds on the other hand is shown to reduce the risk of conflict (Lujala et al. 2005:560). They do not go into the specifics of what this finding entails, but it seems plausible that primary diamonds are more likely to be mined, or at least taxed, by the government. Hence they might provide the government with funds, which can be used to prevent conflict, as have been proposed by Smith (2004) and Basedau and Lay (2009) when looking at the effect of oil on armed conflict onset.

Humphreys (2005), using his self-compiled, and aggregated, diamond production measure, also find diamonds to increase the likelihood of armed conflict onset in his studies of the purported mechanisms linking natural resources to armed conflict onset, although he notes that this is highly dependent on model specification. Ross (2006), contrary to previous findings, finds primary, and not secondary, diamonds to be related to the onset of civil war. He notes that this might be a result of there being few cases of civil war taking place in countries producing substantial amounts of diamonds. The division between primary and secondary diamonds, he points out, might also not be clear-cut, leading to somewhat questionable results (Ross 2006).

In brief, the evidence to date is inconclusive regarding the role of diamonds in the onset of conflict. There are indications, however, that the effect of diamonds, as with oil, is related to its physical and social characteristics, in form of dependence and abundance, and mode of production. In order to examine the effect of diamonds on armed conflict then it appears central to investigate primary and secondary diamonds separately, as well as separating between diamond dependence and abundance.

2.2.3 Illegal drugs

While there have been limited studies on the role of diamonds in conflict, the amount of studies looking at illegal drugs is even more scarce. This is hardly surprising since studying illegal activities is problematic and getting reliable data is difficult. In spite of this some scholars have attempted to unravel the effects of illegal drugs on armed conflict.

Ross (2004a) does not find any evidence of illegal drugs being related to conflict onset in his study of 13 cases. He claims that in none of the four coca-exporting states in his sample were rebels involved in drug cultivation prior to the conflict began. Illegal drugs do on the other hand appear to prolong a conflict once it has been initiated, by providing funding to rebels (Ross 2004a). Cornell (2007) concurs, and finds no link between drug cultivation and civil war onset. He does however find evidence of drug cultivation leading to prolonged and more severe conflict (Cornell 2007:216-217). Rather than conflict being a cause of large quantities of drug cultivation, the opposite seems to be the case according to Cornell (2007). Narcotics fundamentally alter armed conflict, and their production and distribution is fundamentally altered by it (Cornell 2007:222). Gray (2008) argues that this has been the case in Colombia, where conflict has led to rebels becoming drug traffickers, but cautions that the two groups of actors are not inevitably the same. They may utilize the same means, but do not necessarily share the same objectives. Bodea and

Elbadawi (2007) do not find any link between narcotics and conflict in their revision of the greed and grievance debate.

In summary, while the research examining the effect on illegal drugs on conflict is not extensive, virtually all studies argue that narcotics are not related to conflict onset. On the other hand, several studies find illegal drugs to be related to conflict duration and severity. Since there are few previous studies examining the effect of narcotics on armed conflict onset and since drugs production have been found to affect conflict duration, the effect of drugs on armed conflict onset deserves further examination. Additionally, drugs are similar to secondary diamonds in terms of their physical characteristics, and could therefore have similar effects. On the other hand, in contrast to secondary diamonds, drugs are illegal and more difficulty to turn over. Further investigation of the role of drugs on armed conflict onset is therefore warranted.

2.2.4 The importance of resources

The literature review on oil, diamonds, and drugs shows that there are no clear results on the role of natural resources in armed conflicts. This appears partly due to a lack of disaggregation, a subject that will be discussed in more detail in the next section, as well as a lack of separation between resource *dependence* –and *abundance*. In studying if, and how, natural resources affect armed conflict onset, disaggregating resources, as well as separating between abundance and dependence therefore appears central. This could in part explain why, in some cases, natural resources go hand in hand with a wealthy and healthy democracy, and in other cases coexist with permeating conflict. Hence, in order to properly examine the research question, disaggregating natural resources and separating between resource abundance –and dependence should prove fruitful.

2.3 Classifying natural resources

2.3.1 Why classify?

There are three overarching problems related to the classification of natural resources; two analytical and one policy-related. Firstly, while, as demonstrated in the previous section, there have been some previous findings that might suggest that a relationship between natural resources and armed conflict exists, there have been few coherent explanations as to why. In order to better be able to focus on the mechanisms that might link natural resources and armed conflict it is beneficial to classify them. While correlations in themselves are interesting, proper explanations are more satisfying. This requires disaggregation of the concept of natural resources.

Secondly, previous studies have sometimes grouped different types of resources into one broad category or variable. In doing this one might fail to recognize that not all resources are the same (Lujala 2003). Combining different resources in the same variable may cause it to be based on problematic data, and can thus give poor and spurious results (Brunnschweiler and Bulte 2009:654, Lujala 2003:4, Ross 2004b:338). By using one broad category of natural resources one risks diluting empirical results since different natural resources might have differing, and even opposite effects on armed conflict (Lujala 2003:4, Snyder 2006:963). Diamonds and oil, for example, are in several studies grouped together as primary products, but involve very different methods of extraction and production. This holds true within types of resources as well, as some forms of oil and diamonds require more extensive means of extraction and production than others. There is, for example, a huge difference in the capital and technology required to extract primary diamonds (kimberlitic), which are found underground, as opposed to secondary diamonds (alluvial), which mostly occur along riverbeds. Furthermore, resources may differ in their legality, detectability and elasticity of supply (Snyder 2006). These factors are important for how resources are connected to local and international markets. Any study of natural resources and conflict should therefore be concrete as to how and why resources are classified.

The third problem revolves around the policy implications that might result from grouping together natural resources. If natural resources differ in their effect on civil war it stands to reason that policy responses should reflect this (Lujala 2003:4-5).

2.3.2 How to classify?

The geography of natural resources

While there are clear indications as to *why* one should classify natural resources, the issue of *how* one should classify is more debatable and problematic. Although recent literature has tended to take into account the problem of treating natural resources as a single variable by disaggregating it, there have been few systematic attempts at developing a classificational scheme. Among those who have done this more extensively are Lujala (2003) Le Billon (2001), Buhaug and Gates (2002), and Ross (in Ballentine and Sherman 2003). They all agree on the importance of the physical aspects of natural resources, but disagree on how these should be weighted. There is additionally some disagreement on the importance of the social features of resources.

Geographic concentration

Lujala (2003:7-11) identifes geographic concentration as an important dimension of natural resources. This aspect relates to how dispersed or concentrated the resources are, which again affects how easily they can be controlled and looted. According to Le Billon (2001), in his work on the political ecology of war, lootability is a central aspect of natural resources as related to the funding of conflicts. In other words, how easily a resource is accessible matters to both sides of a conflict. This purportedly stems from the fact that natural resources, especially extracted ones, often are easily accessible and desirable for both sides of the conflict, and are spatially fixed. Hence, natural resources cannot be relocated, as is the case with manufactured goods, and to some extent agriculture (Le Billon 2001:569). Natural resources are thus easily affected by taxing and looting. Extraction points and transport routes consequently become central to both sides of the conflict, and rebels often establish permanent strongholds close to these contested areas (Buhaug and Gates 2002:419).

Within geographic concentration one might distinguish between diffuse and point resources. Diffuse resources are dispersed over a wide area, like timber, while point resources are usually highly concentrated, like minerals and gems (Lujala 2003:7, Le Billon 2001:570, Buhaug and Gates 2002:420). Hence, the extraction of point resources requires a larger degree of capital and technological investment than diffuse resources. Point and diffuse resources, it is argued, affect conflict differently.

Since point resources are more concentrated one might expect that these are more easily monopolized which might lead to fierce contestation and conflict, increasing the likelihood of both conflicts over government and territory (Le Billon 2001:570, Ross in Sherman and Ballentine 2003:56). Diffuse resources, on the other hand should be more easily available to insurgents and might accordingly lower the threshold required for mobilization against the center of government. Therefore it would seem that both diffuse and point resources should increase the likelihood of armed conflict, but through separate mechanisms.

There are, however, difficulties with viewing resources are strictly point or diffuse. First of all, some resources do not easily fit within one of these categories (Lujala 2003:8). An oil field can for example cover a wide area even if the extraction sites can be considered point, and might therefore better be described as semi-diffuse (Lujala 2003:7-9). In other words, the distinction does not take geographical scale into consideration. A resource might also be considered as point on a local scale but diffuse on a global scale, as can be said of placer diamonds (Lujala 2003:8-9). Furthermore, one might argue that the two categories are too broad, and incorporates resources that do not have the same characteristics and impact on conflict (Lujala 2003:9). A more refined classification is therefore desirable.

Geographic location, and the social construction of resources

While the geographic *concentration* is important to the classification of natural resources, (Le Billon 2001:572) highlights geographical *location* as well. The greater the distance between the resource and the center of control, the more difficult and costly the resource will be to control, and the risk of losing it to the adversary will be higher (Le Billon 2001). Resources should therefore be classified as *proximate* or *distant*, where the reference point is the center of control of the government (Le Billon 2001:570). Resources closer to the capital are therefore expected to be more difficult to access for rebels than more distant resources.

Furthermore Le Billion (2001:571) argues for considering conflicts over natural resources as a socio-historical product linked to the social construction and political economy of resources. In other words, one should also consider the social aspects of value and price placed on resources. Resource dependence should therefore not be considered as deterministic to conflict, as the value and desirability of resources is shaped by global markets and commodity chains (Le Billon 2001:575). Diamonds are a prime example of this as they have no apparent value except for some industrial applications, but are still among the highest priced commodities we have today (Le Billon 2001:576).

2.3.2 Towards a classification of natural resources

In Ross's (in Sherman and Ballentine 2003) work on the varying roles of natural resources in civil war, he identifies *lootability*, *obstructability*, and *legality* as the main factors in the classification of natural resources. Lootability is understood as how easily unskilled workers can appropriate the resource. Drugs, timber and alluvial gemstones are for example relatively lootable, while oil and natural gas are considered as relatively unlootable (Ross in Sherman and Ballentine 2003:54). Furthermore, a resource's obstructability is based on how difficult it is to block its transportation. Resources that have high value-to-weight ratio, and can be flown out of an area, are more difficult to block than resources that are transported at ground level, over long distances (Ross in Sherman and Ballentine 2003:54). Lastly, drugs are considered illegal resources, as these cannot be legally traded on international markets (Ross in Sherman and Ballentine 2003:54). This leads to the following classification:

Table 1 Classification of natural resources according to lootability, obstructability and legality

	Lootable	Unlootable
Highly obstructable		*Onshore, remote oil* and gas
Moderately obstructable	Agricultural products Timber	Deep-shaft minerals
Unobstructable	***Coca*** ***Opium*** *Alluvial gems*	*Deep-shaft gems* *Offshore oil* and gas

Table 1: Natural resources by lootability, obstructability and legality. Bolded resources are considered illegal, and resources in italics have available data and findings, and are the ones included in the thesis analysis.
Source: Ross 2003

The classification in figure 1 shows that primary diamonds and offshore oil, and secondary diamonds and drugs, fall into the same categories. Onshore oil is separated from primary diamonds and offshore oil since it is highly obstructable due to mostly being transported in ground-level pipelines.

Ross's classification incorporates the elements previously distinguished as central, mainly geographical concentration –and location, and the social construction of resource demand. First of all, one might argue that whether a resource is point or diffuse is an element of lootability (Lujala 2003:9). Since point resources might be easier for governments to control than diffuse resources, all things being equal, one would expect that rebel forces to have less difficulty looting diffuse resources than point resources (Lujala 2003:9). Furthermore, by looking at the lootability and obstructability of a resource, one can take into consideration the geographic location of natural resources as well. Lastly, a distinction between legal and illegal resources can incorporate some the social aspects of value and price, which is a core argument of Le Billon (2001). In accordance with this I will therefore use Ross's classification of natural resources as a background for this thesis' analysis, and seek to examine the following hypothesis

> *H1:"The effect of a natural resource on armed conflict onset is dependent upon its lootability, legality and obstructability"*.

The hypothesis serves to examine the importance of classification, and can provide a clearer view of *why* resources might affect armed conflict. It furthermore serves as a basis for the broader aim of identifying and testing the mechanisms that are argued to lie behind the relationship, as these are likely to be related to a resource's physical and social characteristics. A further exploration of these mechanisms will be given next.

2.4 Examining the mechanisms

There is, as has been exemplified, no clear consensus on the relationship between resources and armed conflict. Hence, several authors have argued for an increased focus on the mechanisms supposedly connecting natural resources to armed conflict (Smith 2004:242-43, Ross 2004a;2004b, Humphreys 2005). This will be done throughout this section.

As it has been argued previously, the quantitative literature on armed conflict has been criticized for neglecting explanations, and over-interpreting correlations. This it is argued, is a part of the reason for the often conflicting results said literature has produced. In order to take this criticism into account it is fruitful to identify, and test mechanisms that have been identified as linking natural resources to armed conflict. While mechanisms are usually examined in qualitative research, there are no inherent impediments that make the examination of mechanisms unsuitable to quantitative research (Humphreys 2005:518-19). However, that is not to say that are no issues involved in examining mechanisms in quantitative research. First and foremost, it is difficult to identify mechanisms, and since they might be similar and present at the same time, it can be hard to separate between them. Secondly, testing mechanisms requires reliable fine-grained data, some of which is often hard to obtain. In spite of this, by disaggregating the explanatory and dependent variables, the study of some the mechanisms linking natural resources to armed conflict is achievable (Humprheys 2005). It should be noted, however, that not all of the presented mechanisms are sufficiently testable with available data. I still choose to include them in order to give an overview of some of the existing mechanisms that have been identified as important, and in order to provide grounds on which future research with better data might build.

The section will start with defining mechanisms and give an account of the two main types of mechanisms, as identified by Elster (1998). This will be followed by a discussion of how one can approach the study of mechanisms in quantitative studies of conflict. Lastly, a presentation of the two overarching themes of mechanisms identified as linking natural resources and armed conflict is given, those who focus on the state, its institutions and economy, and those who focus on the rebels' opportunities and motivations.

2.4.1 Mechanisms and quantitative study of armed conflict

In brief, mechanisms can be described as "*frequently occurring and easily recognizable causal patterns that are triggered under generally unknown conditions or with indeterminate consequences"* (Elster 1998). In other words, mechanisms calls for a focus on explanation, based on past events, but do not allow for prediction, since the consequences are indeterminate, and the conditions unknown. It is useful to operate with two types of mechanisms when examining the relationship between natural resources and armed conflict (Humphreys 2005:518-22), Type-B and Type-A mechanisms respectively.

Type-B Mechanisms

In systems with Type-B mechanisms multiple mechanisms may operate at the same time, sometimes with opposite effects (Elster 1998). In cases where Type-B mechanisms are at place one might infer that an explanatory variable has no effect, while it in fact has several, possibly opposing, effects (Humphreys 2005:518). In the instance of a Type-B system, the challenge lies in identifying the opposing effects, or if multiple mechanisms work in the same direction, assessing the different contribution of the different mechanisms. In order to achieve this, two approaches are fruitful. Both involve utilizing more fine-grained data and measures.

The first approach involves disaggregating the explanatory variable(s) of interest, and the second involves disaggregating the dependent variable. This thesis will focus on the former. By utilizing disaggregated variables of more fine-grained data it is possible to arrive at measures that can compare competing or confounding mechanisms. The importance of disaggregating when examining natural resources and armed conflict has already been noted in the previous section, and will therefore not be debated in detail here.

Type-A Mechanisms

In systems with Type-A mechanisms there are two possible processes that link an explanatory variable to the dependent variable, but for any observation only one applies (Humphreys 2005:521). This is as opposed to Type-B mechanisms where multiple mechanisms can operate at once. Hence, the problem in Type-A systems is to identify which (if any) causal chain will be triggered. Identifying the mechanisms in Type-A systems is again dependent upon whether the process linking the explanatory variable to the dependent variable is known or unknown (Humphreys 2005:521).

In the case where the linking process is known, identifying the mechanism quantitatively can be done by introducing an interactive term in the statistical model between the explanatory variable and the "process-variable". This will be used to examine the (weak) state mechanisms where it is argued that natural resources affect the likelihood of armed conflict onset by decreasing state strength.

If the process linking the explanatory and dependent variable is unknown –or stochastic, modeling the stochastic process as a function of explanatory variables can solve the Type-A problem. This is rather more difficult than when the linking process is known. It can, nevertheless, be done by utilizing a "switching regression" (Humphreys 2005:521-22). This is, however, out of the reach of this thesis, which will only attempt to examine Type-B mechanisms and Type-A mechanisms with known linking processes.

In an article focusing on the mechanisms between natural resources and conflict, Humprheys (2005) identifies six principal mechanisms. I will follow Humprheys in his identification of mechanisms, but I will categorize the six mechanisms into two groups, in accordance with Lujala (2010). I therefore separate the mechanisms linking resources to conflict accordingly: those who focus on the state, its institutions and its economy; and those who focus on the insurgents and their motivations and opportunities.

2.5 Mechanisms and the state.

A weak state has commonly been cited as a mechanism explaining the link between natural resources and armed conflict. The core argument of the weak-state approach is that leaders in states that are dependent on natural resources do not develop reciprocal obligations with their citizens, in form of taxes, due to a reliance on “unearned” income in form of natural resources (Di John 2007:967-68). Thus, what has been considered an important aspect of modern state formation has to some extent been bypassed. Resource abundance, it is argued, creates an environment where the state does not need to levy taxes, leading to a lack of political accountability, as poorly functioning institutions can be sustained by readily available resource rents (Lujala 2010:16, Di John 2007:962-63). In a series of papers on the role of resources in conflict, Ross (2004a, 2004b, 2006) proposes that state weakness makes conflict more likely by reducing states’ ability to resolve social conflicts. His arguments draw on the work of scholars who argue that oil wealth in Middle-Eastern states have sustained weak state apparatuses with little capability of resolving social conflicts (Ross 2004a:42).

Consequently, it is argued that in these states elites maintain power through corruption and patron-client relationships, rather than through an establishment of a social contract based on deliverance of public goods financed through taxation (Di John 2007:967). Fearon and Laitin (2003), for example, argue that oil states therefore are less likely to have strong institutions and bureaucracies since they are not as reliant on them for revenue as non-oil dependent states. This lack of legitimacy and political, administrative and military capacity, in turn, makes them more vulnerable to insurgency and rebellion. With limited bureaucratic capacity and presence in tax collection, the state’s ability to stay informed of what happens at the grassroots level might become limited, making planning and executing insurgency and rebellion easier (Di John 2007).

It is furthermore argued that as states become more independent of its citizens, predatory behavior amongst those in power becomes less costly and more likely, and reduces the need for leaders to make long-run political bargains with interest groups (Di John 2007:967). Taxation and revenues are therefore unpredictable, and when resource rents collapse and disappear, as they eventually do due to their non-renewable nature and fickle value, elites might find themselves in a financial situation dependent on arbitrary confiscation in order to maintain power (Di John 2007). This mismanagement of wealth combined with historical circumstances might create long lasting grievances, making especially secessionist conflict more likely (Di John 2007). Weak state institutions have also been linked to slow economic growth and low-income levels, factors that have been shown to increase the likelihood of conflict (Lujala 2010:16).

