"THE CONDITION OF MAN… IS A CONDITION OF WAR OF EVERYONE AGAINST EVERYONE"
- THOMAS HOBBES

THE INFLUENCE OF ECONOMIC ACTIVITY ON THE ONSET OF CIVIL WAR

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SECTION 1: Introduction

Civil war is the most common form of conflict and a source of immense human suffering. It is estimated that civil wars have resulted in three times as many deaths as wars between states since World War II (Fearon and Laitin, 2003). Since the existence of mankind humans have been striving for conflict, but what for? What factors cause the onset of a conflict? These questions are important if one tries to solve a conflict in the origin. Knowing where civil war results from might give us the power to prevent its happening. We know mostly political, sociological and economic factors seem to play a role. But what specific role and to what degree has to be established yet.

With this thesis I want to contribute to these questions raised above. I will focuses explicitly on the influence of economic factors on the onset of civil war. There is a growing body of literature that highlights the association between economic conditions and civil war. However, the existing work has not established an overall accepted relationship yet. Moreover, most of the research has looked exclusively at the characteristics of countries at large and neglected variation within countries, even though features such as poverty, income growth and inequality tend to vary substantially within countries.

In this thesis I will develop an econometric model which predicts the outbreak of civil conflict based on economic activity. Therefore, three different indicators of economic activity will be examined: (1) poverty, (2) economic growth and (3) inequality between regions. I use disaggregate Geographic Information Systems (GIS) sub-national data.

I will proceed as follows: the next section summarizes the existing literature on the link between economic variables and civil war, which will be used as background information for my own research. In the section Methodology and Research Design I will clarify the disaggregate dataset, the econometric models, robustness tests and a set of testable hypotheses. In the section Results and Analysis I will present the outcome of the models and elaborate in a discussion on the underlying causes. Finally, I will conclude and suggest an agenda for future research.

SECTION 2: Theoretical framework

This research aims to cover the statistical analysis of the onset of civil war, focussing specifically on the relevant economic causes. In this section I will define civil war and outline the relevant existing literature focussing on the three different indicators of economic activity.

2.1 Definition of Civil War

'What is a civil war?' – a precise definition of an imprecise and poorly observed phenomenon is difficult to give, since there is still no legitimate consensus in the existing literature. The main objective is to demarcate interstate wars from intrastate wars. In this paragraph I will shorty outline the different definitions used for civil war.

The Correlates of War (COW) project as described in Singer and Small (1982, 1994) argues that the definition of civil wars is based on four main characteristics. (1) It requires that there is organized military action and that there are (2) at least 1,000 battle deaths as a result. In order to distinguish wars from genocides, massacres and pogroms there has to be effective resistance (3) that at least five percent of the deaths have been inflicted by the weaker party. A further requirement is that (4) the national government at the time was actively involved. This excludes some forms of internal wars from the civil war definition, most notably wars of liberation from colonialism.

An even narrower definition is given by Doyle and Sambanis (2000, pp. 779-802). The criteria under which they demarcate civil war are: (1) causes more than one thousand deaths; (2) challenges the sovereignty of an internationally recognized state; (3) occurs within the recognized boundaries of that state; (4) involves the state or state-claimants as a principal combatant; and (5) involves rebels with the ability to mount organized armed opposition to the state.

The above-specified definitions of civil war are both quantitative and qualitative. When we conduct econometric research we need a more rigid quantitative measure of the severity of civil war. Overall the absolute number of deaths as a threshold is commonly used to define conflicts. The UCDP/PRIO Armed Conflict Dataset defines a conflict as 'a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in *at least 25 battle-related deaths*' (Harbom et al., 2009). This latter definition is obviously stricter, but in my opinion more realistic to use. Incorporating the standard of 1000 battle-related deaths is excluding a lot of small conflicts, which might cause a miss measuring of what really happens. Secondly, the UCDP/PRIO definition is widely used in quantitative empirical research, and therefore my results will be easier to compare to other related research. For these reasons, I have decided to use these latter definitions of civil war.

2.2 Literature findings

Why do people strive to fight? There is still no consensus on a comprehensive set of

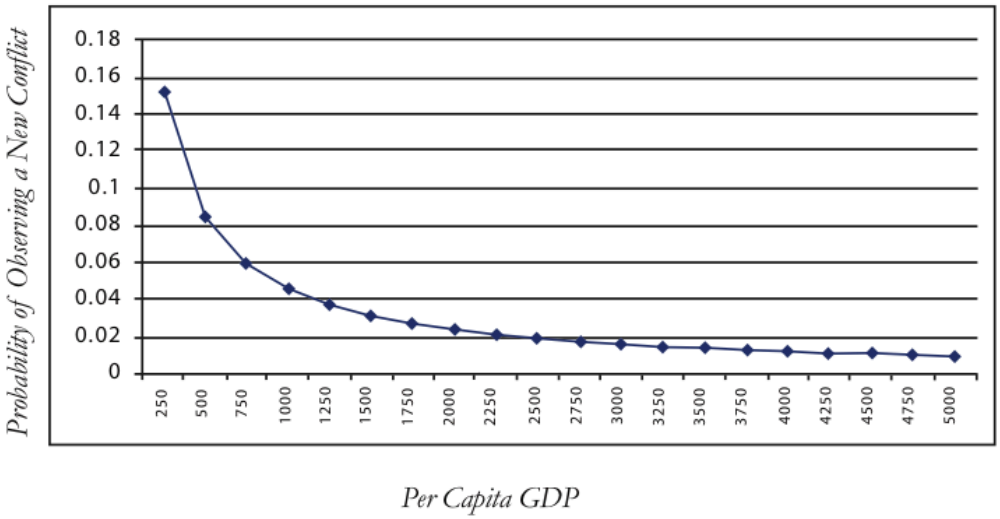
significant causes of civil war, although it has been proven that some economic conditions make rebellion more attractive and feasible than others.[1] In this research I focus on three different forms of economic activity: poverty, economic growth and income inequality.

2.2.1. Poverty

The econometric analysis on the causal link between poverty and civil war can be seen as reasonably robust despite the evident reverse causality. Countries with low income *per capita* are at increased risk of civil conflict.

Statistical research on poverty by the WorldBank (2003) suggests that for a country at the lowest fiftieth percentile for income, the risk of experiencing civil conflict within five years is 7-11 percent. For countries at the lowest tenth percentile, the risk rises to 15-18 percent. The graph below illustrates the decline in conflict risk associated with higher increments of GDP *per capita:*

Figure 1: Risk of Civil War and GDP per Capita, 1960-1999



Source: World Bank

Collier and Hoeffler (2000) support this finding. They have conducted a research in which they examined two determinants of poverty, viz. low education levels and infant mortality. Both are positively correlated with the onset of war, which suggests that the risk of civil war will be significantly reduced by policies that raise education levels and improve public health. Also Fearon and Laitin (2003) find that a high poverty level is the most salient determinant of insurgency. They use per capita income as proxies for state institutional capacity and find that these are robust predictors of civil war.

[1] Although this research focuses on the economic variables that cause civil unrest, I do not want to undermine the importance of other – social, political, ethnical and environmental – factors (see appendix 1).

Despite the robustness of the empirical relationship between low income and conflict, there remains substantial debate as to *why* this relationship exists. Intuitively, unrest arises when civilians are not satisfied by their economic conditions. There are two dominant underlying explanations. The first emphasizes opportunity costs for rebellion, while the other focuses on state capacity.

Murdoch and Sandler (2002) and Collier and Hoeffler (2001) allege that poverty indicates a lack of opportunities, making recruitment for armed forces easier. The benefits for participating in conflict may appear more attractive then benefits from other, legal activities (Cameron & Parikh, 2000; DiPasquale & Glaeser, 1998). If civilians cannot conduct any working activities or do not have any stakes (such as a farm), they simply have nothing to lose. Murdoch and Sandler (2002) measure this by taking the gap between the returns from taking up arms relative to those from conventional economic activities, such as farming. Rebels are thus seen as rational actors, who weigh the costs and benefits of civil war.