It can, however, be argued that resource wealth has an opposite effect, leading to a stronger state with more durable institutions. Examining the effect of oil wealth, Smith (2004) argues that some states might have had stable social coalitions that existed prior to finding oil. Therefore it might not be the case that oil regimes had the need for buying fragile legitimacy with oil rents. Contrary, it might be the case that oil states have used their revenues to build strong institutions, rather than on patronage and delicate legitimacy (Smith 2004:242-43). Basedau and Lay (2009:760) are in agreement with Smith in that resource wealth has differing effects on armed conflict depending on historical and institutional context. Firstly, they argue, in resource abundant states, governments have more resources to spend on their security apparatus, making rebellion more demanding and less feasible (Basedau and Lay 2009). Secondly, the feasibility of rebellion can be reduced by the increased likelihood of external support on behalf of the incumbent regime, especially if it’s a major oil exporter. Energy security is a major concern for most major international actors, and an intervention in order to maintain stability becomes more likely, making rebellion less feasible (Basedau and Lay 2009:761).

On the other hand, Smith (2004) does point out that case studies of smaller oil exporting states have shown that oil can be a destabilizing political factor. This illustrates that the effect of resources on state institutions may not be as clear as previously claimed. Institutional context does matter, and this should be taken into consideration when studying the relationship between resources and.

2.5.1 Examining the (weak) state mechanism

In order to examine if the weak state mechanism is able to explain the link between natural resources and armed conflict, Humphreys (2005) proposes testing if there is a correlation between armed conflict and past oil revenues relative to tax revenues. This appears to be a fruitful approach. As mentioned, the weak sate approach argues that the low level of tax income relative to natural resource revenues explains the link between resources and armed conflict. If this were in fact the case, one would expect to observe a significant positive effect between oil revenues relative to tax income and armed conflict (Humphreys 2005). In other words, countries with higher dependence on oil revenues as compared to tax income should be more likely to experience conflict.

There is, however a severe lack of reliable data on tax revenues in general, and even more so in states afflicted by conflict. An alternative may be to employ Basedau and Lay's (2009) resource dependence measure for oil. Similar measures for diamonds and drugs are unfortunately not available, restricting our ability to make inferences. Nevertheless, it can provide some indication of the weak-state mechanism being at place. While the measure is of resource production relative to economic activities in general, and not strictly tax revenues, it might provide an approximation of Humphrey's suggested approach. Accordingly the thesis sets out to study the following Hypothesis in order to provide a better understanding of how natural resources may affect armed conflict onset.

> "*H2: Resource dependence rather than abundance increases the likelihood of armed conflict onset"*.

Furthermore, Humphreys (2005) proposes testing interactive effects between types of natural resources and measures of state strength. By looking at the effect of the interactions between resources and state strength it is possible to examine whether the effect of natural resources is dependent on institutional capacity. It could, for example, be the case that resource wealth increases the likelihood of armed conflict in states with weak institutions, and reduces it in states with strong institutions (Humphreys 2005:521). As has been mentioned previously whether resource wealth increases the likelihood of conflict, or reduces it, has been actively debated in the conflict literature. It might in fact be the case that it does both. By examining the aforementioned interactions it is possible to shed some light on this disagreement, further expanding our knowledge of *how* resources affect armed conflict onset. Examining an interaction between institutional capacity and natural resources is furthermore possible for diamonds and drugs in addition to oil, providing a valuable alternative to testing resource dependence. The thesis will therefore investigate the following hypothesis:

> *H3: "The effect of resource wealth on conflict onset is dependent on institutional capacity".*

To summarize, natural resources are argued to affect the likelihood of conflict onset through state institutions. Natural resource wealth is argued to increase the likelihood of conflict onset in states with low institutional capacity, and decrease it in states with high institutional capacity. State institutions are not the only pathway through which natural resources are argued to influence conflict however. The role of rebel's motivations and opportunities, to which we will now turn, should also be considered.

2.6 Rebel's motivations and opportunities

According to Collier et al. (2009:3) the defining feature of armed conflict is a rebel army capable of large-scale violence. Virtually all governments maintain armies. The defining aspect of armed conflict is therefore the existence of an opposing non-governmental party (Collier et al. 2009). In order for such a group to emerge there has to be some reason for its convergence. There is, however, no consensus as to what causes rebel groups to engage a government through violent means, and how natural resources affect rebel groups, but three main "motivators" have often been cited as central: economic "greed", political grievances, and military –and financial feasibility.

2.6.1 Economic "greed".

In order to address the previous lack of focus on economic variables in the study of armed conflict, Collier and Hoeffler (1998, 2004) present a new framework focusing on what they term the "greed hypothesis". They posit that resource rents might generate economic incentives for insurgents, which might lead to a conflict with the government. When natural resources posit a higher value than the cost to obtain them, they argue, individuals will be induced to spend time and resources to acquire them. In other words, where resources are lootable and obstructable, individuals will seek to obtain them, an activity often denoted as "loot-seeking" behavior. Hence rebellion is viewed mainly a question of financial gain. This is in contrast to previous research, which has tended to focus on "political grievances" as the main motivator behind rebellion. Collier and Hoeffler (1998, 2004) furthermore argue that due to being geographically fixed, lootable resources are easier appropriable than for example manufacturing, which can be relocated (Collier and Hoeffler 2004:7-8). What causes insurgency and conflict is thus viewed as mainly a matter of business opportunities rather than political motivation based on grievances. Motivation is merely a justification of loot-seeking behavior, determined by whichever "social-entrepreneur" comes first.

Fearon and Laitin (2003) also agree that greed and the possibility of obtaining natural resources, can be a motivator for rebel groups, but argue contrary to Collier and Hoeffler that this works through bids to gain state control. In states with large amounts of resources the value of capturing the state becomes larger, leading greedy rebels to take up arms against the government. While it would be beneficial to separate Collier and Hoeffler's and Fearon and Laition's arguments into different mechanisms this is out of reach of this paper. I will instead view them as comprising a single "greed" mechanism, while noting the issues of treating them as such. Identifying the greed mechanism directly in a quantitative study is difficult, and Collier and Hoeffler have received criticism for concluding that rebels are driven by greed on basis of the correlation between resources and conflict. I do not attempt to identify this mechanism directly since it requires more precise and disaggregated data on rebel movements and their places of operation.

Instead, I will follow Humphreys (2005) example, and examine the "greedy rebels" mechanism indirectly. He argues that the greedy rebels mechanism can be examined through testing if resource reserves significantly affect armed conflict onset after controlling for production. If this is the case, he claims, this indicates that natural resources affect armed conflict onset through the greedy rebels mechanism. While

Humprhey's approach is only an approximation of the concept that is being tested, it is among the better proposals available for testing the greedy rebels mechanism. It should therefore prove fruitful. In accordance with this, the thesis seeks to investigate the following hypothesis.

> *H4: "A larger reserve of natural resources per capita increases the likelihood of armed conflict onset"*

Feasibility and the promise of future payoff

In his case study of 15 civil wars, (Ross 2004a) does not find evidence of the greed mechanism suggested by Collier and Hoeffler. In none of the investigated cases do rebel groups appear to have funded their startup cost from the resource sector, as Collier and Hoeffler (2004) claim. Ross (2004a) does, conversely, find two unexpected mechanisms. Firstly, he finds that natural resources can trigger foreign intervention on behalf of the rebels, especially from neighboring countries. He hypothesizes that neighboring states support rebel groups in order to later obtain access to resources (Ross 2004a:56-57). This, he argues, has been the case in both Sierra Leone and the Democratic Republic of Congo (DRC). In Sierra Leone in 1991, the former Liberian president Charles Taylor allegedly helped organize and support the rebel movement, RUF, in order to gain access to the country's diamond fields. Likewise, both the Ugandan and Rwandan governments helped the rebels in DRC partly as an opportunity to profit from the country's resource wealt[2]. Ross furthermore suggests that this is a hypothesis well suited to statistical analysis with more widespread data.

Secondly, Ross (2004a) finds that rebels are able to fund their startup costs by selling "booty futures", rights to exploit resources the rebels have not yet captured, but hope to capture in the future. He again uses the cases of Sierra Leone and DRC to illustrate. This mechanism is difficult to test statistically though, as there is only circumstantial evidence of this happening. Furthermore it is not entirely apparent how, and if, this mechanism is separate from the previous. Hence, I would argue that the future booty mechanism could be understood as a part of the foreign intervention mechanism. I

[2] Un panel of Experts 2001 and 2002

will therefore not differentiate between them in the analysis, but do acknowledge that this would be an interesting point of inquiry for future research.

In a follow up article to their influential work on the greed hypothesis, Collier and Hoeffler (2009) introduce the concept of the "feasibility" of armed conflict. Their analysis of civil war during the period of 1960-99 shows that conflict is more likely in countries where rebels have more sources of finance, larger pools of potential rebels, and the government has low defensive capabilities, as well as problematic economic income, in form of level, growth, and structure. They find the core results from their earlier studies to be consistent with their new model, which they argue is more robust (Collier and Hoeffler 2009:17-23). The focus, however, is shifted away from the pure greed aspect of conflict, and focuses more on the opportunities of rebels. They find colonial history, mountainous area and proportion of young males in the population to significantly affect the likelihood of conflict onset. This leads them to conclude that rebellion and conflict will occur where it is economically, and militarily feasible (Collier et al. 2009:24). Creating and maintaining a rebellion is expensive and organizationally difficult. Arguably even more so than a political party (Collier et al. 2009). This entails that a rebellion needs access to large amounts of dependable resources, at least on the short term. Natural resources can provide one with such an opportunity.

Therefore it could be argued that natural resources affect armed conflict onset mainly through increasing the structural opportunities of rebels. This can, as Ross argues take place through contributions from neighboring states. One can therefore arguably see Ross' mechanism as one part of the larger concept of feasibility. The thesis will therefore examine the feasibility mechanism indirectly through testing if natural resources affect armed conflict onset through increased probability of foreign intervention. Accordingly, the following hypothesis is proposed:

> *H5: "Resource wealth increases the likelihood of armed conflict onset by increasing the probability of foreign intervention on behalf of rebel movements"*

2.6.2 Political grievance

There is no consensus regarding the effect of loot seeking on rebel recruitment however. Case studies have often highlighted rebel movements that do not appear to be based on a quest for economic rewards. Hanlon and Yanacopulos (2006:178) emphasize the examples of FARC in Colombia and FMLN in El Salvador where membership conditions often were grueling, and looting often were prohibited (Hanlon and Yanacopulos 2006:179). In spite of this, both rebel movements had a large number of volunteers, even compared to competing groups who provided payment. Furthermore, there have been cases of rebel movements that have based large amounts of their recruitment on coercion, as was the case with the MPLA and UNITA in Angola (Hanlon and Yanacopulos 2006). Several researchers therefore argue that one therefore cannot write off grievances as motivation for armed conflict, and that the economic explanation of armed conflict onset is lacking (Nathan 2005).

There are several types of arguments as to how natural resources are connected to grievances (Humphreys 2005), all of which involve dissatisfaction with their distribution and extraction. In spite of the compelling arguments as to why political grievances could link natural resources to armed conflict onset, testing the grievance mechanism is difficult as they are intangible, and therefore cannot be tested directly. Grievances are also linked to dissatisfaction with the state, and separating between a weak-state mechanism and the grievance mechanisms is therefore difficult. I will therefore, in accordance with Humphreys (2005), view the tests for the weak-sate approach as incorporating the grievances mechanism, and discuss them accordingly in the thesis' analysis.

2.7 The importance of mechanisms

To summarize, there are several types of mechanisms that might link natural resources and armed conflict. Some of these can, and will be tested and identified quantitatively by using Elster's (1998) mechanisms type framework. Others are more problematic to test with available data. It is fruitful to divide the purported mechanisms linking natural resources to armed conflict into two approaches, those focusing on the state and those focusing on rebels. In light of the weak-state mechanism natural resources are argued to lead to a weak-state, which is disassociated from its citizens, increasing the likelihood of armed conflict, although some argue that the opposite could also be the case. The rebel approach focuses on the goals, motivations and opportunities of rebels, where economic greed, political grievances, and financial and military feasibility are argued to be essential.

The mechanism framework does not necessarily preclude several mechanisms from operating at one time, and therefore allows for some flexibility in the examination of the relationship between natural resources and armed conflict. It might in fact be the case that the effect of natural resources on armed conflict is not uniform depending on contextual circumstances. A further examination of these mechanisms does, however, require a review of the other factors that are likely to affect armed conflict onset, in quantitative studies known as control variables.

2.8 Control variables

While empirical results have shown that there are links between different kinds of natural resources and conflict, natural resources do not explain all of the variation in where, when, and how conflict takes place. Therefore, as is usually the case in quantitative studies of social phenomena, it is necessary with appropriate control variables in order to study if, and how natural resources affect armed conflict onset. Hence the aim of this section will be to give an overview of what previous research have found to be the most robust variables in in explaining the likelihood of armed conflict.

While some studies have tended to view several of these factors as competing, I view them as complementary, a point that has been made elsewhere (Murshed and Tadjoeddin 2007, Malone, Berdal and International Peace Academy 2000:124). Based on literature on peace and conflict I have identified three main themes, socio-economy, politics and history and geography. The theoretical overview will be given accordingly.

Firstly, an account of the socio-economic factors that are prevalent in the explanations of conflict will be given. Secondly, the politico-historical aspects important in the study of the onset of conflict will be covered. This will be followed by an account of the relevant geographical and demographic variables. The overview is by no means comprehensive but covers the most recent and relevant developments in the theoretical and empirical findings in the literature on armed conflict, as pertinent to the study the resource-conflict link.

The distinction between themes is somewhat overlapping, and is made on what is considered to be most theoretically logical. The variables are not necessarily categorized in the same manner as presented in the respective literature. This is partly due to the differing, inconsistent, and non-existing classification of variables in the literature, but also due to the fact that these phenomena are interrelated and hard to categorize. The classifications do not bear any direct analytical impact, but are made in an effort to better connect diverging strands of theory.

In a review of 47 studies of conflict onset Dixon (2009) has identified 203 different independent variables, divided on 99 different statistical models. These are ranked according to the degree of confidence on their direction and significance. In order to arrive at the most parsimonious model possible the inclusion of control variables will to a large degree be based on Dixon's work, as relevant to the theoretical framework provided previously. Since the thesis includes several interaction effects in order to better examine the mechanism that are argued to link natural resources to armed conflict onset, a parsimonious model is desirable. This will be discussed in further detail in the methods section.

2.8.1 The socio-economic factors of armed conflict

The socio-economic perspective on civil war can arguably be recognized by a focus on poverty related indicators. A common denominator among those who focus on the socio-economic aspects of conflict is an interest in lack of economic development, which again is argued to lead to poverty and increased likelihood of conflict.

Among those who have argued extensively for the importance of socio-economic factors in the study of armed conflict are Collier and Hoeffler (2004, 2009). According to them, earlier research has tended to focus on institutions and idiosyncratic aspects of conflict. Collier and Hoeffler (2004), on the other hand, claim that contrary to belief, actor's inspirations, in form of greed and economical gain, rather than institutions, political grievance, and ethnic strife, is better able to explain why some countries are more likely to experience conflict than others. Their analysis of civil war during the period of 1960-99 shows that conflict is more likely in countries where rebels have more sources of finance, larger pools of potential rebels, and the government has low defensive capabilities, as well as problematic economic income, in form of level, growth, and structure.

Collier et al. are not alone in their focus on the importance of socio-economic features of conflict. Several researchers have found socio-economic variables to be significant in the study of civil war onset (Humphreys 2003, Besley and Persson 2008, Collier and Sambanis 2002, Hegre and Sambanis 2006, Sambanis 2004, Buhaug 2006, Miguel, Satyanath and Sergenti 2004, de Soysa and Neumayer 2007, Fearon and Laitin 2003, Malone et al. 2000, Brunnschweiler and Bulte 2009). While they differ in their method of approach and data, most studies have reached similar conclusions regarding the impact of socio-economic variables on armed conflict. Economic growth is among the more widely reported empirical results. Elbadawi and Sambanis (2002:329-332) find economic growth to be significant, and show that very poor countries are at a high risk of experiencing conflict while rich countries are unlikely to experience conflict.

Murshed and Tadjoeddin (2007:34-35) argue that economic prosperity is the most robust predictor of conflict, since people with a higher income potentially get a greater economic loss from the harmfulness of conflict, and also due to the lack of impoverished potential rebel recruits. Di John (2007) also notes that lower per capita income and economic decline are important factors in determining the risk of conflict onset, but emphasizes the intervening role and importance of institutions. In their sensitivity analysis of civil war onset Hegre and Sambanis (2006) also find economic growth and income to be robust across different models of armed conflict, a result that is consistent with previous findings.

One of the more novel approaches to the study of economic factors influence on conflict is Miguel et al. (2004:740). They find that a one percent decline in GDP increases the probability of conflict by two percentage points in Africa, employing rainfall as an instrumental variable for economic growth. According to them this method is better able to cope with problems of endogeneity and omitted variable bias, both of which are frequently debated methodological issues. It is however important to recognize that this strategy may not be applicable to other regions, since weather might not be as closely linked to income growth as in Africa, an issue the authors duly discuss. In spite of this the findings is interesting as it provides further indications, utilizing a new approach, of the importance of economic growth in reducing the likelihood of armed conflict.

To summarize, while researchers disagree on why, and to what degree socio-economic variables influence the onset of armed conflict, there are indices that certain variables are robust predictors of armed conflict. Economic development and growth, for example, has been shown to be a consistent predictor of conflict in different methods of approach and data. There is less certainty regarding the importance of level of economic development, but there are indications that this factor might influence the onset of conflict. While the economic perspective on armed conflict has gained merit both in academic and policy-circles, it has received a lot of criticism from several angles, which has led to a surge in the focus on the role of politics, history, and institutions in research on armed conflict. It is to these aspects we now turn.

2.8.2 The politco-historical aspects of armed conflict

The emphasis on greed, and economic incentives and motivations as the main determinants of armed conflict has received criticism from several sources. A common criticism is the lack of inclusion of political and historical variables. It is often argued that studying conflict without taking politics, institutions and history into consideration leads to problems of omitted variable bias and thus skewed results. These aspects should therefore be included in models of armed conflict.

Democracy and political stability

Democracy has been a contested variable in the study of conflict. Studies that have looked at democracy and conflict as a linear relationship have tended to find no significant effect (Collier and Hoeffler 2004, Collier et al. 2009, Regan and Norton 2005, Fearon and Laitin 2003, Smith 2004). On the other hand, researches that have included a square-term of democracy have tended to find a significant relationship (Dixon 2009). In other words, it appears that both highly democratic and highly autocratic states are less likely to experience conflict. In their cross-study Hegre and Sambanis (2006) find political stability, and level of democracy to be robust predictors of the onset of armed conflict. Several other studies have also found political –or regime stability to increase the likelihood of conflict (Dixon 2009). The link between democracy and peace has become a stylized fact. This seems to be confirmed for the relationship between democracy and conflict as well, but appears to hold true for highly autocratic states as well as democratic ones.

Historical factors

There has been an increased call for employing the knowledge of historians in conflict research. Conflict is not a new phenomenon and applying concepts and information acquired by historians should therefore be beneficial. The lack of utilizing historical concepts is one of Dixon's (2009:729-30) main criticisms of the conflict literature. He notes that most authors have not used historical proxies in their analyses, and calls for future research to include historical factors.