Fearon and Laitin (2003) on the other hand argue that opportunity costs do not matter. They interpret GDP per capita as a measure of state strength and argue that wealthier states see less conflict because they are better able to deter rebellion and enact countermeasures. In their model, important determinants affecting the balance of power between states and rebels include the following factors: (1) whether a state is newly independent (and thus, still fragile), (2) political instability in a country, (3) a large population, which requires greater police capacity to suppress insurgency, and (4) oil dependency, which Fearon and Laitin consider to be associated with weak state capacity. Thus, high income per capita indicates well-developed infrastructure such as roads, and a greater degree of central government control over rural areas. For Fearon and Laitin, low national income *per capita* is a proxy for a state's financial, administrative, police and military capabilities. From this we can see that, overall in the literature, there is an agreement about the negative influence of poverty (measured as a low income per capita) on the onset of civil war. Hence, my first hypothesis asserts that H_1: *the risk of conflict onset increases with lower income.*

2.2.2. Economic growth

In addition to the importance of a country's level of income per capita, a drop or rise in income – measured by a country's per capita GDP growth rate – may also foreshadow conflict. While the relationship between changes in GDP per capita and the chance of civil war is not as robust as a country's level of GDP per capita, there is strong evidence in its favor.

Collier and Hoeffler find that a 1 percent increase in the GDP growth rate reduces the risk of conflict by approximately 1 percent. They suggest that the dual effect of both low levels of per capita GDP and slow or negative economic growth – a poor country that is making little if any growth gains – directly and substantially increases the risk of conflict.

Another particularly strong evidence for the conflict-inducing effects of negative growth rates is brought about in a study on conflict in Africa examined by economist Edward Miguel (2004) and others. In order to address the problem of

endogeneity[2], they examine the link between growth and civil conflict in Sub-Saharan Africa by using exogenous rainfall differences as a proxy for growth – whereas they assume that rainfall correlates with farming revenue and thus with income growth. They conclude that higher levels of rainfall are correlated with significantly less conflict (Miguel, Satyanath, and Sergenti, p:737 & p:745). They find that a negative growth shock of 5 percentage points increases the risk of civil war by nearly 50 percent in the following year. The underlying explanation is that negative rainfall shocks reduce incomes and thereby increase conflict risk.

Bohlken and Sergenti (2010) focus on the relationship between economic conditions and riots. They examine the effect of economic decline on the outbreak of Hindu–Muslim riots in 15 Indian states between 1982 and 1995. Controlling for other factors, the authors find that just a 1% increase in the growth rate decreases the expected number of riots by 5%. While short-term changes in growth influence the occurrence of riots, this study finds no evidence of a relationship between the levels of wealth in a state and the incidence of ethnic riots. Moreover, by including state fixed effects, the authors determine that the negative relationship found between economic growth and riots is driven primarily by the relationship between growth and riots within a state over time rather than across states.

But what are the potential mechanisms through which economic growth could influence the occurrence of civil violence?

First, growth may influence civil unrest through the effect it has on electoral competition and the electoral incentives of politicians (Horowitz, 1985; Wilkinson, 2004). The slower the rate of economic growth, the more advantageous it may become for politicians to arouse (ethnic) sentiments in order to distract the attention of voters away from the bad economic conditions. This applies especially to politicians for whom it would be beneficial to split the electorate on an ethnic basis, encourage their supporters to blame the other ethnic group (Wilkinson, 2004).

Secondly, the effect of economic decline may work through the mechanism of more intense (ethnic) competition (Olzak, 1992). As economic conditions worsen, competition between groups may increase because limited resources are available. This leads to possible violence.

A third possible mechanism through which economic growth could decrease the probability of civil war is the same mechanism through which poverty causes civil unrest: opportunity costs. The opportunity costs of engaging in a riot may be lower during periods of relatively slower growth. Such periods may be associated with fewer job opportunities, lower wages, and a less bright future.

Though it might be intuitive that economic growth causes a decline in civil unrest, there are some authors that assert the opposite.

Gurr (1970) argues that modernization leads to political disorder. He examines the effect that industrialization and the additional radical social changes had on political disorder and civil unrest. He finds a significant correlation between modernization and civil unrest. Also Harms & Zink (2005) argue that economic

[2] A loop of causality between the independent and dependent variables of a model.

growth can lead to unrest. When an economy is growing this leads to a phase of investment opportunities. Conflicts over redistribution of these opportunities increase the likelihood of violence. These arguments might stand, but looking at the density of conflict outbreak over time, the literature shows that this is greater when there is a bad economic outlook. Therefore, my second hypothesis asserts that H_2: *the risk of conflict onset decreases when there is economic growth.*

2.2.3. Income inequality

It might be that there is another effect which might cause civil unrest when the economy grows, namely the increasing inequality between the poor and the rich. Global economic growth has been for a greater part unbalanced, with the benefits from globalization being spread unevenly across different regions and groups. Although early studies on civil war have dismissed the role of inequalities, the division between 'vertical' and 'horizontal' income inequalities have shed a different light on the relation.