In spite of this, there have been some researchers who have included historical factors in the study of armed conflict. Some have, for example, attempted to look at the effect colonial heritage (Collier et al. 2009, Fearon and Laitin 2003, Lujala 2010), but no robust effect has been found. The two variables that have demonstrated to be the most robust is a previous history of conflict and "peace years" (Dixon 2009). Collier et al. (2009) incorporate these jointly into the concept of a "conflict trap". The variables jointly provide controls for fixed effects that might have occurred before the initial war, which are likely to make the country prone to future wars, and legacy effects of previous wars, which are expected to fade with time.

2.8.3 The geography of conflict

Ethnicity

Among the more contested politico-historical findings is ethnicity. It has long been argued that conflict should be more likely in more ethnically diverse societies. While some studies have confirmed this, many others have found no such indication. Elbadawi and Sambanis (2002), for example, find ethnolinguistic fractionalization to have been underestimated in economic studies of conflict. They find ethnolinguistic fractionalization to substantially increase the likelihood of conflict.

Bodea and Elbadawi (2007) find ethnic, religious, and language fractionalization (social fractionalization) to significantly increase the likelihood of civil war. According to their results, a diverse country is three times more likely to experience conflict than a homogenous country (Bodea and Elbadawi 2007). Smith (2004:240) also finds ethnic diversity to increase the likelihood of civil war and notes that diverging results may be due to how one measures conflict. According to Buhaug

(2006) this may in fact be the case. He finds ethnic fractionalization to impact the onset of conflict, but notes the importance of distinguishing between conflicts over government and conflicts over territory. In other words, the objective of the rebels matters. Accordingly, his results show that ethnicity affects only the likelihood of separatist wars, not conflicts over government. The more diverse a country is, the more likely it will experience conflict. Furthermore, he finds that the effect of ethnicity is more apparent in smaller conflicts (Buhaug 2006:774-76).

Population

Among the more robust demographic findings in the conflict literature is population. De Soysa (2002) finds population and population density to be related to conflict onset, as do Collier and Hoeffler (2004, 2009). Population density serves mainly as a control of the size of a country, where larger countries are expected to be more prone to conflict and protest than smaller ones (Smith 2004). De Soysa and Wagner (2003) furthermore point out that the effect of population is dependent on how conflict is measured. If one operates with a high death-threshold, as is often the case, larger countries are more likely to reach this threshold since they usually have larger battles (De Soysa and Wagner 2003:22). Furthermore, larger countries have more groups, making it harder for authorities to appease all of them (De Soysa and Wagner 2003:22). Given this, it is not surprising that population has been a robust predictor of conflict.

Physical Geographic features

Several physical geographic features have been proposed as predictors of conflict. Researchers have looked at the amount of forest area, total length of borders, number of bordering countries, total amount of land area, length of riverbeds, and more. The only result that has been somewhat consistent across studies, however, is *mountainous area* (Dixon 2009). The theoretical foundation for the link between mountainous terrain and conflict is not well developed, mostly due to it being treated as a control variable, rather than an explanatory variable, in most studies of conflict. Where it has been included it has been hypothesized that mountainous terrain can provide rebels with a safe haven outside the reach of the state's center (Smith 2004, Djankov and Reynal-Querol 2007). It is uncertain if this is in fact the case, but since it has been shown to be somewhat consistent across studies, it seems beneficial to control for it.

Geographical contagion has also been hypothesized to make armed conflict more likely. According to Sambanis (2001:275) neighborhood effects make ethnic conflicts more likely, but do not seem to have any effect on non-ethnic wars. His results show that countries that have land borders with countries at war are significantly more likely to experience an ethnic war (Sambanis 2001:275). In a similar vein, Buhaug and Gleditsch (2005) find conflict to be contagious, while controlling for country specific attributes. They do however note that this holds true only for separatist conflict. Conflicts over government do not appear to be contagious. Salehyan and Gleditsch (2006) also argue in favor of the contagious nature of conflict. Furthermore they claim that this can partly be explained by refugee flows, even when the main factors expected to influence armed conflict are controlled for. These findings are disputed by Hegre, Ellingsen, Gates and Gleditsch (2001), who find no such effects.

2.9 A basic model of armed conflict?

The literature on armed conflict has greatly expanded since the late 90's. Several models and variables have been presented and examined. There have been few consistent results and little consensus on a basic statistical model of conflict. In spite of this, some variables have proven to be robust predictors of the onset of conflict. In short, socio-economic variables, such as economic growth and level of economic development, have been shown to decrease the likelihood of a conflict occurring. The same holds true for democracy, for extreme values. That is to say, highly democratic regimes, and highly autocratic regimes are less likely to experience conflict. Regime change has also been shown to be detrimental to peace. Regarding the geographical features of conflict, ethnic diversity, larger population, conflict contagion, and mountainous areas have all been shown to increase the likelihood of conflict.

Examining the relationship between natural resources and armed conflict onset therefore requires one to control for these factors. If this is not done one might arrive at spurious results, thereby being unable to make proper inferences on the relationship. Hence the thesis will include control variables for the aforementioned concepts. These will be detailed more extensively in the next chapter, which presents the thesis' data.

3.0 Data

This section will give an overview of the data, measurements and operationalization of the variables used in the thesis' analysis with a general focus on reliability and validity. In quantitative analysis, concepts such as conflict are measured in form of numbers, and hence a discussion of to which degree one is able to quantify these concepts is necessary. Reliability and validity are terms used to judge to which degree one is able to achieve this. Validity refers to the degree to which measures included in the analysis is able to meaningfully represent the concept or phenomena it is supposed to measure (Adcock and Collier 2001:529). Reliability on the other hand refers to the trustworthiness of a measure (Skog 2005). In other words, if one were to measure the same concept on the same units multiple times would the scores be equivalent? Reliability and validity are related, in that a valid measure presupposes reliability, but a reliable measure is not necessarily valid. Consistent measurement of a poorly represented concept is unsatisfying. Therefore, this section will focus on these two concepts as applied to the study of conflict data with a main focus on measuring conflict onset and natural resources.

Firstly, I will give an account of some of the issues involved in studying armed conflict onset, with a focus on the difficulties of collecting data on countries that have experienced conflicts. Subsequently, the UPPSALA-PRIO armed conflict dataset compiled by Gleditsch, Wallensteen, Eriksson, Sollenberg and Strand (2002), which contains data on internal armed conflicts during the period of 1946-2010. Here it will be argued that the UPSALA-PRIO armed conflict dataset is among the most robust and comprehensive conflict datasets, and well suited to studying the relationship between natural resources and armed conflict onset. Secondly, a discussion of the dependent variable, conflict onset will be given. This will be followed by an overview of the natural resources variables, oil, diamonds, and drugs. Lastly, a discussion of the control variables included in the analysis will be provided.

3.1 On the quantitative study of conflict data and choice of dataset

The thesis seeks to analyze countries that have had or have ongoing conflicts using quantitative data. As Nathan (2005) highlights, availability and reliability of data remains a major concern when studying conflict. Since conflict often occurs in developing countries, accurate and complete data on the major characteristics of the countries, such as GDP; Population; size etc. are often lacking (Nathan 2005:13).

Accurate data on natural resources have also proved scarce. Furthermore it has been found that the poorer a country is the worse its quality of data (Dawson, DeJuan, Seater and Stephenson 2001). Since armed conflict repeatedly has been found to be associated with poverty this is an important concern.

Furthermore it has been argued that data on African states often is incomplete and of low quality (Lemke 2003). Since the number of armed conflict onsets is higher than the average in African states this might cause systematic errors in the data, also known as bias[3]. Systematic error in the data material can prove problematic for validity and hence reduce our ability to make valid inferences based on the data at hand (Adcock and Collier 2001).

Since conflict data needs to cover a certain amount of time in order to achieve a number of conflict onsets that allows for satisfactory quantitative analysis, historical data is necessary. This poses a problem since historical data often contains gaps and inaccuracies, which are difficult to overcome (Nathan 2005:17). Methods for gathering data, and data availability, have evolved rapidly the last decades, and much reliable data are now available for recent time periods. Improving data from previous time periods is inherently more difficult, and utilizing data covering the period from 1950-2003, as will be done in this thesis, can prove problematic.

Moreover, using battle-related deaths as a measure to identify and operationalize armed conflict, as has been common practice in conflict research, can be problematic (Nathan 2005). This measurement is likely to be unreliable since armed conflicts are chaotic and dangerous. In the heat of battle, deaths may go unreported and uncounted, and both sides of the conflict might have political and military reasons to skew the number of reported deaths (Nathan 2005:14). Besides, distinguishing between combat –and non-combat-related deaths is problematic, leading any measure of battle-related deaths to be largely unreliable. Hence, a definition of armed conflict that operates with a strict threshold of battle-related deaths could prove problematic.

The choice of UPSALA-PRIO armed conflict dataset can alleviate some the concerns relating to battle-related deaths and identification of conflict. The UPSALA-PRIO armed conflict dataset has been widely used since its inception and has been known to

[3] In the UPSALA-PRIO armed conflict dataset armed conflict in Africa comprise about 40 percent of the total conflict onsets.

provide updated and reliable data on characteristics of conflict. Furthermore, by operating with a threshold of 25 battle related deaths annually it is also less likely to be heavily influence by measurement error when identifying conflict. All identified conflicts in the dataset are additionally examined critically by comparing various sources, which should make the number of omitted conflicts small (Gleditsch et al. 2002:618). A further presentation of the UPSALA-PRIO armed conflict dataset will be given next.

3.2 UPSALA-PRIO armed conflict dataset

The UPSALA-PRIO armed conflict dataset is a joint project between the Uppsala Conflict Data Program (UCDP) and the Centre for the Study of Civil War at the international Peace Research Institute in Oslo (PRIO). It was first presented by Gleditsch et al. (2002) in 2002 and has been updated annually since, with the most recent version being released in 2011. The UPSALA-PRIO armed conflict dataset contains various information on internal armed conflict during the period of 1946-2010, where an internal armed conflict in the dataset is defined as:

> *"a contested incompatibility that concerns government or territory or both where the use of armed force between two parties results in at least 25 battle-related deaths. Of these two parties, at least one is the government of a state (Gleditsch et al. 2002)"*

In comparison to most conflict datasets the UPSALA-PRIO armed conflict dataset has a lower battle related deaths threshold of 25. This is beneficial for several reasons. Firstly, it allows for the inclusion of more conflicts, which have often been neglected due to arbitrarily high thresholds for battle-related deaths. Conflicts that last over long periods can be quite severe even though don't necessarily achieve a large amount of battle-related deaths in a single year. This is, for example, evident in the case of the Northern-Ireland conflict, which generated over 3000 casualties during the period 1971-93, but never achieved more than 1000 battle-related deaths in a year (Gelditsch et al. 2002:617), a criterion that is common in many datasets. Reducing battle-related death threshold is statistically beneficial as well, since the increased amounts of conflicts allows for easier estimation of models with shorter time periods.

Moreover, as Nathan (2005) argues, a lower battle-related death threshold is also better able to make inferences regarding rebels and rebellions, which may differ largely in their strategies and opportunities, causing the number of battle-related deaths to vary to a large degree between conflicts. On the other hand the threshold should also not be too low, or one would risk including incidents that do not have much impact on political or economic life (Gleditsch et al. 2002:617). A threshold of 25 battle related deaths annually therefore seems to strike a balance between being too inclusive and too restrictive.

A further strength of the dataset is its strict and transparent coding rules, which increases the reliability of the data, and provides researchers ample room to replicate results found in research based on the dataset. Moreover, as can be seen by the revisions of the dataset, critique is handled thoroughly with an emphasis on continually enhancing the quality of the dataset.

In conclusion, the PRIO-UPPSALA dataset is one of the most transparent and reliable dataset on armed conflict available to date. It therefore appears to be the most apt dataset for studying the link between natural resources and armed conflict. It allows for testing a number of hypotheses, and the datasets annual revisions provide a solid fundament for studying conflict quantitatively. By employing the conflict data from the UPSALA-PRIO armed conflict dataset I seek to build a methodological framework that can accommodate diverging strands of theory and clarify some of the contradictory results that have been found, while taking into consideration the critique that has been directed at quantitative studies of conflict data. With this in mind we will now turn to an overview of the thesis' data sample, the dependent variable conflict onset, followed by an overview of the thesis' independent variables, with an emphasis on natural resource measures.

3.3 Selecting the sample

A quantitative study of conflict onset necessarily requires one to include cases of conflict onsets as well as non-onsets, lest one risks selecting cases on the dependent variable, which can be detrimental for valid inferences (King, Verba and Keohane 1994). The sample of the thesis is based on Strand (2006) conflict onset data, which is based on the UPSALA-PRIO armed conflict dataset (Gleditsch et al 2002), as well as its definition of the international system, where a state is defined as either *a) An internationally recognized sovereign government controlling a specified territory*

b) An internationally unrecognized government controlling a specified territory whose sovereignty is not disputed by another internationally recognized sovereign government previously controlling the same territory.

It is furthermore required that a country has more than 250.000 inhabitants and a relatively autonomous administration over some territory (Themner and Wallensteen 2011, Gleditsch and Ward 1999). This definition serves as a solid basis for including countries for conflict onset analysis. Since the UPSALA-PRIO armed conflict dataset is based on this definition, inclusion of countries that have not experience conflict needs to be based on it as well in order to not be biased. The definition provides researchers with relatively clear criteria for case selection while still remaining flexible. In total 167 countries are included during the period of 1950-2003[4], which provides sufficient data for studying conflict onset quantitatively, and follows King et al's. (1994) recommendation of including as many cases as possible. The chosen period of 1950-2003 is based on data availability on the thesis' main explanatory variables.

3.4 Conflict onset

The thesis' dependent variable, conflict onset, measures whether a country has experienced conflict in a given year. Hence, it consists of both cases of presence and absence of conflict for the selected 167 countries during the period 1950-2003. Cases of conflict are coded as "1" while cases of no conflict -or peace are coded as "0". Conflict onset is as mentioned based on UCDP's definition of conflict, and is defined as a contested incompatibility between a government or state, and at least one opposing group, and which result in at least 25 battle-related deaths in a year. There are a total of 253 conflict onsets during the period. Conflict onset is therefore coded for only about 3.1 percent of country years and is a relatively rare event[5].

[4] See appendix for list

[5] Some (e.g King and Zeng 2001) argue that special techniques are required to study rare events. These techniques are, however, incompatible with the thesis' method of approach.

3.5 Explanatory variables: Natural resources

This section will give an overview of the variables measuring natural resources. It will follow the order of presentation given in the theoretical chapter starting with measures of oil, followed by measures of diamonds and drugs. All resources contain a dummy-variable measures as well as a continuous measure. The reason for including both types of measures is that continuous measures of resources are relatively rare and seldom differentiate between a resource's mode of production, which is necessary in order to examine *H1:"The effect of a natural resource on armed conflict onset is dependent upon its lootability, legality and obstructability"*. Moreover, examining "*H2: Resource dependence rather than abundance increases the likelihood of armed conflict onset"*, and *H4: "A larger reserve of natural resources per capita increases the likelihood of armed conflict onset"* requires continuous measures. Hence, both types of measure are required for fully examining if, and how natural resources affect armed conflict onset. Additionally, including both dummy and continuous measures is beneficial, since continuous measures of resource production are more likely to be affected by endogeneity, due to production being likely to be affect by the presence of conflict (Lujala 2010:18). All continuous measures are lagged one period in order take the time dimension into account.

3.5.1 Oil

The measures of oil are based on the PETRODATA dataset compiled by Lujala, Rod and Thieme (2007) and data collected by Humphreys (2005)[6]. The PETRODATA is collected from Lujala (2010) replication data[7]. The variables collected from Lujala are dummy variables and contain information about the presence of oil production, as well as the mode of production in form of onshore or offshore. A country is given the value of 1 at the first year of discovery or production and for each subsequent year, and coded 0 otherwise. A measure combining the aforementioned is also included, and is given the value of 1 if either offshore –or onshore oil production has taken place and 0 otherwise.

The variables collected from Humphreys contain estimates of oil production and the size of reserves. The oil production measure records the average amount of oil extracted per day in a given year. The measure of oil reserves is recorded in billions

[6]http://prio.no/misc/Download.aspx?file=%2fcscw%2frd%2fReplication+Data%2fReplication+data+Lujala+(47(1).zip
[7]http://jcr.sagepub.com/content/suppl/2006/11/22/49.4.508.DC1/Humphreys.zip

of barrels, and is defined as "*the volume of oil remaining in the ground that geological and engineering information indicate with reasonable certainty to be recoverable from known reservoirs under existing economic and operating conditions.*" (Humphreys 2005:523). Both measures are derived from data reported in BP Statistical Review of World Energy/BP Statistical Review of the World Oil Industry (various years), PennWell Corporation's Oil & Gas Journal, the U.S. Department of Energy, the OPEC Bulletin, and Petroleum Economist. In cases of difference between sources an average of the estimates is used.

3.5.2 Diamonds

The dummy variable measures of diamond production are collected from the conflict diamonds dataset compiled by Gilmore, Gleditsch, Lujala and Rod (2005) The continous diamond measure is collected from Humphrey's (2005). The conflict diamonds data contains information on the production of primary (kimberlitic) or secondary (alluvial) diamonds deposits in a country in a given year. As with the PETRODATA variables the variables are coded 1 if for the first year of production and for the subsequent years, and 0 otherwise.

Humphrey's diamond data contains a measure of the quantity of diamond production based on information gathered from the Mining Annual Review, the Metals and Minerals Annual Review, and the Diamond Registry (based on U.S. Geological Survey data) (Humphreys 2005:523). The measure does not differ between the production of primary and secondary diamonds as is done in the conflict diamonds dataset.

3.5.3 Drugs

As was highlighted in the theoretical overview, data on drug cultivation is not generally available. The number of countries involved in large-scale production of illegal drugs is low, and obtaining reliable data on drug cultivation across time and space is inherently difficult (Cornell 2007). Nevertheless, some researchers have managed to collect data on illegal drug cultivation.

The DRUGDATA dataset compiled by Buhaug and Lujala (2005) contains basic information on the timing and location of opium poppy and coca bush cultivation. It also contains some limited information on cannabis cultivation, although it is noted that cannabis cultivation is more widespread and difficult to identify. Drug cultivation is a dummy variable that takes the value of 1 if production of cannabis, opium, or coca takes place in a country in a given year and 0 otherwise. It should be noted that this is a crude measure, and its reliability is questionable. In spite of this, the measure is among the more reliable that exists to date. Furthermore, investigating the effect of illegal drugs on armed conflict onset has largely been neglected. I therefore include the dummy variable in the thesis' analysis while noting that any conclusion on its effect should be carefully evaluated.

3.6 Control variables

The inclusion of independent control variables will follow the overview provided in the theoretical section. The control variables that are described here are what were found to be the most consistent in the literature on armed conflict. While, as discussed, there is no consensus on what control variables to include in a statistical model on armed conflict, several variables have proven to be consistent across models and datasets.

3.6.1 Socio-economic variables

As identified in the theoretical summary economic growth and level of development have been identified as consistent predictors of armed conflict onset. The measure of economic growth chosen for the thesis' analysis is annual growth in GDP per capita. The data for this variable is gathered from Lujala (2010)'s replication dataset and which is based on Fearon and Laitin (2003)'s GDP-variable but is updated using the Penn World Tables 6.0 (Heston, Summers & Aten, 2002) and World Bank Development Indicators (World Bank, 2002), to cover the period of 1992-2000, which is not present in Fearon and Laitin's variable. Since GDP per capita tends to be skewed the variable is logarithmically transformed, which compresses it and reduces the problem this poses for regression analysis. In addition, the variable is lagged by one year in order to take into consideration the fact that it is likely to take time before changes in the variable affects the dependent variable, conflict onset. Both lagging and loging are common procedures in the conflict literature and are used in order to enhance robustness.

Level of development is measured by illiteracy rate and infant mortality rate. Illiteracy rate is measured in percent of adult population that are illiterate, and infant mortality rate is measured as infant mortality per thousand. Both measures variables are based on measures collected from the World Banks development indicators, and are gathered from Sambanis (2006) replication data. Since the concept of economic development is intangible these measures are necessarily crude. It is therefore questionable if they are valid measures of the concept of economic development, but they have been found to be significant predictors of armed conflict, and are therefore included.

3.6.2 Politic-historical variables

Institutions

The main consistent politico-historical variables that have been found to affect the likelihood of armed conflict onset are democracy and political stability. The polity score is the most widely used in the armed conflict literature, and has repeatedly been found to be a significant predictor of armed conflict onset. Level of democracy and autocracy will be measured by the polity IV score variable (Marshall and Jaggers 2000). The polity score variable goes from -10 to 10, where -10 is considered to be most autocratic and 10 most democratic. Polity IV has been widely used in conflict studies, and while it has been noted that the effect of the Polity IV score variable may have been overestimated (Dixon 2009:727), its use has not been commonly contested. The variable is included as squared since there has emerged some agreement that the relationship between democracy and armed conflict is nonlinear (Dixon 2009). In order to reduce problems of endogeneity caused by Polity IV score being affected by conflict and vice versa, the Polity IV variable is also lagged by one year.

The variable measuring instability is collected from Sambanis' (2006) replication data. It is a dummy-variable signifying whether a country has experienced a larger than two point change in polity score during the previous three years. Countries that have experience a greater than two point change during the three previous years are given the value of 1, while others are given the value of 0. The three-year requirement is in line with previous research and provides a balance between a too strict and not strict enough time requirement.

State capacity

The variable measuring state capacity is gathered from Braithwaite (2010) and is based on the work of Arbetman-Rabinowitz and Johnson (2007). In brief, it measures a government's relative success in extracting resources. It is calculated as the ratio of the total value of actual extractions to the predicted value of extractions. The predicted extraction rates are calculated using a combination of predictors, including mining incomes, agricultural productivity, trade exports, and dependence upon oil exports (Braithwaite 2010). This is, at best, an approximation of state capacity. It does, however, contain several aspects that have been identified as important in measuring state capacity (Arbetman-Rabinowitz and Johnson 2007). This, combined with the variable's data availability makes it well suited for examining *H3:"The effect of resource wealth on conflict onset is dependent on institutional capacity"*.

Third party intervention from neighboring countries

Since third party intervention is quite rare and difficult to measure, third party intervention is proxied by neighboring countries average score on the polity scale. The measure of average neighborhood polity score is gathered from Samabanis' (2006) replication data. The reasoning behind this proxy is research on democratic peace that has shown that leaders in competitive political institutions face greater restrictions on the use of force (Gleditsch 2007). Accordingly, third-party intervention is expected to be less likely in countries surrounded by democratic countries. This proxy is unsatisfactory and could capture several other effects than third-party intervention. On the other hand, there are few other more satisfactory variables measuring third-party intervention as pertinent to armed conflict onset. Since the variable contains available data for most countries during the period of analysis, it can therefore contribute to examine *H5: "Resource wealth increases the likelihood of armed conflict onset by increasing the probability of foreign intervention on behalf of rebel movements"*.

History

Previous history of conflict and peace-years has been found to affect the likelihood of experiencing future conflict onset. While these conventionally have been directly included in the statistical model as a dummy-variable and the number of years since last conflict, I follow the recommendations of Carter and Signorino (2010) and include a polynomial of time since last conflict onset. This will be discussed in further detail in the methods section.

3.6.3 Demographic and geographical factors

Ethnicity

Measuring diversity is contentious and difficult. Since ethnicity is a salient issue, conclusions on ethnicity tend to be controversial and disputed. Nevertheless, there are findings that suggest that ethnicity, especially ethnolinguistic fractionalization, affects the likelihood of armed conflict onset. The thesis will employ Alesina, Devleeschauwer, Easterly, Kurlat and Wacziarg's (2003) measure of ethnolinguistic fractionalization, which contains up to date data for a wider range of countries. The variable ranges from 0 to 1 and measures the probability that two randomly selected individuals in a given country belongs to the same ethnolinguistic group. The measure does have issues, but for the purposes of serving as a control variable it should prove adequate[8].

Population

Population has repeatedly been found to be a significant predictor of armed conflict onset. Since population is inherently skewed as population varies widely between countries, the population variable is logarithmically transformed in order to take this into consideration. The population data is collected from Fearon and Laitin (2003) who have updated data from the World Bank with data collected from the CIA world fact book. As mentioned previously, poor states are less likely to have reliable data, which is especially true for population measures since many developing states lack reliable censure data, which may cause systematic errors in the measurement.

4.6.4 Physical geographical factors

The two main findings on the physical geographical variables that are likely to affect armed conflict onset is percentage of mountainous area in a given country and if a neighboring country is experiencing an ongoing conflict, often referred to as "conflict contagion". Mountainous area is a measure of the percentage of a country's total area that is mountainous. The included variable measuring mountainous area is gathered from Fearon and Laitin (2003), which base their data on work by the geographer A.J Gerard.

Conflict contagion has usually been studied by including a dummy variable indicating if a neighboring country is experiencing armed conflict in a given year. The thesis will adjoin this practice, and includes a contagion variable that denotes if at least one neighboring country has an ongoing conflict in a given year. The variable takes on the value of 1 if this is the case, and remains 0 otherwise. The variable is gathered from Braithwaite (2010) and is based on data from Buhaug and Gleditsch (2008). The

[8] See Alesina, A., et al. (2003): "Fractionalization". *Journal of Economic Growth,* 8 (2): 155-194 for an in-depth discussion of measuring ethnic diversity.

variable is compatible with the definition and coding of conflict in the UPSALA-PRIO armed conflict dataset. It is therefore well suited for the thesis' analysis.

With the data in place we will now turn to the method, were a discussion of how these data can be analyzed in a satisfactory manner will take place.

4.0 Method

Previous studies of the relationship between natural resources and civil conflict have arrived at different and often contradicting results. This partly stems from inconsistencies in the methodological approaches utilized by different scholars. In order to better illuminate the relationship between resources and conflict onset it is therefore crucial to have a clear, and as robust as possible, method of research. The thesis will employ a quantitative method of approach using a binary dependent variable and panel data. While, as it has been highlighted previously, qualitative studies of the relationship between resources and conflict are valuable, they provide a large challenge when studying conflict. Since conflicts are rare, they require large amount of resources and time, and hence are physically and logistically difficult. Furthermore, since the thesis seeks to examine the broader field of armed conflict and several types of resources, a quantitative approach is fruitful. Combined with a focus on examining the mechanisms provided in the theoretical section, I seek to provide a methodology that is coherent and fertile, and that can enlighten some of the discussion surrounding the relationship between natural resources and armed conflict onset.

Based on previous research, several methodological considerations have been identified as central. Firstly, as pointed out previously, disaggregating natural resources is helpful. Secondly, identifying and examining mechanisms is fruitful. Lastly, thinking of conflict as inherently multilevel is beneficial. The relevance of disaggregating natural resources and identifying and examining mechanisms has already been discussed in the previous chapter. This chapter will focus on how this can be done with available quantitative methods.

The chapter starts with an overview of logistic regression models. Since armed conflict onset is a dichotomous variable, logistic regression is applicable. The presentation of the logistic regression model is followed by a presentation of the benefits and issues involved in utilizing panel data when studying armed conflict onset. Here autocorrelation, hetereogeneity bias, and heteroskedasticity are identified as the main issues involved with analyzing panel data. Next, an overview of the fixed –and random effects models are given, which are "competing" suggested techniques for handling some of these analytical problems. This is followed by a presentation of the hybrid approach, which combines various benefits of both the fixed –and random effects approaches. Lastly, a discussion of interaction effects and accounting for time dependence is given.

4.1 Regression on categorical dependent variables: Logistic regression models

The thesis seeks to examine if and how natural resources affect armed conflict onset by employing a quantitative analysis. As discussed in the data section, the thesis' dependent variable is categorical, consisting of cases of armed conflict onset, and cases of peace. When dealing with categorical dependent variables most of the techniques derived from regular linear regressions become inapt (Powers and Xie 2008, Hosmer and Lemeshow 2000). Hence, special techniques are required for regression analysis of dichotomous dependent variables. Logistic regression is among the more developed and most widely used techniques for estimating models with dependent binary variables (Long and Freese 2006:131).

Simply stated, what distinguishes the logistic regression from linear regression with continuous dependent variables is a dichotomous, dependent, variable (Hosmer and Lemeshow 2000). Logistic regression is therefore aptly suited for this thesis' research question. Indeed, in the quantitative literature, conflict onset has mainly been studied through the use of logistic regression models. While logistic regression is not the only technique suited to analyze categorical variables, the flexibility and reproducibility it provides is attractive for the thesis' research question. Furthermore, logistic regression has been well developed to accommodate different model specifications (Cramer 2003:2). Additionally, analyzing mechanisms through interaction effects is fairly straightforward in logistic regression (Hosmer-Lemeshow 2000:70-74). Hence, logistic regression appears to be a well suited method of approach for studying the relationship between natural resources and armed conflict onset.

4.2 The nature of panel data

The main distinguishing feature of a panel dataset is that it has multiple observations on the same units over time (Baum 2006:219). Accordingly, the thesis' dataset, falls under the category of a panel dataset, since it contains information on countries over time. Utilizing a panel dataset has several benefits as well as some drawbacks. Firstly, by increasing the amount of data points available panel data allows for a greater degree of freedom and reduced collinearity among explanatory variables (Hsiao 2003:3-4). The added data points are especially beneficial in studies of conflict onset as conflicts are rare and a cross-sectional dataset without a time dimension would provide very few cases of conflict onset. Furthermore, the increased degrees of freedom allows one to include more explanatory variables, which combined with the reduced collinearity can provide grounds for increased confidence in the estimated model (Hsiao 2003:1-8).

Secondly, panel data allows one to control for individual heterogeneity (Baltagi 2008:6). In other words, one can incorporate in the model the fact that the units under study are not the same due to some unobserved attributes of said units. Due to panel data containing information on both individual units and time, one is also better able to control for the effects of variable omissions, through varying techniques (Hsiao 2003:5-6). The omission of explanatory variables can have substantial consequences on the estimated model, and in worst case can lead to a model that is not representative of the studied phenomena. The problems of omitted variables have therefore been a recurring critique of the natural resources civil conflict link, and quantitative studies in general. While panel-data does to some degree mitigate this problem, it is important to note that this is not solely a methodological problem and can, and should, also be made on basis of relevant theory, as was discussed in the thesis' theoretical chapter.

Thirdly, and related to the previous benefit, panel data are well suited to study the dynamics of adjustment (Baltagi 2008:7-8). This allows one to study the changes of a unit over time, and how this affects the outcome of interest. Hence, panel data allows for studying dynamics, which often provide more intuitive inferences in the social sciences. As was discussed in the theoretical section, the time dimension is argued to be important when studying conflict, since history, especially previous conflict, has been identified as an important predictor of conflict. Without the added time-dimension included in panel data, sufficiently controlling for conflict history would be problematic.

Lastly, panel data allows for estimating more complicated and realistic models, than most other types of data (Baltagi 2008:8-9). Since quantitative studies of social phenomena often are critiqued for being too simplistic and unrealistic, panel data with an appropriate statistical model seems apt to deal with this criticism. Additionally, examining the interaction effects suggested by *H3: "The effect of resource wealth on* *conflict onset is dependent on institutional capacity”* and *H5: “Resource wealth increases the likelihood of armed conflict onset by increasing the probability of foreign intervention on behalf of rebel movements”* would be more problematic without the added benefits panel data provides. On the other hand, there are some important methodological issues involved in utilizing panel data, of which the most pertinent will be discussed next.

4.2.1 Autocorrelation, heteroskedasticity, and heterogeneity.

While panel data models have a lot of strengths, they are not without issues (Baltagi 2008:10-11, Hsiao 2003:8-11 Menard 2002:234-39). Some of these pertain to data collection and measurement, and were discussed in the data section. The other main problems involve autocorrelation, heteroskedasticity, and heterogeneity bias, (Menard 2002, Hsiao 2003, Baltagi 2008), and failing to take them into account when utilizing panel data can lead to problematic interpretations of the studied relationship.

Autocorrelation arises due to the fact that the same units are studied over time. Since past behavior also affects future behavior, this needs to be taken into consideration in order to arrive at proper inferences on the studied relationship (Menard 2002:237). Issues of heteroskedasticity occur when some units are more variable than others, leading to problematic results (Menard 2002:233-34). The last issue is one of heterogeneity bias, which comes in two forms. Firstly, heterogeneity bias can occur if all units under analysis are affected by a “shock” during the same period. In the case of armed conflict the end of the Cold War has been hypothesized to constitute such a shock, although research has largely dismissed this (Fearon and Laitin 2003:77, Collier and Hoeffler 2004:574, Sambanis 2006:522, Dixon 2009:717). Additionally, and more relevant for the research question, is heterogeneity that occurs due to time-stable differences between units. In the case of armed conflict, institutions are often the most likely perpetrators in this regard.

Consequently, since the thesis utilizes panel data the issues of autocorrelation, heteroskedasticity and heterogeneity bias into must be taken into consideration. Hence, a discussion of statistical techniques that have been especially developed for reducing these issues will be given next.

Heterogeneity and the fixed –and random-effects model

In part to accommodate the issue of heterogeneity two dominant and opposing approaches, known as the fixed –and random effects approaches have been developed. Fixed -and random-effects are both techniques of estimating panel data, and differ mainly in how they deal with the problems of heterogeneity bias (Baum 2006:220-21). The procedures involve different methods of estimation and in some cases produce different and ambiguous substantive interpretations of results (Bartels 2008:1). Hence, the choice of estimation technique should be based on the needs of the researcher and should be stated explicitly.

4.2.2 Fixed –and random-effects models and the study of armed conflict onset

The main difference between the fixed –and random effects model is, as noted, how they deal with the issues of heterogeneity that may be caused by repeated observations on the same unit. Both approaches have benefits in studying the relationship between natural resources and armed conflict onset.

The fixed effects approach solves the unobserved heterogeneity issue by allowing each unit to have its own intercept, essentially making it its own control (Rabe-Hesketh and Skrondal 2008). This reduces the problem of omitting time-stable differences that might cause heterogeneity bias (Menard 2002:236-37), making the results of an analysis more robust. On the other hand, the fixed-effects model does so at the loss of efficiency and the inability to include time-invariant variables in the model, since these are perfectly collinear with the unit intercept (Baum 2006:222).

The random-effects approach, on the other hand, attempts to model the unobserved heterogeneity by including it in the regressions error term, treating the unobserved time and unit differences as random variables (Menard 2002:234). In contrast to the fixed-effects model, the random effects model is efficient and allows for the inclusion of time-invariant variables (Menard 2002:235-36). This does, however, come with a cost. The random-effects approach assumes that the explanatory variables are not correlated with unobserved unit characteristics and that error terms are unit specific and static (Menard 2002:482). This is, in most cases, an unrealistic assumption. Hence, the fixed-effects model is often argued to be superior (Menard 478-82).

Since the research question at hands seeks to examine cross-sectional hypotheses by examining the intersection between time-invariant institutions and natural resources a random-effects model is the only applicable of the two approaches. Additionally, the thesis also includes largely time-invariant dummy variable measures of natural resources, since continuous measures are hard to obtain and rarely separate resources according to mode of production, the latter being a requirement for examining *H1:"The effect of a natural resource on armed conflict onset is dependent upon its lootability, legality and obstructability"*.

On the other hand, it is not apparent that any of the thesis' included variables are not in part correlated with unobserved factors that might affect armed conflict onset, which could cause the random-effects model to be biased. Moreover, a fixed-effects model would be desirable in order to better handle the problem of omitted variable bias, which is a desirable benefit for clarifying the relationship between natural resources and armed conflict onset.

Estimating ordinary logistic regression with corrections for panel structure, and fixed –or random effects models have been the most common practice in previous studies of armed conflict onset. Developments have, however, been made towards models that combine some of the benefits of both the fixed –and random-effects approaches. Since both the fixed –and random-effects approaches have advantages for the research question, a model combining the main benefits of both is highly attractive. The thesis will therefore employ such a model. Consequently the next section will present an alternative that has been called a "hybrid" approach, and which is argued to, in many cases, be superior to both the fixed –and random-effects approaches.

4.3 A hybrid model

Analyzing panel data within quantitative studies of armed conflict onset has, as mentioned, usually been restricted to fixed –or random effects panel data models. A third option, however, is to utilize a combination of both, often denoted as a unified or hybrid approach. This approach is argued by its proponent to contain the efficiency and flexibility of a random-effects model and the robustness a fixed-effects model can provide. It arguably aptly suited to account for two of the main issues involved in analyzing panel data, heterogeneity and heteroskedasticity. Furthermore, it is quite flexible regarding which hypotheses that can be examined (Bartels 2008), and allows for inclusion of interaction effects between time-variant and time-invariant variables. This is essential for examining *H3: "The effect of natural resources on conflict onset is dependent on institutional capacity"* and H*5: "Resource wealth increases the likelihood of armed conflict onset by increasing the probability of foreign intervention on behalf of rebel movements".*

On the other hand, the approach does not in itself handle the issues of autocorrelation –or time dependence. It does, however, allow for the application of separate techniques that have been found apt to handle time-dependence in logistic regression (Bartels 2008), which will be discussed in further detail later in the chapter. The hybrid approach is arguably therefore especially well-suited for examining the relationship between natural resources and armed conflict onset.

What Bartels (2008) refer to as a "unified approach" and Allison (2009) calls a hybrid method, works by including variables that calculate unit specific means and deviations for all time-varying variables, and thereby including them into a random-effects regression, treating time as one level and units as another. By doing this one is able to separate within unit and between unit effects (Allison 2009, Bartels 2008). In the case of the thesis' analysis, this provides the ability to separate between within country effects and between country effects of the independent variables, thereby reducing the aforementioned problems of heterogeneity. This approach furthermore contributes to solving two additional problems that have been prevalent in studies utilizing panel data (Bartels 2008).

Firstly, by distinguishing between within and between effects, the hybrid approach is able to handle the problem of cluster confounding (Bartels 2008). This problem occurs when a level-1 (time-variant) variable exhibits separate within and between effects. Not taking this into account can significantly alter the interpretation of the effects of the included independent variables. Separating between within and between effects furthermore allows one to, for instance, examine if the argued effect of natural resources on armed conflict onset is mostly due to changes within countries or between countries. Hence, the hybrid framework allows for more substantive interpretations of effects (Bartels 2008).