Collier & Hoeffler (2004) dismiss inequality as a cause of civil wars since they find no relationship between income inequality on an individual level and conflict. Similarly, Fearon & Laitin (2003) and Hegre, Gissinger & Gleditsch (2003) find no evidence for a significant relationship between income inequality and conflict.

However, these studies consider measures of vertical income inequality between individuals; disregarding the relationship between inequality within social cleavages. Vertical inequality standard measures the distance between the poorest and richest people in the population. This vertical definition of income neglects the *group aspect*. Horizontal income inequality, on the other hand, focuses on inequality between different (ethnical, geographical) groups, thereby measuring the difference between social groups that are neglected and those that can be considered as elites. By distinguishing 'vertical' from 'horizontal' inequality, Stewart (2009) and her colleagues shift the focus to 'inequalities in economic, social or political dimensions or cultural status between culturally defined groups'. Sambanis (2005) and Steward (2001) suggest that horizontal inequality is an important factor of civil conflict. Especially for poor countries, inequalities between ethnic groups are related to high risk of domestic armed conflicts. Some of these accounts follow the logic of Gellner (1969) and Hechter (1975). They suggest that differences in regional economic development in peripheral regions fuel nationalism – which is strongly correlated with civil conflict. Hechter's (1975) internal colonialism thesis asserts that exploitation of peripheral regions breeds secessionist conflicts. Poor regions will eventually stand up and resist. Other scholars have considered the possibility that *both* rich and poor regions may have reasons to fight. In the analysis of regional economic development, Gourevitch (1979) identifies inequality as an important, though not unique, factor influencing the emergence of conflict. He argues that underdeveloped regions as well as developed - but politically excluded regions - tend to engender conflict. Likewise, Horowitz (1985) argues that both advanced and backward regions can develop grievances over revenue imbalances. More advanced regions are likely to see

themselves as subsidizing poorer regions, and backward regions may not receive the per capita proportionate spending they would need to catch up economically with the rest of the area. Also Bookman states that on average rich and poor regions may claim that they are giving too much or, respectively, are getting too little from the economic centre, so that both low- and high-income states have a basis to complain (Bookman, 1992, p.115). The primary message we may draw from the existing research literature is not that inequality is necessarily unrelated to conflict, but that it may depend on which level of analysis we choose, and what dimension of inequality we try to measure. Therefore, my third hypothesis focuses on the horizontal standard of income inequality and asserts that H_3: *the risk of conflict onset increases with larger income deviations in regions from the national average*.

SECTION 3: Empirical framework

In this part I will outline the structure of my empirical research. The aim of this thesis is to examine whether – and in what proportion – economic activity influence the onset of civil conflict. I will first describe the dataset. This is followed by the outline of the models used. I will describe my parameters in the subsection main variables. Finally, I will give several robustness tests to strengthen the econometric analysis.

3.1 PRIO-GRID dataset

Contributions to the quantitative civil war literature so far have mainly used country-level data, instead of spatial data. I would like to argue that making use of aggregate data has a big impact on the validity of the inferences. This is particularly true for conflicts that are spatially limited and in cases with several simultaneous conflicts within the same country.

Civil conflicts are by definition sub-national events, and rarely cover the entire country. When operating with country-level aggregates, the effect of distance from the actual conflict area to neighboring countries is totally ignored. Furthermore, the proposed control factors, such as ethnic differences and rough terrain, have substantial sub-national variation.

To account for the above problems I use a conflict-specific spatially disaggregated GIS dataset named PRIO-GRID (Tollefsen, Strand, and Buhaug, 2012). The dataset provides a global grid with a resolution of 0.5 x 0.5 decimal degrees (roughly 55 x 55 km). Gridded data are inherently apolitical entities; they are fixed in time as well as space and are insensitive to political boundaries and developments. The grid structure consists of one grid per calendar year for the period 1946 – 2008. I will make use of a subsample from 1990 till 2008, primarily because this timeframe contains the best quality data on conflict and economic activity. The set has in total 62.000 cells partitioning the earth's landmass.

3.2 Models

In this subsection the specific testing methods and models are described. I have built three separate models for each of the three main economic parameters; poverty, growth and inequality.

Although my dependent variable is the dichotomous indicator of the onset of armed intrastate conflict, I do propose an approximately linear model of interest. With reference to Angrist and Pischke (2008), I perform an ordinary least square regression, which contain country/year dummies. It controls for unobservable that change over time, but only those who are not different between the gid cells within the corresponding country. These fixed effects may, for example, include the specific country's political or institutional system. I have chosen for this level of fixed effects since controlling for only country level fixed effects would not include fixed effects that are differing over time. Also, by including specific fixed variables such as percentage of mountains and forest and the travel time to the nearest capital, would

make controlling for only gid cell fixed effects rather redundant. Furthermore, high-resolution data as used in this research often display spatial correlation. It is unreasonable to treat individual cells in our data as independent of one another – cells close to each other often have the same characteristics. Spill-over of conflict and unrest across borders may increase conflict propensity. Previous studies on interstate war have shown that conflicts are spatially dependent and that they form clusters in space (Ward & Gleditsch, 2002; Braithwaite, 2005). Also O'Loughlin claims that 'nations located in proximity to each other are more likely to go to war than nations located far apart' (1986, p.64) and he concludes that 'spatial factors are as important as military expenditures and are more important than commonly used political and economic predictors in explaining war behaviour' (1986, p.78). Without controlling for this spatial correlation, my models would give a wrong picture. To avoid this problem I clustered my error terms on a country/time scale. These clusters make sure that cells, which lie within the same country in the same year, are not treated as if they were independent of each other. Therefore I assume that the error term may be correlated between the gid-cells in the same country in the same year.[3]

MODEL 1: $Y_{i,c,t+1} = \beta_1 \mathrm{GCP}_{i,c,t} + \beta_2 \mathrm{GCPPC}_{i,c,t} + \beta_3 \mathrm{X'}_{i,c,t} + \theta_{ct} + \varepsilon_{i,c,t}$

MODEL 2: $Y_{i,c,t+1} = \beta_1 GCP\mathrm{growth}_{i,c,t} + \beta_1 \mathrm{GCPPCgrowth}_{i,c,t} + \beta_2 \mathrm{X'}_{i,c,t} + \theta_{ct} + \varepsilon_{i,c,t}$

MODEL 3: $Y_{i,c,t+1} = \beta_1 \mathrm{posdev}_{i,c,t} + \beta_2 negdev_{i,c,t} + \beta_3 \mathrm{X'}_{i,c,t} + \theta_{ct} + \varepsilon_{i,c,t}$

$\mathrm{GCP}_{i,c,t}$	denotes the gross cell product
$\mathrm{GCCPPC}_{i,c,t}$	denotes the GCP per capita
$\mathrm{GCP-growth}_{i,c,t}$	denotes percentage of growth in GCP related to the previous year
$\mathrm{GCPPC-growth}_{i,c,t}$	denotes percentage of growth in GCP per capita related to the previous year

[3] i is the denotation for gid cell. This is a unique id code for each cell in the grid data set.
c is the denotation for country. Numerical country code for the country to which the cell is allocated.
t is the denotation for time.

Y denotes civil conflict onset
$\mathrm{X'}_{i,c,t}$ denotes the matrix of covariates that also affects gid cell conflict onset.
θ_{ct} controls for the period-specific effects within a country
$\varepsilon_{i,c,t}$ is a random error term

$posdev_{i,c,t}$	denotes the difference in percentage if the gid cell income is larger than the average country income
$negdev_{i,c,t}$	denotes the difference in percentage if the gid cell income is smaller than the average country income

3.3 Main variables

In this part I will construct the endogenous variable, the exogenous variables of interest and the control variables used for modeling.

3.3.1 Conflict

The dependent variable is the dichotomous indicator of the onset of armed intrastate conflict. It is defined with a threshold of 25 battle-related deaths (Harbom et al., 2009). I coded the dependent variable as 1 if a grid cell experienced a conflict onset, and 0 otherwise. Years of ongoing conflict were stated as missing. This dummy variable is based on the UCDP/PRIO Armed Conflict Dataset (Gleditsch et al. 2002; Themner and Wallensteen 2011). The dependent variable is added as lead, which means that it is measured one year later than the measurement of the independent variables. I conducted this lead because it is most likely that a conflict start approximately a year after changes in economic activity takes place.