Secondly, by estimating a random-effects model one is able to model unobserved heterogeneity at the cluster (country) level. Unobserved heterogeneity at the cluster level can produce significant results where none exist. By estimating a random-effects model with included cluster means –and deviations this problem is largely reduced (Bartels 2008). Moreover, including the means and deviations of time-variant variables, which represent between and within effects respectively, has the advantage of satisfying the main assumption of the random-effects model, namely that the time-variant independent variables are uncorrelated with the error term (Bartels 2008:11-12). Separating between within and between effects and accounting for cluster-level heterogeneity also serves to minimize the problems of heteroskedasticity, which was previously highlighted as one of the main issues in analyzing panel data (Bartels 2008:14).

Lastly, the hybrid model allows for the assessment of cluster confounding by testing if the differences between within-cluster –and between-cluster effects are statistically significant (Bartels 2008:12-14). This furthermore serves as an alternative to the widely used Hausman-test, which test for differences between coefficients from an FE and RE model (Bartels 2008), and is widely used to choose between FE and RE models. The Hausman test has, however, been found to be biased toward fixed-effects models (Guggenberg 2010 in Verbeek 2012:386). The alternative posed by the hybrid approach is therefore more fruitful. If the within and between effects are not significantly different, a random-effects model is therefore arguably preferable due to its efficiency.

In conclusion then, the hybrid approach has several benefits for the research question. However, as with most methodologies, the hybrid approach is no panacea. It does for instance not solve the issues of time-dependence, which are highly relevant when panel data is analyzed. A discussion of how to best account for time when studying the relationship between natural resources and armed conflict onset is therefore given next.

4.4 Accounting for time

Modeling the dynamics –or time aspect of armed conflict, which can be considered as grouped duration data (Carter and Signorino 2010), is a complicated and debated issue, both theoretically –and methodically. Several solutions have been proposed based on the nature of the data at hand. Most conflict datasets can technically be considered as Time-Series Cross-sectional (TSCS) datasets in that they have relatively large number of time observations relative to number of countries. This is opposed to panel datasets, which usually have a large number of units observed over few occasions. Based on this Beck and Katz (1995) and Beck, Katz and Tucker (1998) argue that separate techniques are required in order to take the time dependence, and bias in the standard errors, into account. They therefore present a solution, which consists of including a series of time-dummies that they show are able to accommodate the fact that, especially in conflict studies, past history of conflict, and country dynamics, are likely to affect the future likelihood of conflict. The time-dummy approach has been practiced and found appropriate in several quantitative studies of armed conflict (Fjelde 2009, Lujala 2010, Buhaug, Gates and Lujala 2005, Hegre, Ellingsen, Gates and Gleditsch 2001, Hegre and Sambanis 2006).

Carter and Signorino (2010) on the other hand argue that including time dummies is inefficient and can lead to problems of separation. When the number of time periods increase it is likely that more time-dummies will have to be included, which results in less efficiency (Carter and Signorino 2010). While the efficiency issues of time-dummies pose some analytical problems, the separation issue is potentially more severe (Carter and Signorino 2010). Separation occurs when one or more variables perfectly predict the outcome of interest, in which case most statistical software will drop both the time-dummy and the perfectly predicted observations. When the duration of an event is fairly long, typically more than 15 time periods, separation is likely to take place (Carter and Signorino 2010). This can occur in several variations, a discussion of which is out of reach of this thesis[9].

Both the issue of inefficiency and separation are likely to take place in conflict data. Consequently, utilizing time-dummies could prove problematic. Carter and Signorino (2010) present a solution to these issues, however, which involves using a cubic polynomial smoothing procedures. This basically entails including a variable measuring time since the last event (t), and including the exponent of this variable in the second (t^2) and third degree (t^3). Carter and Signorino (2010) find this solution apt to handle both the issue of inefficiency and separation. They furthermore show

[9] See Carter and Signorino (2010:275-76) for an excellent account.

that the solution is flexible to different model specification and estimation. Hence, including a variable measuring time since last conflict onset will be the method used in the thesis' analysis for handling the issues of dynamics, which should make the results more robust.

4.5 Interaction effects

The theoretical overview presented several hypotheses on the relationship between natural resources and armed conflict, some of which pertain to the interaction between natural resources and other factors. Interaction effects are therefore of high theoretical interest for the research question at hand. Interaction effects are, however, technically demanding (Hox 2010:63-68). This is often amplified in multilevel and longitudinal analyses, where interaction effects often are of a cross-level nature, between variables at different levels. Since both time-variant (level-1) and time-invariant (level-2) measures of natural resources are included in the thesis' analysis, hypothesis *H3: "The effect of natural resources on conflict onset is dependent on institutional capacity"* and H5*: "Resource wealth increases the likelihood of armed conflict onset by increasing the probability of foreign intervention on behalf of rebel movements",* can be considered cross-level interactions.

There are two main arguments on which to base cross-level interactions (Snijders and Bosker 2011:82. The first, and perhaps dominant, is inductive and is based on finding a significant random-slope for a variable when exploring the data. The second is deductive, and is based on theoretical arguments formulated before examining the data. The cross-level interactions in this thesis are of the latter kind. The cross-level interactions included in the analysis are therefore included without testing for random slopes, due to the high computational requirements involved in testing for random slopes, especially when the dependent variable is dichotomous. Snijders and Bosker (2011:82-83) argue that this is a viable approach, since the statistical test for cross-level interactions is considerably higher than one for random-slopes. Therefore, while it is acknowledged that testing for random slopes of the explanatory variables could provide valuable information on the relationship between natural resources and armed conflict; this is left to future research.

Moreover, the inclusion of interaction effects imposes two important technical considerations (Hox 2010:63-68), which are relevant for the thesis' analysis. Firstly, an interaction should be interpreted as a system and the variables encompassing the interaction should therefore be included in the model, even if they are not by themselves significant (Hox 2010:63). This furthermore entails that an interaction should not only be interpreted on its own significance but whether or not it together with its encompassing parts significantly improves model fit. This will be done by a log-likelihood ratio test which can identify if the model including the interaction system significantly fits the data better than the one without the interaction.

Secondly, when an interaction is included in a model, the meaning of the variables that make up the interaction changes (Hox 2010:63-64). The effect of one variable now represents the expected value of the variable when the other is equal to zero. This poses problems of interpretation if one of the variables has a value of zero that is widely beyond the range of values that have been observed, as is the case of many variables such as age, or education. It is therefore generally recommended to center the variables that make up an interaction on their grand mean. This is, however, as will be shown subsequently, not an issue for the variables that will comprise the interaction systems in this thesis' analysis. Furthermore, this issue is largely reduced in newer statistical software[10], which allows for easier interpretation of interaction effects.

4.6 Summary

Quantitative studies of the relationship between natural resources and armed conflict have often reached contradicting conclusions, which have partly been contributed to different research strategies and methodologies. This thesis seeks to improve upon previous studies by employing a relatively novel methodological framework, which can clarify some of the methodological issues of previous research, while maintaining the ethos of parsimony. The chapter has therefore firstly given an overview of the conventional logistic regression, as well by an overview of the benefits and issues of employing panel data, which is the type of data utilized in the thesis. Here autocorrelation, heterogeneity and heteroskedasticity were identified as the most important issues to account for. Methods for taking these issues into consideration were discussed next. Here the fixed –and random-effects approaches were highlighted as the previously most widely applied solutions to the aforementioned issues.

[10] All models in the thesis are estimated using Stata 12. Interaction effects are interpreted using the margins, and marginsplot command.

Subsequently, an approach combining some of the benefits of both the fixed –and random-effects approaches was highlighted. This hybrid approach was suggested as aptly suited to handle the issues of heterogeneity and heteroskedasticity, as well as potentially providing more substantiated analytical results. Lastly, the issues of time-dependence and examining interaction effects in quantitative studies of the relationship between natural resources and armed conflict onset were discussed. With the methodological considerations accounted for, we will now move on to the analysis, which will put the method into practice.

5.0 Empirical analyses and results

The previous chapters have presented a series of hypotheses on the link between natural resources and armed conflict onset, as well as a method for evaluating them. This chapter builds on the established foundations, and I will here present the empirical analysis and results. Accordingly, this chapter will through a range of statistical models provide the results of the empirical analysis of the five formulated hypotheses on the relationship between natural resources and armed conflict onset.

The chapter will start with an overview of the pertinent descriptive statistics of the dependent variable, armed conflict onset, and the pertinent explanatory –and control variables, focusing on the means, deviations, maximum –and minimum values, and number of units. The descriptive statistics serves as a broad overview of the main variables and are fruitful as a general indication of the relationship under study.

The descriptive statistics will be followed by a presentation of the hybrid model, which serves as a test of if there are significant within and between country effects on any of the explanatory or control variables, as well as a litmus test of the assumptions of the random-effects model. Here it will be shown that none of the included explanatory –or control variables have significant differences in their within and between effects, and that the assumptions of the random-effects model are upheld.

The third part presents the explanatory models, starting with the resource-dummy models, followed by the models with the continuous resource measures. Here it is found that among the included resources, only secondary –and primary diamonds significantly affect armed conflict onset. In addition, the effect of diamonds works in opposite directions. Secondary diamond production appears to increase the likelihood of armed conflict onset while primary diamond production, on the other hand, appears to decrease it. The part ends with a presentation of a reduced model, which only includes the variables that have proven significant predictors of armed conflict onset in the prior models.

The last part builds upon the reduced model, and examines the interaction effects suggested by H3 and H5. As discussed, interaction effects are more difficult to estimate, and are likely to be significantly affected by model specification. Hence, a reduced and parsimonious model is desirable when examining interactions. The reduced model therefore serves as a fruitful foundation for if natural resources affect armed conflict onset indirectly through state capacity (H3) and foreign intervention (H5).

5.1 Descriptive statistics

This section will provide a brief overview of the key descriptive statistics of the variables included in the thesis, starting with the dependent variable, armed conflict onset. This will be followed by an account of the explanatory variables of interest, natural resources. Lastly, descriptive statistics of the control variables will be given. The descriptive statistics for all variables will be given as mean, standard deviation minimum and maximum, and number of units, N. These descriptive statistics serve as a useful overview of the investigated relationship and provide fertile grounds for the more complex regression models. A summary of all the key descriptive statistics are presented in Table 2.

Table 2 Descriptive statistics of included variables

Variable	Obs.	Mean	Std.Dev	Range
Onset	7049	0.03	0.17	0/1
Onoilp	7049	0.49	0.50	0/1
Offoilp	7049	0.19	0.39	0/1
Oilp	7049	0.52	0.50	0/1
Sec.Diap	7049	0.17	0.37	0/1
P. Diap	7049	0.08	0.27	0/1
Oilprod_capita	5016	0.05	0.28	0/5
Dia_capita	5020	0.08	0.73	0/13
Pc_reserves	5041	0.81	6.77	0/162
GDP	6877	3.80	4.66	0/67
Popul.	7020	33060.79	107599.65	222/1288400
Ethno.ling	6502	0.39	0.29	0/1
Polity. squared	6986	56.60	32.08	0/100
Mountain	6956	0.18	0.21	0/1
Infant mort.	4290	76.21	54.32	3.7/215
Illiteracy	2880	37.53	26.72	0.3/94
Instability	6945	0.13	0.34	0/1
Bordering conf.	6232	0.35	0.48	0/1
State capacity	4501	0.98	0.50	0/7
Neigh. Polity^2	6232	28.97	28.17	0/98
Oil / GDP	4996	0.03	0.27	-3.8/16

5.1.1 Armed conflict onset

Armed conflict onset is the dependent variable, and as mentioned is a dummy-variable that takes on the value of 1 if a conflict takes place in a given year, and 0 otherwise. This, of course, entails that the variable has a minimum value of 0 and a maximum value of 1, with the mean being 0.03. Accordingly, the average number of conflicts during the entire period is about three percent, which fits with previous studies of armed conflict using the UPSALA-PRIO armed conflict dataset. The standard deviation is 0.17, which signifies that there is considerable dispersion around the mean.

5.1.2 Natural resources

As indicated by their means, onshore –and offshore oil production occurred in respectively 49 and 20 percent of country years in the period. The numbers for diamonds are, as expected, lower, being sixteen percent for secondary diamond production and eight percent for primary diamond production. All of the resource production and discovery dummies have large dispersion around the mean, as can be seen by their standard deviation.

The table furthermore shows that the average amount of oil production over the period is 0.05 barrels per capita, with the minimum being zero and maximum being 4.9 (Kuwait in 1964). The standard deviation of 0.28 shows significant variation around the mean. The average production of diamonds per capita is 0.08 with a minimum of zero and maximum of 13 (Botswana in 1991) and a standard deviation of 0.8. Oil reserves per capita has a mean of 0.81 with the minimum being 0 and maximum being 162 (Kuwait in 1964).

Stated briefly, the descriptive statistics of the natural resources variables show that there are large variations across countries and time in the presence and production of natural resources. This is expected, as natural resources are unevenly distributed globally. This could cause problems for the regression models. A discussion of this will be given at the end of the chapter.

5.1.3 Control variables

GDP per capita in USD1000 has a mean of 3.8, a minimum of 0.3 (North Yemen), and a maximum of 66.73 (Kuwait). The standard deviation of 4.7 signifies large dispersion around the mean. Population has a mean of 33 million, with a minimum of 220000 (Bahrain) and a maximum of 1.2 billion (China) with a standard deviation of 10 million. Ethnolinguistic fractionalization has a mean of 0.39 with a substantial standard deviation of 0.29. The average polity score squared is 57 with a standard deviation of 32. Mountainous area shows a mean of 18 percent, a minimum of 0.001 percent, a maximum of 94.1 percent, and a standard deviation of 21 percent. Infant mortality rate has a mean of 76, a minimum of 3.7 (Sweden during the 90's), and a maximum of 215 (Sierra Leone in 1970) with a standard deviation of 54. Lastly, illiteracy rate has a mean of 37 percent, a minimum of 0.3 (Poland during the 90's), a maximum of 94.1 percent (Niger in 1971) with a standard deviation of 27 percent. Instability has a mean of 0.13 with a considerable standard deviation of 0.34. Conflict at border has a mean of 0.35 with a standard deviation of 0.48. State capacity has a mean of 0.98 with a standard deviation of 0.5, with a minimum of 0 and a maximum of 7. Lastly, average neighborhood polity score has a mean of 28.93 with a standard deviation of 28.17, and a minimum of 0 and a maximum of 98.

Missing data

Several of the control variables have problems with missing values. This is especially the case for illiteracy and infant mortality rate, which only contains data for 2880 and 4290 of the 7049 observations respectively. Missing data is a serious problem, something that can be seen by an abundance of literature discussing it, most of which relate to imputation of data in order to obtain a complete dataset (Twisk 2002:106). This thesis, does, however, deal with the problem by utilizing multilevel estimation techniques, in form of the random-effects and hybrid model, which are arguably better suited to handle problems of missing data than imputation (Twisk 2002:107). This does not solve the problem completely, but is arguably one of the better approaches for handling the problem.

5.2 The hybrid model

In the methods section, the hybrid model was suggested as a fruitful methodological approach for examining the relationship between natural resources and armed conflict, since it can handle several of the issues involved with utilizing panel data. This section therefore presents the results of an estimated hybrid model, which includes within (deviations) and between (means) effects of all time-variant variables. This model allows for a relatively unbiased litmus test of the random-effects model, and serves to examine if any of the independent variables have significant differences in their within and between effects.

Table 3 The hybrid models: Dependent variable armed conflict onset

VARIABLES	(1) Coeff.	Stdr.Er	(2) Coeff.	Stdr.Er
drugs	-0.32	(0.30)		
oilp	0.15	(0.32)		
SdiaP	0.41	(0.32)		
PdiaP	-0.86*	(0.48)		
meanoilpprod			-0.37	(1.62)
meandiamonds			-1.27	(1.89)
Ethno. Ling	1.48***	(0.49)		
Mountain	0.11*	(0.07)		
Meanpopul.	0.30***	(0.12)	0.33***	(0.09)
meanconfbord	0.13	(0.37)	-0.16	(0.36)
MeanGDP	-0.15	(0.25)	-0.23	(0.24)
Meanillit.	-0.00	(0.01)	-0.01	(0.01)
Meaninfant.	0.00	(0.01)	0.01	(0.01)
Meanpolity2	0.01	(0.01)	-0.00	(0.01)
meaninstab	0.05	(0.99)	0.28	(0.95)
devpopul	0.51	(0.90)	0.90	(0.89)
devconfbord	0.22	(0.35)	0.16	(0.33)
devGDP	-0.00	(0.43)	-0.10	(0.40)
devillit	0.04	(0.03)	0.03	(0.03)
devinfant	-0.01	(0.01)	-0.00	(0.01)
Devpolity^2	-0.01**	(0.01)	-0.01*	(0.01)
devinstab	-0.06	(0.29)	0.06	(0.28)
devoilprod			1.67	(2.15)
devdiamonds			-1.53	(2.02)
devPCreserve			0.06	(0.11)
Constant	-6.04***	(1.33)	-5.84***	(1.07)
Observations	2,651		2,761	
Number of groups	95		100	
Log-likelihood	-388.1		-420.8	

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

The table shows estimated coefficients in form of logits. Coefficients for time polynomials are not shown

Table 3 presents two hybrid models. The first model includes the resource-dummy variables along with the time-invariant control variables, as well as the time-variant means (between-effects) and deviations (within-effects). The second model substitutes the time dummies with the means and deviations of the continuous resource measures, keeping all else equal.

The effects of the coefficients in themselves are not of primary interest here, but rather whether there is a statistically significant difference between the means (between-effects) and deviations (within-effects). In accordance with Allison (2009) a Wald test was performed in order to test the difference between the means and deviations[11]. The results of the Wald test show that none of the time-variant variables have significant differences in their within and between effects. This suggests that the assumptions of the random-effects, namely the absence of cluster confounding and an error term that is not correlated with the independent variables, are upheld. Hence, the random effects model is preferable over the hybrid model as it is more efficient and parsimonious. Subsequent models are therefore random-effects models.

5.3 Main explanatory models

This section will present the results of the estimated random-effects models. The main explanatory models that examine the relationship between natural resources and armed conflict onset through several resource measures variables are presented first, starting with the resource-dummy models, followed by the models including the continuous resource measures.

5.3.1 The resource-dummy models

In order to examine *H1:"The effect of a natural resource on armed conflict onset is dependent upon its lootability, legality and obstructability"* four models with disaggregated resource measures were estimated. Table 4 presents the four estimated models. Model one (1) estimates the effect of drug cultivation, oil production, and primary and secondary diamond production on armed conflict onset. Model two (2) furthermore divides oil production into offshore and onshore production. Model three (3) and four (4) expand model one and two with the pertinent control variables. The model presentation will follow the previous chapters. Accordingly, the effects of oil on armed conflict onset will be presented first, followed by the effects of diamonds and drugs. The models follow a buildup that moves from a simple to a more complicated model in order to give a broader overview of the studied relationship.

[11] The wald test can be found under tests in the appendix

Table 4 Explanatory resource dummy models: Dependent variable armed conflict onset

VARIABLES	(1)	(2)	(3)	(4)
drugs	0.68***	0.67***	-0.26	-0.25
	(0.22)	(0.22)	(0.28)	(0.28)
oilp	0.00		0.12	
	(0.19)		(0.31)	
Sec. Dia.	0.89***	0.88***	0.48	0.49
	(0.27)	(0.27)	(0.30)	(0.30)
P. Dia.	-0.40	-0.40	-0.87**	-0.83*
	(0.36)	(0.37)	(0.44)	(0.45)
offoilp		0.06		-0.06
		(0.21)		(0.28)
onoilp		0.00		0.24
		(0.20)		(0.32)
GDP			-0.07	-0.09
			(0.21)	(0.21)
Popul.			0.31***	0.29**
			(0.11)	(0.12)
Ethno. Ling			1.42***	1.45***
			(0.47)	(0.48)
Polity^2			-0.01*	-0.01*
			(0.00)	(0.00)
Mountain			0.13**	0.12*
			(0.06)	(0.06)
Infant.			0.00	0.00
			(0.01)	(0.01)
Illit.			0.00	0.00
			(0.01)	(0.01)
Instab.			-0.02	-0.02
			(0.27)	(0.27)
Confbord.			0.12	0.11
			(0.24)	(0.24)
Constant	-3.70***	-3.70***	-5.79***	-5.68***
	(0.24)	(0.24)	(1.24)	(1.27)
Observations	7,044	7,044	2,651	2,651
Number of groups	164	164	95	95
Log-likelihood	-908.5	-908.4	-389.8	-389.6

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

The table shows estimated coefficients in form of logits. Coefficients for time polynomials are not shown

Oil

Model one (1) indicates that oil production has a negative effect on armed conflict onset, but the effect is insignificant. Model two (2) indicates that onshore oil production has a negative effect on armed conflict onset, while offshore oil production has a positive effect, but neither of the effects is significant. The signs of all oil production variables change when control variables are included in model three (3) and four (4). The oil production dummies do, however, remain insignificant after the relevant controls are included. Hence, the results of oil production do not appear to support *H1:"The effect of a natural resource on armed conflict onset is dependent upon its lootability, legality and obstructability"*.

Diamonds

The results in model one (1) and two (2) suggests that, diamond production has an effect on armed conflict onset, and that there is indeed a difference in the effect of primary and secondary diamonds. The results show that secondary diamond production increases the likelihood of armed conflict onset while controlling for primary diamond –and oil and drug production. The effect is significant at the 1-percent level and entails that a country with secondary diamond production has a 4.3 percent likelihood of experiencing an armed conflict onset when all of the other production variables are held at their means. This is 2.5 percent more than the estimated likelihood for countries without secondary diamond production. Primary diamond production in model one (1) and two (2), on the other hand, has a negative effect on armed conflict onset, but the effect is not significant.

When the relevant control variables are included, the results change substantially, as can be seen in model three (3) and four (4). The effect of primary diamond production remains negative, but is more than doubled. It also becomes statistically significant at the 5-percent level in model 3 and at the 10-percent level in model four. The effect of secondary diamond production, in contrast, is nearly half of the previous models, and becomes insignificant. Primary diamond production reduces the likelihood of armed conflict onset from three percent to 1 percent when all other variables are held at their means. This can be considered a substantial amount given that armed conflict onset mean of 3 percent.

The diverging results of secondary and primary diamonds give some indications toward supporting H1. Secondary diamonds, which are more lootable and less obstructable than primary diamonds appear to have a different effect than primary diamonds, which are more obstructable and less lootable.

Drugs

Model one and two also show that drug cultivation significantly affects armed conflict onset. The effect suggests that a country with drug cultivation has a likelihood of 3.5 percent of experiencing conflict when diamond and oil production are held at their means, which is a difference of 1.5 percentages from countries without drug cultivation. The effect is significant at the 1 percent level. When including the control variables in model three (3) and four (4), however, the effect becomes negative and not significant. This suggests that the effect of drugs in model one (1) and two (2) is spurious and is removed when the relevant control variables are included. The effect of drugs does not provide any evidence for supporting H1, although it should be noted that the measure of drug production is rather imprecise. Therefore it is problematic to write of the effect entirely. If drug production does in fact affect armed conflict onset one would expect it to increase the likelihood of experiencing armed conflict onset, since it possesses similar lootability and obstructability as secondary diamonds. Further probing of this hypothesis requires better data on drug production, however, and is consequently out of reach of this thesis.

5.3.2 Resource production models

In order to investigate the relationship between natural resources and armed conflict more comprehensively, using continuous resource measures is fruitful. The continuous resource measures allow for examining *H2: "Resource dependence rather than abundance increases the likelihood of armed conflict onset"* and *H4: "A larger reserve of natural resources per capita increases the likelihood of armed conflict onset"*. *Table 5* consequently presents three estimated models of per capita resource production, reserves, and resource dependence, and their effect on armed conflict onset.

Table 5 Explanatory resource production models: Dependent variable armed conflict onset

VARIABLES	(4)	(5)	(6)
Diamonds	-0.40	-2.02	
	(0.55)	(2.08)	
Oil production PC	-0.93	0.19	
	(0.97)	(0.77)	
Oil reserves PC		-0.01	
		(0.04)	
Oil/gdp			0.43
			(0.32)
GDP		-0.03	-0.12
		(0.22)	(0.21)
Popul.		0.26***	0.26***
		(0.08)	(0.08)
Ethno. Ling.		1.56***	1.51***
		(0.53)	(0.53)
Polity^2		-0.01**	-0.01*
		(0.00)	(0.00)
Mountain		0.10	0.11*
		(0.06)	(0.07)
Infant		0.00	0.00
		(0.01)	(0.01)
Illit		-0.00	-0.00
		(0.01)	(0.01)
Instab		-0.04	-0.00
		(0.28)	(0.28)
Confbord		0.03	0.03
		(0.23)	(0.23)
Constant	-3.41***	-5.43***	-5.44***
	(0.31)	(1.11)	(1.15)
Observations	5,016	2,609	2,642
Number of groups	155	94	95
Log-likelihood	-708.5	-390.9	-391.7

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The table shows estimated coefficients in form of logits. Coefficients for time polynomials are not shown

Model four (4) includes diamond –and oil production. Model five (5) additionally incorporates control variables as well as the oil reserves variable. Model six (6) substitutes the continuous resource measures with the measure of oil dependence.

As can be seen by model four (4) and five (5), the effects of production of diamond and oil are both negative in the fourth model, but are not significant. Both effects remain insignificant after including control variables in model five (5), but the effect of oil production goes from being negative to becoming positive. Additionally, model five (5) includes both oil *production* and *reserves*. This serves to examine the greedy rebels mechanism through *H4: "A larger reserve of natural resources per capita* *increases the likelihood of armed conflict onset"*. Model five (5) shows that the size of oil reserves per capita does not significantly affect conflict onset when oil production is controlled for. Hence, the data does not support H4.

Whereas the previous two models included measures of resource production –or abundance, model six (6) includes a measure of resource *dependence*. This allows for testing H2: "*Resource dependence rather than abundance increases the likelihood of armed conflict onset"*. The results show that the effect of oil revenues relative to GDP on armed conflict onset is positive, but the effect is insignificant. Consequently, based on the data at hand, the results do not support H2. Resource dependence does not appear to increase the likelihood of armed conflict onset.

5.4 A more basic model

Table 6 A more basic model: Dependent variable armed conflict onset

VARIABLES	Coeff.	Std.Er
P. Dia	-0.62*	(0.33)
Sec. Dia	0.57**	(0.24)
GDP	-0.18*	(0.11)
Popul.	0.26***	(0.06)
Ethno. Ling.	1.17***	(0.34)
Mountain	0.14***	(0.05)
Polity^2	-0.01***	(0.00)
Constant	-5.38***	(0.70)
Observations	6,262	
Number of groups	146	
Log-likelihood	-783.1	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The table shows estimated coefficients in form of logits.
Coefficients for time polynomials are not shown

Table 6 shows a reduced model including only the variables that have proven consistently significant in the previous models. The reduced model serves two purposes. Firstly, it provides an overview of the main variables that have significant effects on armed conflict onset. Secondly, it provides a solid foundation for estimating the models examining interactions. As discussed in the methods chapter, models containing interaction effects are more difficult to estimate and compute, doubly so for cross-level interactions, and a reduced model therefore is therefore fruitful when estimating such models. The reduced model is primarily used to examine the interaction effects implied by *H3: "The effect of natural resources on conflict onset is dependent on institutional capacity"* and H*5: "Resource wealth increases the likelihood of armed conflict onset by increasing the probability of foreign intervention on behalf of rebel movements".*

The results of the reduced model indicate that both primary –and secondary diamonds significantly affect armed conflict onset. As in previous models, primary diamonds reduce the likelihood of armed conflict onset, while secondary diamonds increase the likelihood of armed conflict onset. Compared to the previous models primary diamonds are reduced from being significant at the 5-percent level to being significant at the 10-percent level. The effect of secondary diamonds on the other hand increases from the 10-percent level to being significant at the 1-percent level. The table furthermore shows that population, ethnolinguistic fractionalization, mountainous terrain, and democracy squared, have significant effects on armed conflict onset at the 1-percent level. In line with previous studies, increased population, ethnolinguistic fractionalization and mountainous terrain, all increase the likelihood of armed conflict onset. The negative effect of democracy and GDP are also in line with previous studies. Increased GDP decreases the likelihood of armed conflict onset, while the squared democracy variable suggests that both highly autocratic and highly democratic regimes are less likely to experience armed conflict onset.

5.5 Mechanisms and interaction effects

The previous models considered the direct effects between oil, diamonds and drugs on armed conflict onset. The models presented in this section will examine the indirect effects that are argued to link natural resources to armed conflict by examining interactions. Accordingly, *table 7, 8* and *9* present models including the interaction effects suggested by *H3: "The effect of natural resources on conflict onset is dependent on institutional capacity"*. The hypothesis is tested by including an interaction term between the various resource measures and state capacity.

Table 10, 11 and *12* serve to examine *H5: "Resource wealth increases the likelihood of armed conflict onset by increasing the probability of foreign intervention on behalf of rebel movements"*. The tables present the results of the models including interactions between oil, diamonds and drugs, and foreign intervention in form of average neighborhood polity score.

Since, as mentioned in the methods chapter, interaction effects should be interpreted as a system, all models including an interaction term are tested against the basic model with a log-likelihood ratio test[12]. This test examines the fit of the models with and without interaction terms and indicates if the interaction system significantly improves the models fit, thereby providing a means of rejecting or confirming H3 and H5.

12 See test section in appendix for an overview of the LR-tests.

5.5.1 Resources and state capacity

Oil

Table 7 Models including interactions between oil production and state capacity: Dependent variable armed conflict onset

VARIABLES	(7)	(8)	(9)
oilp	-0.15		
	(0.47)		
onoilp		-0.23	
		(0.48)	
offoilp			-0.19
			(0.50)
State cap.	-0.47	-0.54	-0.28
	(0.35)	(0.36)	(0.26)
Sec. Dia	0.36	0.36	0.41
	(0.27)	(0.27)	(0.27)
P. Dia	-0.70*	-0.66	-0.79**
	(0.40)	(0.40)	(0.40)
GDP	-0.27*	-0.28**	-0.22
	(0.14)	(0.14)	(0.14)
Popul.	0.22**	0.22**	0.27***
	(0.09)	(0.09)	(0.08)
Ethno. Ling.	1.24***	1.25***	1.24***
	(0.45)	(0.45)	(0.45)
Mountain.	0.15**	0.14**	0.14**
	(0.06)	(0.06)	(0.06)
Polity^2	-0.01**	-0.01**	-0.01**
	(0.00)	(0.00)	(0.00)
oilp#State cap.	0.39		
	(0.45)		
onoilp#State cap.		0.52	
		(0.46)	
offoilp#State cap.			0.08
			(0.50)
Constant	-4.90***	-4.84***	-5.44***
	(0.99)	(0.99)	(0.98)
Observations	4,308	4,308	4,308
Number of groups	111	111	111
Log-likelihood	-576.5	-576.1	-577.0

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The table shows estimated coefficients in form of logits. Coefficients for time polynomials are not shown

Table 7 presents three models with interactions between oil production and state capacity. All of the interactions have a positive effect on armed conflict onset, but as can be seen, none are significant when diamond production, GDP, population, ethnolinguistic fractionalization, mountainous terrain, and democracy are controlled for. The log-likelihood tests comparing the models to the reduced model also confirm that none of the interactions significantly improve model fit. Consequently, the results of the interactions do not provide any supporting evidence of H3. It does not appear that the effect of oil on armed conflict onset is dependent on state capacity.

Diamonds

Table 8 Models including interactions between diamond production and state capacity: dependent variable armed conflict onset

VARIABLES	(10)	(11)
Sec. Dia	0.42	1.15**
	(0.26)	(0.49)
P. Dia	-0.27	-0.72*
	(0.75)	(0.38)
State cap.	-0.21	-0.06
	(0.24)	(0.24)
GDP	-0.22*	-0.20
	(0.13)	(0.13)
Popul.	0.24***	0.24***
	(0.08)	(0.08)
Ethno. Ling	1.23***	1.25***
	(0.44)	(0.43)
Mountain	0.15**	0.15**
	(0.06)	(0.06)
Polity^2	-0.01**	-0.01**
	(0.00)	(0.00)
P.Dia#State cap.	-0.56	
	(0.71)	
Sec. Dia#state cap.		-0.88*
		(0.51)
Constant	-5.19***	-5.32***
	(0.91)	(0.88)
Observations	4,308	4,308
Number of groups	111	111
Log-likelihood	-576.8	-575.6

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The table shows estimated coefficients in form of logits. Coefficients for time polynomials are not shown

Table 8 shows the estimated models with interactions between state capacity and the various measures of diamond production. Model ten (10) includes an interaction between primary diamonds and state capacity. As can be seen by the table, the interaction is negative but not significant. A log-likelihood ratio test also confirms that the interaction indeed does not significantly improve model fit. Model eleven (11) includes an interaction between state capacity and secondary diamonds. The interaction is negative and significant at the 10-percent level. Furthermore, a Log-Likelihood ratio test indicates that its inclusion significantly improves the model fit.

Given the complications involved in estimating models including interactions, further probing of the interactions is fruitful. Hence, *figure 1* and figure *2* provide a more in depth illustration of the interaction between secondary diamonds and state capacity.

Figure 1 Changes in predicted mean of armed conflict onset for presence and absence of secondary diamond production for different values of state capacity

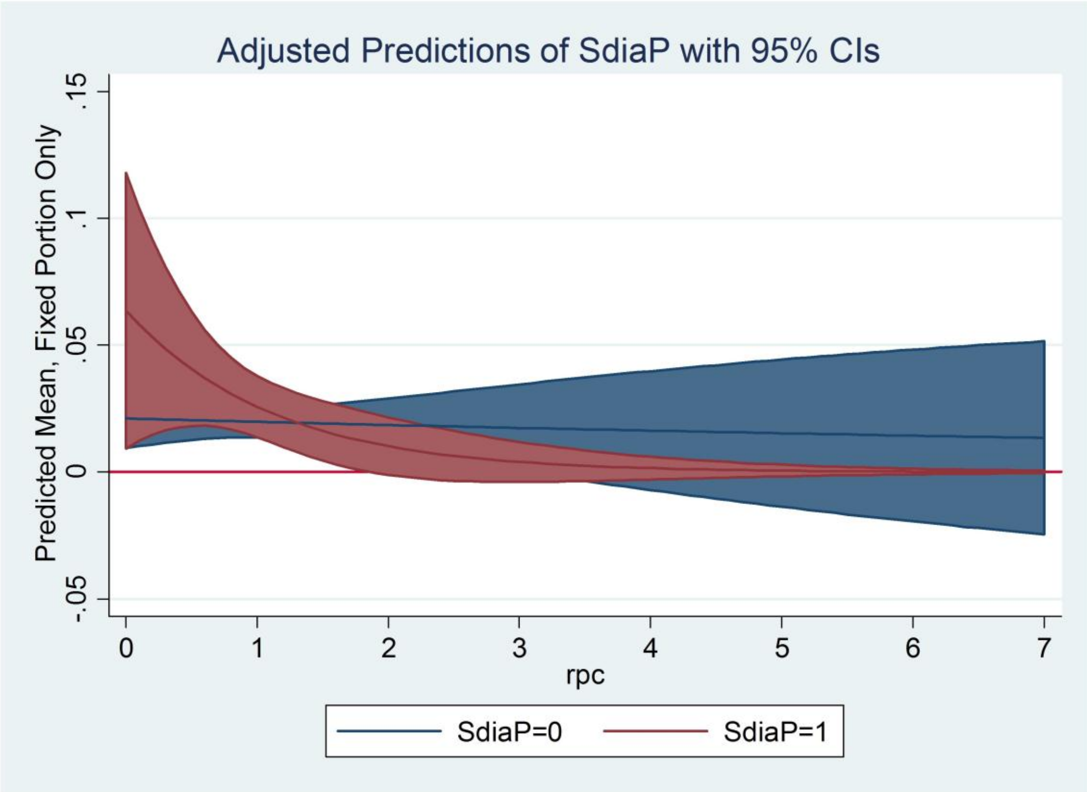

Figure 1 shows the predicted probability of conflict onset when secondary diamonds are present, for different levels of state capacity. All other explanatory variables are kept at their means, and the confidence level is 95-percent. The graph illustrates that as state capacity increases, when secondary diamonds are present; the predicted probability of armed conflict onset becomes exponentially lower. The effect is most pronounced for moving from low (0) to moderate (1.7) levels of state capacity.

Although the graph gives a fair overview of the general effect of the interaction, it is fruitful to graph the difference in predicted probabilities between having and not having secondary diamond production for the different levels of state capacity. This provides a more in depth account of the interaction, and thereby H3.