3.3.2 Economic activity

The main independent variables provide measures of poverty, economic growth and the regional inequality. This research will use G-Econ, a geographically disaggregated dataset by Nordhaus (2006). This file includes the economic gross cell product (GCP), indicating the level of local economic activity for five-years intervals on 1990, 1995, 2000 and 2005. The basic measure of output is gross value added in a specific geographical region: gross value added is defined as total production of market goods and services minus purchases from other businesses. Under the principles of double-entry bookkeeping, GCP also equals the incomes of factors of production located within the region. Under the principles of national economic accounting, GCP will aggregate up across all cells within a country to the GDP.[4] Since economic data was only available on a five-years interval, I assumed a linear rate of growth (or decline) in the in-between years.[5]

From the Nordhaus (2006) dataset I derived several variables to examine whether poverty, economic growth and income inequality have significant influence

[4] See appendix 2

[5] Therefore the 5-years interval differences have been computed and spread evenly over the in-between years. For example, if the GCP level of gid cell X was 100 in year 1990, and 200 in year 1995, I assumed as linear growth of 20 every year. So, 1991 would have a GCP level of 120.

on the onset of civil war.

(1) *Poverty* is measured by two variables: GCP and the GCP per capita.
(2) *Economic growth* is measured by percentage of growth in GCP and GCP per capita related to the previous year. Since data are only available on a 5-year interval, I compute the difference and assume that the growth is linear proportional every year.
(3) *Income inequality* is measured by the difference between the GCP and the GDP – the latter computed by the average sum of all GCP per country. In this research I focus specifically on the horizontal definition of inequality since this has a stronger influence on the onset of civil war than vertical inequality according to the literature. I thus compare the regional welfare per gid with the average welfare of a country, thereby measuring the deviation of the particular gid cell from the national average.[6]

3.3.3 Control variables

This research considers a series of control variables that may plausibly be linked with conflict.[7] Previous studies have highlighted the role of rough terrain. Therefore I will control for the proportion of mountainous terrain and forest areas within each cell. The population density (cell population) might cause conflict due to scarcity of land, housing and employment. Additional to that, populated areas have a higher number of individuals that can mobilize and are likely to contain targets of attacks. To control for this, the population size for each cell is included.

Furthermore, I will control for ethnic differences and tensions. In order to ensure that our inferences about economic activity do not simply reflect the importance of ethnic cleavages, I constructed a Herfindahl index[8]. This ranges from 0 to 1, moving from a huge number of very small ethnical groups to a single dominant ethical group. Furthermore, there is a control variable for the number of different ethnical groups within each cell.

I also included a number of variables to control for peripheral cell positions. Conflict is more common in areas further away from the core of countries and in border locations. Proximity to international border may facilitate mobilization, as rebel groups may seek safe havens across the border, and weapons may be easily smuggled into border regions. To control for these factors, I used four variables. The first one gives the distance from the cell center to the national capital in the corresponding country. The second one gives the distance from the cell centroid to the border of the nearest neighboring country. The third one gives the distance form the cell center to the border the nearest contiguous neighboring country. The last one controls for the estimated cell-average travel time to the nearest major city.

Finally, I controlled for the war history of a grid cell. I used a dummy variable, which indicates whether an area has experienced a civil conflict in the previous three

[6] See appendix 3
[7] See appendix 4 for the list of control variables
[8] See appendix 5

years. This dummy also corrects for a part of the reverse causality which might occur in the relation between economic activity and civil war.

3.4 Robustness checks

This research considers various robustness tests to ensure that my results do not arise as artifacts due to measurement errors.

3.4.1 Spatial correlation

As we have already seen it is unreasonable to treat individual cells in our data as independent of one another. We assumed that adjacent neighboring observations within a country and within one year might not have independent information. To even oppose a more strict delineation, I assume that the error term of the gid cells are not independent within one country – regardless of the period of time. Therefore as a first robustness check I cluster the data strictly on country level (instead of country/time level).

3.4.2 Fixed effects

By including fixed effects on country/year basis, I control for the average differences that change over time and/or over country. By assuming fixed effects, I impose time and/or country dependent effects for each entity that are possibly correlated with the regressors. The fixed effect coefficients soak up all the across-group action, but it does not control for the fixed effects that are different in each gid cell (for example desert area or river channel). Therefore I perform a robustness check with fixed effects on gid cell level that controls for the unobservables that change over gid cell but not over time.[9]

3.4.3 Reverse causality

Despite the inclusion of the war history dummy, the regression analysis might still be suffering from reverse causality. It is plausible not only that poor regions have a higher likelihood for conflict but also that conflict destroys infrastructure – necessary for trade – and hence may substantively diminish a region's wealth.