Figure 2 Illustration of significance of changes in probability on armed conflict onset between presence and absence of secondary diamonds for different values of state capacity

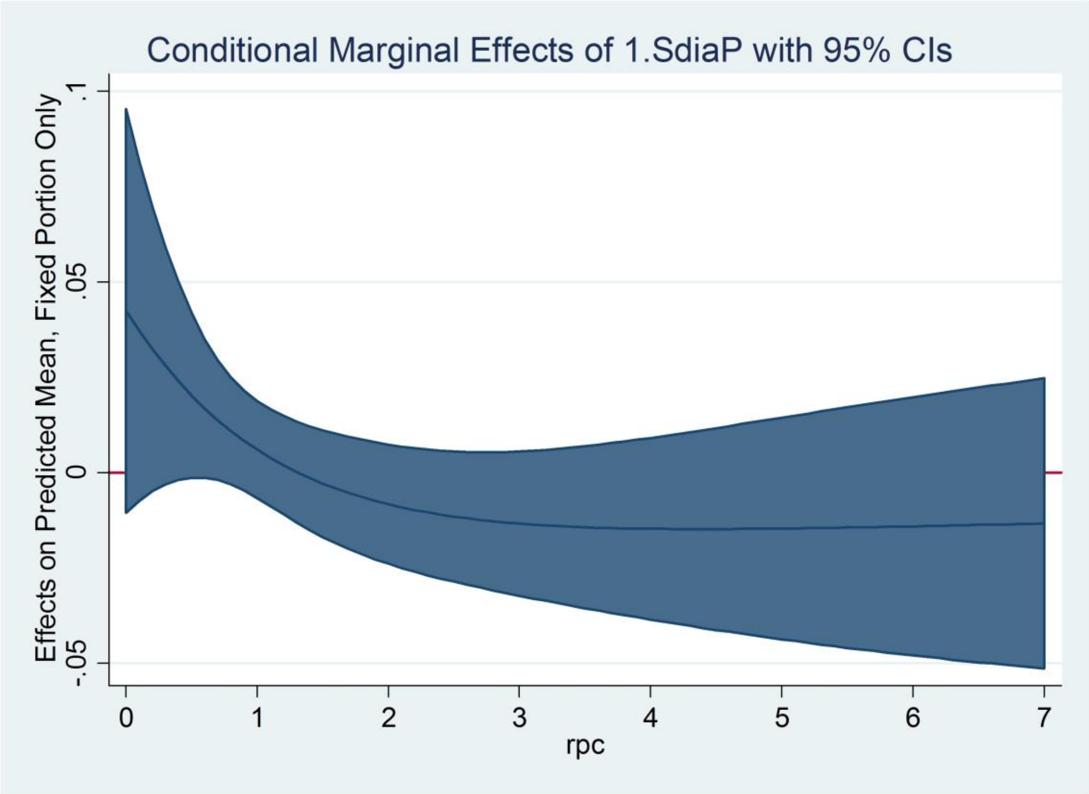

Figure 2 illustrates the discrete change in probabilities on armed conflict onset when secondary diamonds are present and absent, for different levels of state capacity. The null axis represents the base category, in this instance no secondary diamonds, while the blue area represents the changes in probability between the two categories with a confidence interval of 95-percent. If the graphed confidence interval in its entirety falls below or above the null axis, the changes in probabilities are significant for those values. As can be seen by the graph, this is not the case for any values of state capacity, making it difficult to conclude if the interaction between secondary diamond production and sate capacity significantly affects armed conflict onset. One can therefore not conclude that the significant interaction between secondary diamonds and state capacity supports H3.

Drugs

Table 9 Models including interactions between drug production and state capacity: dependent variable armed conflict onset

VARIABLES	(12)	
Drugs	0.80*	(0.42)
Sec. Dia	0.44*	(0.24)
P. Dia	-0.73**	(0.35)
State cap.	0.06	(0.23)
GDP	-0.25**	(0.13)
Popul.	0.29***	(0.08)
Ethno. Ling	1.06**	(0.42)
Mountain	0.15**	(0.06)
Polity^2	-0.01***	(0.00)
Drugs#State cap.	-1.34***	(0.49)
Constant	-5.68***	(0.87)
Observations	4,308	
Number of groups	111	
Log-likelihood	-572.9	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The table shows estimated coefficients in form of logits. Coefficients for time polynomials are not shown

Table 9 shows the model (12) containing an interaction between drugs and state capacity. As can be seen by the results the interaction between drugs and state capacity is negative and significant at the 1-percent level when controlling for diamond production, GDP, population, ethnolinguistic fractionalization, mountainous terrain, and democracy. As with secondary diamonds, the interaction indicates that when state capacity increases, the presence of drug cultivation decreases the likelihood of armed conflict onset. A log-likelihood ratio test also indicates that the model including the state capacity interaction provides a significantly better fit than the reduced model, at the 5-percent level. The effect of the interaction is illustrated by *figure 3* and *figure 4.*

Figure 3 Changes in predicted mean of armed conflict onset for presence and absence of drug production for different values of state capacity

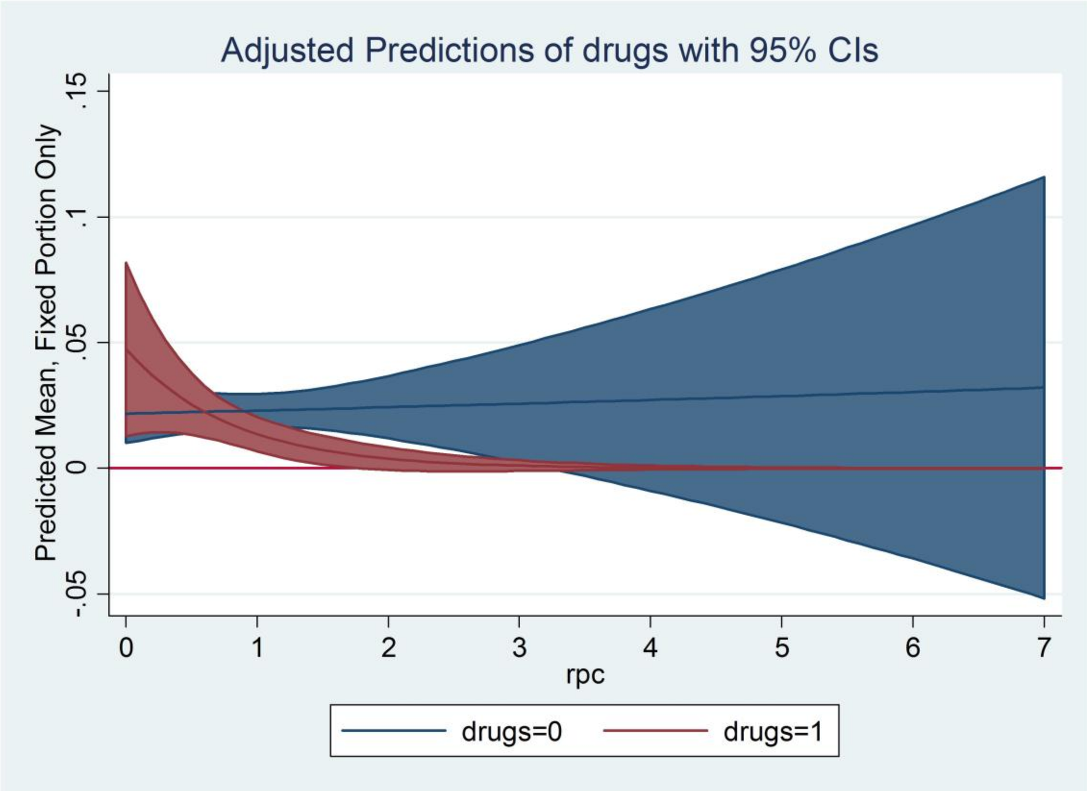

Figure 3 illustrates the interaction between drugs and state capacity. The graph shows the change in predicted probability of conflict onset for levels of state capacity in the presence and absence of drug cultivation. As can be seen by the graph, when state capacity increases from a low level (0) to a more moderate level (1), the effect of drug cultivation becomes negative making conflict onset less likely.

Figure 4 Illustration of significance of changes in probability on armed conflict onset between presence and absence of drug production for different values of state capacity

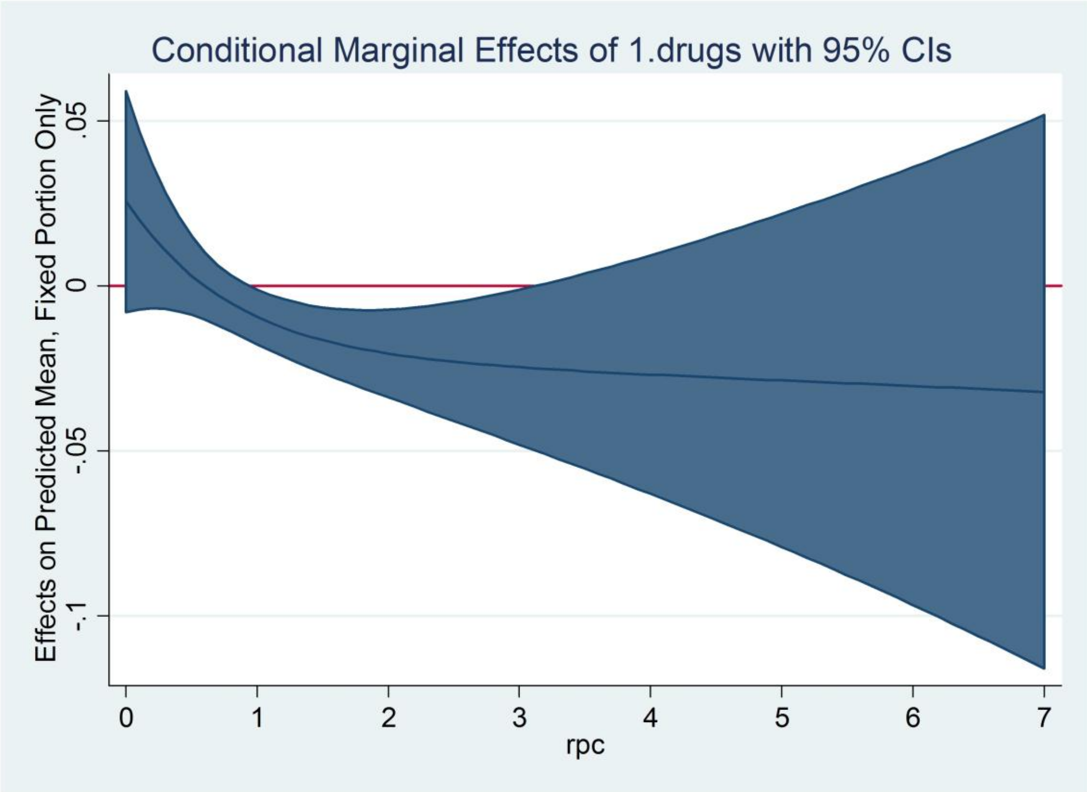

Figure 4 shows the discrete change in probability between presence and absence of drugs for each value of state capacity. The graph illustrates that the difference in probabilities are significant for values of state capacity between one and three, signified by the area below the red line on the zero axis. In other words, the graph indicates that the difference in probabilities between the two categories is significant when state capacity has a value between one and three. In sum, the result of the interaction between drugs and state capacity provides evidence in support of H3. Nevertheless, it is important to note that interactions are to a large degree subject to model specification. Therefore more evidence on the interaction is necessary in order to make a solid conclusion. This, however, is out of reach of this thesis.

5.5.2 Foreign intervention

It has been argued that one of the mechanisms linking natural resources and armed conflict onset is an increased probability of neighboring states intervening on behalf of rebel movements, in order to subsequently gain access to the natural resources. In order to examine this, the following hypothesis was formulated: H5: *"Resource wealth increases the likelihood of armed conflict onset by increasing the probability* *of foreign intervention on behalf of rebel movements"*. This section will present the models examining the aforementioned hypothesis by including an interaction term between the natural resource measures and average neighborhood polity score.

Table 10 Models including interactions between oil production and average neighborhood polity score: dependent variable armed conflict onset

VARIABLES	(13)	(14)	(15)
oilp	0.02		
	(0.30)		
onoilp		0.12	
		(0.30)	
offoilp			0.08
			(0.30)
Neighpol^2	0.00	0.00	0.00
	(0.01)	(0.01)	(0.00)
Sec. Dia	0.50*	0.49*	0.50*
	(0.26)	(0.26)	(0.26)
P. Dia	-0.74**	-0.72*	-0.77**
	(0.38)	(0.38)	(0.37)
GDP	-0.19	-0.19	-0.18
	(0.12)	(0.12)	(0.12)
Popul.	0.29***	0.29***	0.30***
	(0.08)	(0.08)	(0.07)
Ethno. Ling	1.25***	1.26***	1.24***
	(0.38)	(0.38)	(0.38)
Mountain	0.14***	0.14***	0.15***
	(0.05)	(0.05)	(0.05)
Polity^2	-0.01***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)
oilp#c.neighpolsq	0.00		
	(0.01)		
onoilp# Neighpol^2		0.00	
		(0.01)	
offoilp# Neighpol^2			-0.00
			(0.01)
Constant	-5.77***	-5.76***	-5.85***
	(0.84)	(0.83)	(0.83)
Observations	5,647	5,647	5,647
Number of groups	141	141	141
Log-likelihood	-716.2	-716.2	-716.3

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The table shows estimated coefficients in form of logits. Coefficients for time polynomials are not shown

Table 10 displays the interactions between foreign intervention and oil production. All of the interactions hover around zero and are insignificant. It does not appear that the oil production affects armed conflict onset through a foreign intervention mechanism. This is furthermore confirmed by a log-likelihood ratio test, which confirms that the model fit is not significantly better than the reduced model.

Table 11 Models including interactions between diamond production and average neighborhood polity score: dependent variable armed conflict onset

VARIABLES	(16)	(17)
P. Dia	-0.84*	-0.76**
	(0.45)	(0.37)
Sec. Dia	0.50*	0.65**
	(0.26)	(0.31)
Neighpol^2	0.00	0.00
	(0.00)	(0.00)
GDP	-0.17	-0.17
	(0.12)	(0.11)
Popul.	0.31***	0.30***
	(0.07)	(0.07)
Ethno. Ling.	1.25***	1.28***
	(0.38)	(0.38)
Mountain	0.14***	0.14***
	(0.05)	(0.05)
Polity^2	-0.01***	-0.01***
	(0.00)	(0.00)
P. Dia# Neighpol^2	0.00	
	(0.01)	
Sec. Dia# Neighpol^2		-0.01
		(0.01)
Constant	-5.89***	-5.87***
	(0.80)	(0.80)
Observations	5,647	5,647
Number of groups	141	141
Log-likelihood	-716.3	-716.0

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The table shows estimated coefficients in form of logits. Coefficients for time polynomials are not shown

Table 11 presents the two models on the interaction between the different measures of diamond production and the proxy for foreign intervention, neighborhood polity score. As can be seen by the table, both of the effects of the interactions are negligible, and neither of the interactions is statistically significant. As with the oil production model, the log-likelihood ratio test confirms the insignificance of the interactions.

Table 12 Models including interactions between drug production and average neighborhood polity score

VARIABLES	(18)	
Drugs	0.01	(0.28)
Neighpol^2	0.00	(0.00)
Sec. Dia	0.52**	(0.26)
P. Dia	-0.77**	(0.37)
GDP	-0.16	(0.12)
Popul.	0.30***	(0.08)
Ethno. Ling.	1.24***	(0.39)
Mountain	0.14***	(0.05)
Neighpol^2	-0.01***	(0.00)
Drugs#Neighpol^2	0.00	(0.01)
Constant	-5.85***	(0.81)
Observations	5,647	
Number of groups	141	
Log-likelihood	-716.2	

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

The table shows estimated coefficients in form of logits. Coefficients for time polynomials are not shown

Table 12 presents the results of the interaction between foreign intervention and drugs. The results remain the same as with diamonds and oil. Accordingly, based on the evidence provided by the models, hypothesis 5 is rejected. It does not appear that natural resources affect armed conflict onset through an increased probability of foreign intervention.

5.6 Diagnosis

In order to investigate the results more comprehensively several checks of the results were performed[13]. All tests are presented under the *tests* section in the appendix. Firstly, I performed a test of multicolinearity. Since all correlations are under 0.5, the results indicate that multicolinearity does not pose a substantial problem.

Secondly, in order to account for outliers and regional effects, I estimated a model including a dummy for Africa South of Sahara[14]. In the model including the Africa South of Sahara dummy the effect of *primary diamonds* decreases slightly, and goes from being significant at the ten percent level to being slightly less significant, and is no longer significant at the ten-percent level. Secondary diamonds lose some of its effect but remains significant at the five-percent level.

[13] Due to the large amount of estimated models all checks were performed on the reduced model expanded to include state capacity and drugs, due to the significant interactions.
[14] The choice of regions is based on the uneven distribution of diamond production, which is significantly more likely to take place in these regions. A table of distribution can be found in the appendix. The regional categorization is gathered from Lujala's (2010) data.

5.7 Discussion

The thesis' research question has sought to examine whether natural resources do in fact affect armed conflict onset, and if this is the case, how do natural resources affect armed conflict onset? Accordingly, five hypotheses on the relationship between natural resources and armed conflict onset were formulated. The previous section presented the empirical analysis that was utilized in order to examine these hypotheses. In brief, the evidence gives some support for *H1:"The effect of a natural resource on armed conflict onset is dependent upon its lootability, legality and obstructability"* and *H3" The effect of natural resources on conflict onset is dependent on institutional capacity"*. In contrast, the results do not support *H2: "Resource dependence rather than abundance increases the likelihood of armed conflict onset"*, *H4: "A larger reserve of natural resources per capita increases the likelihood of armed conflict onset"* and *H5: "Resource wealth increases the likelihood of armed conflict onset by increasing the probability of foreign intervention on behalf of rebel movements"*.

Firstly, the fact that primary and secondary diamonds both were found to significantly affect armed conflict onset firstly suggests that classifying and disaggregating resource measures is vital in understanding the relationship between natural resources and armed conflict onset. Accordingly, the calls of Ross (in Ballentine and Sherman 2003), Le Billion (2001, 2008), Lujala (2003), and Buhaug and Gates (2002) for more thorough classification of natural resources appear justified. This becomes apparent when comparing the results of the aggregated continuous diamond measure, which had no significant effect on armed conflict onset, with the diamond dummy measures, where secondary and primary diamonds were found to significantly affect armed conflict onset, but in opposite directions. This finding moreover gives some support for Gilmore et al. (2005) initial finding that both primary and secondary diamonds affect armed conflict onset.

On the other hand, no such results were found when separating between onshore and offshore oil, which were found to not affect armed conflict onset, as Lujala (2010) argued could be the case. According to the suggested resource classification, both offshore oil and primary diamonds are classified as unlootable and obstructable. One would therefore expect them to affect armed conflict onset in a similar manner. The fact that this does not appear to be the case based on the data at hand is rather puzzling. It can be argued that this might be due to either the classification or measures not being precise enough, or perhaps both. Either way, based on the results at hand, there is not sufficient evidence to either reject or confirm H1. Cross-discipline cooperation between geographers and conflict study researchers towards better categorization and classification of resources would be of great benefit in this regard.

Furthermore the evidence suggests that oil does not significantly affect armed conflict onset. This is in contrast to much of the findings in the armed conflict literature where oil has been found to be one of the more robust predictors of armed conflict onset. This highlights some of the model specification sensitivity that permeates the quantitative study of armed conflict onset. Further examination of the relationship between natural resources and armed conflict onset would benefit greatly from more precise theory that can provide more comprehensive guidelines for model specification. More collaboration between qualitatively focused researches and quantitative focused researchers would be of great benefit. This could alleviate many of the criticism posed by qualitatively oriented researches, as summarized by Nathan (2005).

Secondly, since it has been argued that resource dependence, rather than abundance affects armed conflict onset, *H2: "Resource dependence rather than abundance increases the likelihood of armed conflict onset"* was formulated. It has been argued that natural resources matter only insofar that a country becomes dependent on them for its revenue stream (Le Billion 2008, Basedau and Lay 2009). The results of the analysis do not support this notion. Oil production relative to GDP was not found to significantly affect armed conflict onset, as has been argued by e.g Basedau and Lay (2009). Since data on diamond revenues are not available, estimating a model on diamond production was not possible. Further investigation of this hypothesis using disaggregated diamond measures relative to GDP would be highly interesting.

Thirdly, as a test of the suggested state mechanisms, *H3:"The effect of natural resources on conflict onset is dependent on institutional capacity"* was formulated. The results indicate that the effect of natural resources on armed conflict might be dependent on institutional capacity giving support both to those who argue that weak-states are more likely to experience armed conflict onsets (Di John 2007, Ross 2004a

2004b 2006, Fearond and Laitin 2003), and those who argue that natural resources reduce the likelihood of armed conflict onset in strong states (Basedeau and Lay 2009, Smith 2004). Both the interaction between secondary diamonds and drugs and state capacity were initially found to be significant. The diamond interaction did, however, upon closer inspection not prove significant. In spite of this, the results do suggest a significant link between natural resources and state capacity and armed conflict onset.