To control for this possible causality, I use a modeling selection effect approach and incorporate an alternative instrument for economic growth. I will follow the instrumental two-stage least square approach advanced by the paper of Miguel, Satyanath and Sergenti (2004). They use rainfall variation as an instrumental variable for economic growth in African countries. Weather shocks are plausible instruments for growth in gross domestic product in economies that largely rely on rain-fed agriculture and do not have extensive irrigation systems. Applying this approach they

[9] In this check I also cluster my data by gid cell since otherwise panels are not nested within clusters and Stata will not be able to produce any output.

take a subsample of Sub-Saharan Africa since only 1 percent of cropland is irrigated in the median African country. I use a slightly different approach by taking a sub-sample of all grid cells that have an average yearly temperature between 13 and 35 degrees Celsius and have less than 5% area equipped for irrigation within each cell. I capture the weather variation by the current and lagged rainfall growth and use it as instrument for per capita economic growth. I perform an IV-2SLS estimation following Achen (1986) to correct standard errors in the presence of a dichotomous dependent variable. Again, I control for country/year fixed effects.

3.4.4 Poor countries

Both income growth and income inequality might have (totally) different effects in poorer and wealthier states. More specifically, high local wealth may increase conflict primarily in very poor countries, where the state is weak and the distorting effects of inequality are relatively large. To control for this problem I performed a robustness check where I interacted the main explanatory variables with a Least Development dummy; this dummy has the value of 1 if a country belongs to the poorest quartile of the dataset.

SECTION 4: Results and Analysis

4.1 Main results

In this section my main results are discussed. In the table below one can observe the main results of the three different models[10]. The remaining tables can be found in the Table Appendix. The number between brackets, found in the table reference, amounts to the column in the corresponding table.[11]

TABLE MAIN RESULTS

EXPLANATORY VARIABLES	MODEL 1	MODEL 2	MODEL 3
Distance to neighbouring conflict	-.00177	-.00087	-.00230
Distance to international border	.00354	.00228	.00428**
Distance to capital city	-.00093	-.00091	-.00102
Travel time to nearest major city	.00006	-.0002	-.00006
Population size	.00017	.00057***	.00032**
Number of ethnical groups	.00129 **	.00176***	.00159***
Percentage forest cover	-.00003**	-.00003**	-.0000**
Proportion mountainous terrain	.00220	.00232*	.00289**
Ethnic fractionalization	-.00023	-.00028	-.00015
War history	.10022***	.09541***	.10303***
GCP	.0005***		
GCP per capita	-.00313***		
GCP growth per gid		.00281	
GCP growth per capita		-.0048	
Positive income deviation from GDP			1.35e-07
Negative income deviation from GDP			-.00002
Constant	.03195***	.00106	.00101
Country/time fixed effects	yes	yes	yes
Country fixed effects	no	no	no
Gid cell fixed effects	no	no	no
Clustering	yes	yes	yes
R^2	0.0267	0.0242	0.0254
Observations	636789	691038	766000

[10] The models in the table represent the most extensive models, with controls, clustering and country/time fixed effects.

[11] For example, the reference (Table 5 – [3]) amounts to Table 5 in the appendix, column 3.

4.1.1 Hypothesis 1: poverty and conflict

When we look at the parsimonious specification (Table 1 – [1]), we can see that both GCP, as GCP per capita have a highly significant influence on the onset of civil war. Even if we add all the control variables in the specification (Table 1 – [2]), the GCP per capita variable stay significant under conventional levels. When I complement the model with fixed effect and clusters in the specification (Table 2 – [1] and see above table main results model 1), both variables are significant.

Main variables

Consistent with hypothesis 1, I find a statistically significant negative effect on the onset of civil war for GCP per capita. This indicates that areas with low absolute income per person have a higher risk of conflict onset, although the effect is rather small. A 1% change in the GCP per capita will result in a 0.003 (0.3%) change in the conflict variable.

A more ambiguous result is the positive significant effect of GCP on civil conflict. With a positive coefficient of 0.000453, it indicates that countries with a higher GCP have higher risk of conflict onset. Though, this might be due to colliniarity. GCP per capita is based on the two included explanatory variables: GCP and population. Regressing with just one of the two main variables of interest generates a totally different picture (Table 2 – [2] and [3]). The GCP per capita stays negative and remains significant. The GCP becomes negative, but also insignificant. Since GCP per capita and population still show resemblances, I excluded the (insignificant) population variable. When I regress GCP per capita we see that the variable even gets more significant (Table 2 – [4]).