There are few previous studies that have examined the interaction between natural resources and state capacity, and their combined effect on armed conflict onset. Therefore it is not apparent why state capacity would affect different types of natural resources differently. This might be related to a resource's characteristics, in form of lootability and obstructability, since both secondary diamonds and drugs share similar properties of lootability and obstructability. This, however, requires more in depth investigation with better resource classification and more fine-grained resource and sate capacity data. It should also be noted that issues of endogeneity could affect the relationship between state capacity and armed conflict onset and natural resources. Thies (2010) provides an excellent account of why this might be the case, and furthermore argue that natural resources affect armed conflict onset primarily indirectly through state capacity.

Fourth, the results do not provide any evidence towards supporting *H4: "A larger reserve of natural resources per capita increases the likelihood of armed conflict onset".* This hypothesis was formulated based on the work of Humprheys (2005), which argued that if greedy rebels are the link between natural resources and armed conflict onset, one would expect a larger reserve of natural resources to increase the probability of armed conflict onset, since the profit of capturing the state would be significantly higher, making rebellion more likely. No significant effect between oil reserves and armed conflict onset was found, which suggest that based on the evidence at hand, the effect of natural resources on armed conflict onset does not work through a greedy rebels mechanism, as initially proposed by Collier and Hoeffler (1998, 2004).

Fifth, natural resources do not appear to affect armed conflict onset through an intervention mechanism, as suggested by *H5: "Resource wealth increases the likelihood of armed conflict onset by increasing the probability of foreign intervention* *on behalf of rebel movements".* None of the interactions between the foreign intervention proxy and natural resources were found to significantly affect armed conflict onset. It should be noted, however, that this might be due to the proxy variable not adequately representing foreign intervention. Hence, the thesis does not find any evidence of the natural resources affecting armed conflict onset through the feasibility mechanism, in form an intervention mechanism.

Lastly, the empirical analysis indicates that a random-effects model is well suited for studying armed conflict onset. The analysis, through estimating the hybrid model, provided grounds for confirming that the main assumptions of the random-effects model are fulfilled when the including the variables that have previously been identified as the main predictors of armed conflict onset. Since the random-effects model is readily extensible, it is doubly advantageous as it allows for further disaggregation of the study of armed conflict, which there has been increasing calls for (Cederman and Gleditsch 2009). Armed conflicts are inherently local and analyzing them from the country level can provide a skewed picture. With the advent of new geo-technology and more local data this is becoming more feasible [15]. Expanding the random effects to accommodate the local level, in addition to the occasional and national level should therefore prove fruitful

To summarize, the empirical analysis provide five main results. Firstly, in order to give a complete picture of how natural resources affect armed conflict onset, more comprehensive categorization and disaggregation is necessary. While progress has certainly been made in this area, more remains to be done. Secondly, it is not clear whether resource it is resource abundance or dependence that affect armed conflict onset. Data on diamond revenues relative to other economic activities would be greatly beneficial in studying this further. Thirdly, the results do not support the notion of greedy rebels wanting to capture the state when resource reserves are large, which again has been suggested to increase armed conflict likelihood. Fourth, the results do lend support to the idea of natural resources affecting armed conflict onset indirectly through the state, as evidence by the significant interactions between state capacity and drugs and secondary diamonds. Finally, natural resources do not appear to affect armed conflict onset through increased foreign intervention, as has been

[15] e.g the Armed Conflict Location and Event Dataset (ACLED) compiled by Raleigh, Linke, Hegre and Karlsen (2010)

suggested by Ross (2004a). The results therefore do not support the notion of a feasibility mechanism, in which rebellion is argued to occur where it is militarily and financially feasible.

6.0 Conclusion

The thesis set out to examine *"How do natural resources affect internal armed conflict onset?"* pursuing three main scientific avenues. Firstly, the thesis has endeavored in highlighting the importance of classifying resources according to their geographical and social features inherent in their status as commodities. This led to a two-dimensional classification scheme that identified *lootability*, *legality* and *obstructability* as central to the classification of natural resources. Lootability denotes how easily an unskilled worker can extract a resource; while obstructability signifies how easily a resource's transportation can be hindered. Legality refers to a resource´s legal status as an international commodity. In other words, how easily a commodity can be sold on international markets. Conjointly they provide a means of identifying a resource according to its physical and social properties, allowing for a more nuanced view of the relationship between natural resources and armed conflict onset.

Secondly, studies on the relationship between natural resources and armed conflict onset have been widely criticized for focusing too much on correlations rather than explanations. Hence, the thesis set out to identify and examine the mechanisms that have been argued to link natural resources and armed conflict onset. Accordingly, it was argued that the purported mechanisms linking natural resources to armed conflict onset could be divided into those who focus on the state and its institutions, and those who focus on rebels and their opportunities and motivations.

Thirdly, the thesis presented a relatively novel methodological approach that can accommodate several of the issues involved in studying armed conflict onset. This approach, known as a hybrid approach, indicated that random-effects models are well suited to the study of armed conflict onset, by testing the random-effects assumptions, as well as testing the random-effects model against a fixed-effects model. This was done in order to provide a robust, transparent, and extensible methodology, in a field where the methodology arguably has been too vague and divergent and consistent findings have been few and far between.

6.1 Summary of main theoretical findings

The thesis' main finding is that there is considerable variation in how types of natural resources affect armed conflict onset. The results indicated that, in contrast to previous findings, primary and secondary diamond production, to a certain extent, but not oil production, significantly affects armed conflict onset. Furthermore, primary and secondary diamond production is found to affect armed conflict onset in opposite directions, with secondary diamonds, to a certain extent, increasing the probability of armed conflict onset, and primary diamonds reducing it. The results also provide some support for those who argue that the mode of production is essential in studying the relationship between diamonds and conflict. Additionally, when utilizing an aggregated measure of diamond production, diamonds were not found to significantly affect armed conflict onset. Hence, this could explain why some studies such as that, have not found diamond production to significantly affect armed conflict onset. Mode of production then appears to be central in understanding a resource's role in armed conflicts, at least when diamonds are concerned.

On the other hand, separating between offshore and onshore oil production did not provide the same results. Neither offshore, onshore, or oil production in general, were found to significantly affect armed conflict onset. This is in contrast to previous studies, where oil has been one of the more robust predictors of armed conflict onset. Consequently, *H1:"The effect of a natural resource on armed conflict onset is dependent upon its lootability and obstructability"* remains plausible, as the results are inconclusive. The hypothesis does, however, warrant further examination.

The results do not lend support to the notion of resource dependence rather than abundance affecting armed conflict onset, as suggested by *H2: "Resource dependence rather than abundance increases the likelihood of armed conflict onset"*. Although it is important to note that the only measure available for resource dependence is oil relative to GDP. It therefore cannot be excluded that diamond or drug dependence significantly affects the likelihood of armed conflict onset.

Additionally, the results indicate that the relationship between natural resources and state capacity, and armed conflict onset is unclear and requires further investigation. Since primary diamonds are relatively unlootable and obstructable they are argued to primarily work through their effect on the state and its institutions. The findings on primary diamonds confirm that they do indeed significantly affect armed conflict onset. On the other hand, the interaction between sate capacity and primary diamonds was insignificant, indicating that primary diamonds do not primarily affect armed conflict onset through their effect on state capacity. Furthermore, both the interaction between secondary diamonds and state capacity, and drugs and state capacity, indicate a significant relationship. In both cases, as state capacity increases, the presence of the respective resources decreases the likelihood of armed conflict onset. To summarize, the relationship between natural resources, state capacity and armed conflict onset is unclear and further research would be highly valuable. *H3 "The effect of natural resources on conflict onset is dependent on institutional capacity"* therefore remains plausible.

The evidence of armed conflict onset being a result of increased motivations and opportunities for rebels is more insufficient. It was suggested that rebels might view the state as an attractive financial target it possesses large reserves of natural resources, suggested by *H4:"A larger reserve of natural resources per capita increases the likelihood of armed conflict onset"*. The results do not indicate that this is the case. Moreover, none of the interactions between foreign intervention, in form of average neighborhood polity score, and natural resources are significant, indicating that natural resources do not work through the proposed feasibility mechanism. Increased probability of support from neighboring countries therefore does not appear to lead increased opportunities of rebellion as suggested by the feasibility mechanism. Secondary diamonds have been also argued to increase the motivations and opportunities of rebels. The results, on the other hand, indicate that this link is uncertain.

To summarize, the results indicate that different types of resources affect armed conflict differently, and that resources appear to affect armed conflict onset through their effects on the state rather than by increasing the opportunities and motivations of rebels. It is, however, important to note that the analysis did not provide any clear-cut results, making conclusions and generalizations difficult. Perhaps then, the relationship between natural resources and armed conflict onset is aptly summarized by the following idiom: "it's complicated".

6.2 Contribution to the field of research

The thesis provides three main contributions to the study of the relationship between natural resources and armed conflict. Firstly, it highlights the importance of classifying natural resources in more thorough and transparent manner, both theoretically and empirically. In doing so, the thesis also arrives at results that show how resources can differ in their effect on armed conflict onset according to their lootability, legality, and obstructability. Accordingly, this is something that arguably should receive greater attention in future scholarly work.

Secondly, the thesis' results indicate that natural resources are arguably more likely to affect armed conflict onset through the state and its institutions than through their effect on rebels and their motivations and opportunities. The inception and development of studies of the relationship between natural resources and armed conflict onset have during the past decade been dominated by research focusing on "greedy rebels". Perhaps a greater shift to include states and their institutions into the equation would prove fertile. Consequently, studies examining natural resources effect on state capacity, and vice versa, should figure more prominently in conflict studies than have previously been the case.

Thirdly, the thesis proposed a relatively novel approach to the study of armed conflict onset, known as the hybrid model. More extensive use of this approach could prove useful for future research, both conceptually and empirically. The hybrid approach allows for more substantive interpretations of results and is well suited to accommodate the issues of autocorrelation, heterogeneity bias, and heteroskedasticity that are involved in analyzing panel data.

6.3 Suggestions for future research

The thesis identified the interaction between natural resources and state capacity as a factor that could affect armed conflict onset. It has, however, been out the reach of this thesis to provide a more in-depth analysis of this interaction. More research on the interaction between state capacity and natural resources would therefore most likely prove valuable. Inclusion of additional and more reliable measures of both natural resources and state capacity would be a good place to start.

Additionally, a more thorough classification of resources according to their main physical and social characteristics would be beneficial. It seems likely that natural resources differ in their effect on armed conflicts. A greater understanding of if, and in that case how, this is due to some pertinent physical or social aspects should prove noteworthy. This venture could benefit from greater cooperation across the disciplines. For instance, greater cooperation towards this goal between geographers, political scientists and economists could prove fruitful.

Moreover, further disaggregation of the concept of armed conflict would be beneficial. This can be done by conceptualizing armed conflict as inherently multilevel. Thinking multilevel is conceptually beneficial since it’s becoming increasingly accepted that conflicts are inherently local in their nature. Studying conflict at multiple levels, for instance by examining factors at the local, national and international level could provide new and important information on how conflicts are initiated, and how they can be terminated. Moreover, Local and national data on armed conflicts are becoming more available and reliable. Hence, it’s gradually becoming more feasible to study armed conflict from a multilevel perspective. However, a multilevel methodology is no panacea. It cannot solve all the analytical issues involved in studying armed conflict, but could alleviate some of the outstanding issues.

Lastly, more cooperation between quantitatively and qualitatively focused researchers would benefit the area of research greatly. The relationship between natural resources and armed conflict is seemingly not has been previously argued. Greater cooperation between qualitative and quantitative focused researchers can contribute to provide greater clarification of the relationship by combining qualitative solid and accurate in-depth information with the rigorousness and generalizability of quantification.

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Appendix

Country list

List of included countries

Afghanistan	Albania	Algeria	Angola	Argentina
Armenia	Australia	Austria	Azerbaijan	Bahrain
Bangladesh	Belarus	Belgium	Benin	Bhutan
Bolivia	Bosnia	Botswana	Brazil	Bulgaria
Burkina Faso	Burundi	Cambodia	Cameroon	Canada
Central African Rep.	Chad	Chile	China	Colombia
Comoros	Congo Dem. Rep (Kinshasa)	Congo-Brazaville	Costa-Rica	Cote d'Ivoire
Croatia	Cuba	Cyprus	Czechoslovakia	Czech Rep.
Denmark	Djibouti	Dominican Rep.	Ecuador	Egypt
el Salvador	Eq. Guinea	Eritrea	Estonia	Ethiopia
Fiji	Finland	France	Gabon	Gambia
Georgia	German Dem. Rep.	Germany	Germany Fed. Rep.	Ghana
Greece	Guatemala	Guinea	Guinea Bissau	Guyana
Haiti	Honduras	Hungary	India	Indonesia
Iran	Iraq	Ireland	Israel	Italy
Jamaica	Japan	Jordan	Kazakhstan	Kenya
Korea Dem. (n.)	Korea Rep. (s.)	Kuwait	Kyrgyzstan	Laos
Latvia	Lebanon	Lesotho	Liberia	Libya
Lithuania	Macedonia	Madagascar	Malawi	Malaysia
Mali	Mauritania	Mauritius	Mexico	Moldova
Mongolia	Morocco	Mozambique	Myanmar	Namibia
Nepal	Netherlands	New Zealand	Nicaragua	Niger
Nigeria	Norway	Oman	Pakistan	Panama
Papua N.G.	Paraguay	Peru	Philippines	Poland
Portugal	Romania	Russia	Rwanda	Saudi Arabia
Senegal	Sierra Leone	Singapore	Slovakia	Slovenia
Somalia	South Africa	Soviet Union	Spain	Sri Lanka
Sudan	Surinam	Swaziland	Sweden	Switzerland
Syria	Taiwan	Tajikistan	Tanzania	Thailand
Togo	Trinidad & Tobago	Tunisia	Turkey	Turkmenistan
U. Arab Emirates	Uganda	U.K	Ukraine	Uruguay
U.S.A	Uzbekistan	Venezuela	Vietnam	Vietnam (n.)
Vietnam (s.)	Yemen	Yemen Arab Rep. (n.)	Yemen Peop. Rep. (s.)	Yugoslavia
Zambia	Zimbabwe			

Resource distribution

Regional distribution of resources (dummy measures) in percent

	W.E/N.Am.	E.E/C.E	ME/NAfr.	S.E.A/OCE	L.A	S.S.A
Sec. Dia	0	0	0	31	14	55
P. Dia	12	2	0	21	0	65
Oil	16	14	21	21	19	9
Drugs	0	2	18	29	25	26

Wald tests of hybrid

Oil production
meanpcoil=devpcoil

[eq1]meanpcoil - [eq1]devpcoil = 0

chi2(1) = 0.19
Prob > chi2 = 0.6588

Diamond production
meanpcdia=devpcdia

[eq1]meanpcdia – [eq1] devpcdia = 0

chi2(1) = 0.36
Prob > chi2 = 0.5461

Population
meanpopl=devpopl

[eq1]meanpopl - [eq1]devpopl = 0

chi2(1) = 0.50
Prob > chi2 = 0.4785

Conflict at border
meanconfbord=devconfbord

[eq1]meanconfbord - [eq1]devconfbord = 0

chi2(1) = 0.36
Prob > chi2 = 0.5491

Gdp
meangdppc=devgdppc

[eq1]meangdp - [eq1]devgdp = 0

chi2(1) = 0.10
Prob > chi2 = 0.7501

Illiteracy
meanillit=devillit

[eq1]meanillit - [eq1]devillit = 0

chi2(1) = 1.58
Prob > chi2 = 0.2092

Infant mortality
meaninfant=devinfant

[eq1]meaninfant - [eq1]devinfant = 0

chi2(1) = 0.83
Prob > chi2 = 0.3617

Polity^2

meanpolity2lSQ=devpolity2lSQ

[eq1]meanpolity^2 - [eq1]devpolity^2 = 0

chi2(1) = 0.48
Prob > chi2 = 0.4866

Instability
meaninstab=devinstab

[eq1]meaninstab - [eq1]devinstab = 0

chi2(1) = 0.06
Prob > chi2 = 0.8123

[eq1]meanoil - [eq1]devpcoil = 0
[eq1]meandia - [eq1]devpcdia = 0
[eq1]meanpopl - [eq1]devpopl = 0
[eq1]meanconfbord - [eq1]devconfbord = 0
[eq1]meangdp - [eq1]devgdp = 0
[eq1]meanillit - [eq1]devillit = 0
[eq1]meaninfant - [eq1]devinfant = 0
[eq1]meanpolity^2 - [eq1]devpolity^2=0
[eq1]meaninstab - [eq1]devinstab = 0

chi2(10) = 3.98
Prob > chi2 = 0.9483

Log-likelihood ratio tests

Africa regional effect vs reduced model

Likelihood-ratio test LR chi2=0.55 Prob > chi2= 0.4597

State capacity interactions vs reduced model

Drugs
Likelihood-ratio test LR chi2= 8.63 Prob > chi2 = 0.0347

Secondary Diamonds
Likelihood-ratio test LR chi2= 5.61 Prob > chi2 = 0.0606

Primary diamonds
Likelihood-ratio test LR chi2= 2.29 Prob > chi2 = 0.3180

Oil
Likelihood-ratio test LR chi2 = 3.03) Prob > chi2 = 0.3870

Onshore oil
Likelihood-ratio test LR chi2= 3.67 Prob > chi2 = 0.2998

Offshore oil
Likelihood-ratio test LR chi2= 1.72 Prob > chi2 = 0.6334

Foreign intervention interactions

Drugs
Likelihood-ratio test LR chi2= -4.50 Prob > chi2 = 1.0000

Offshore oil
Likelihood-ratio test LR chi2= -5.09 Prob > chi2 = 1.0000

Onshore oil
Likelihood-ratio test LR chi2= -3.38 Prob > chi2 = 1.0000

Oil
Likelihood-ratio test LR chi2= -3.64 Prob > chi2 = 1.0000

Secondary diamonds
Likelihood-ratio test LR chi2 = 1.98 Prob > chi2 = 0.3721

Primary diamonds
Likelihood-ratio test LR chi2= 0.37 Prob > chi2 = 0.8292

Correlation matrix

	onset	Drugs	P.Dia	S.Dia	GDP	Popul	Eth. Lin	Mountain	Polity^2	State cap.
onset	1.000									
drugs	0.062	1.000								
PdiaP	0.012	0.094	1.000							
SdiaP	0.063	0.128	0.464	1.000						
gdpll	-0.103	-0.262	-0.131	-0.289	1.000					
popl	0.095	0.375	0.207	0.178	-0.008	1.000				
ALlang	0.097	0.071	0.183	0.345	-0.546	-0.005	1.000			
mntn2l	0.062	0.345	0.059	-0.075	-0.041	0.427	-0.224	1.000		
polity2lSQ	-0.083	-0.189	0.009	-0.144	0.507	-0.037	-0.280	-0.043	1.000	
rpc	-0.064	-0.130	0.070	0.015	0.109	-0.087	-0.127	-0.167	0.137	1.000