From this we can conclude that GCP per capita has a clear negative significant influence on the onset of civil war. When people individually earn more, the likelihood of insurgency declines. This is consistent with hypothesis 1. On the other hand, GCP does not seem to have this same influence and is inconsistent with hypothesis 1. Having a high GCP in a specific region might create both serenity and unrest about the distribution of the resources and thus the effect is rather ambiguous. It might provide support for the claim that the level of welfare is important, but more so the individual welfare differences.

Controls

The coefficient on war history is significant under a 1% significance level. The number of different ethnical groups and the percentage of forest within a particular gid cell seem to have a significant positive, respectively negative effect on the onset of civil war under a 5% significance level.

It seems reasonable to conclude (examining the war history dummy) that conflict causes conflict. Therefore we should be cautious with assuming a one-way causal relationship between economic activity and civil war. Intuitively, the number of ethnical groups matters. The diversity of ethnical groups living on a gid cell, causes the likelihood of conflict to increase. Furthermore we can conclude that cells that have a higher share of mountain terrain are more likely to see conflict outbreaks. On the

other hand, forest covered gid cells are less prone to outbreaks. What might happen here is that initial battle fields are rationally chosen; since fighting in a forest is not comfortable, parties might 'move' to more open (mountainous) terrain. Since all of the four variables on peripheral cell positions are insignificant, it might appear that they overlap and therefore soak up each other's significance. When I remove the distance to neighboring conflict variable and the distance to capital city variable (Table 3 – [1]), there arises a positive significant sign on the international border distance coefficient. If I remove the distance to the nearest international border variable from the original model (Table 3 – [2]), we can see that the distance to the nearest neighboring conflict turns up significantly with a positive coefficient (see appendix 7). Therefore, it is indeed the case that some of the peripheral cell positions controls seem to soak up each other's significance.

Overall, due to positive coefficients in peripheral cell positions controls, it seems a solid finding that many initial attack locations are in the inlands of the country, not at the borders. Intuitively, a reason for this might be that most of countries' capitals are in the centroid and initial attacks locations are often close the capitals. If we remove all variables on peripheral cell positions expect by the distance to the national capital city we still see an insignificant coefficient for this variable of interest (Table 3 – [3]), thus this intuition cannot be statistically proven.

4.1.2 Hypothesis 2: growth and conflict

When we look at the parsimonious specification (Table 4 – [1]), we can see that the growth in GCP and GCP per capita has a respectively positive and negative significant influence on the onset of civil war. Even if we add all the control variables in specification 2 (Table 4 – [2]) the variables stay highly significant. Including country/year fixed effects and clustering in the specification (Table 5 – [1] and see above table main results model 2) we see that both growth rates turn insignificant.

Main variables

The significant negative coefficient of GCP per capita growth variable in the first two specifications without fixed effects and clustering is consistent with hypothesis 2. According to these descriptions a percentage of decline in GCP per capita increases the change of civil war. On the other hand, the GCP growth variable has a peculiar sign. This is due to possible collinearity between the GCP growth and GCP growth per capita variable. Hence, a regression with only one of the two variables causes the coefficients to turn up negative, as one would expect (Table 4 – [3] and [4]).

Analysing the specification with the fixed effects and clustering, the growth variable turns statistically insignificant (Table 5 – [1]). With a p-values of 0.812 and 0.684, we cannot say whether growth or decline in the GCP has influence on the onset of civil conflict. When we regress GCP growth and GCP growth per capita both individually, the variables remain insignificant (Table 5 – [2] and [3]). When I remove the population variable, since it could show collinearity with the GCP growth per capita variable, there is no particular change of events (Table 5 – [4]).

By adding fixed effects and clustering of the error terms, I cannot say whether the GCP growth and/or GCP growth per capita affect the onset of civil war. Consequently, there is no evidence in favour of hypothesis 2.

Controls

It seems that most control variables show the same tendencies as the previous poverty model. The only two remarkable differences are the significant population variable and the significant mountainous terrain variable under a 10% significance level. In the previous model on poverty, the GCP per capita variable implicitly includes the population variable[12]. The GCP per capita might take away the significance of the population variable. In the second model on growth, the GCP growth per capita is also based on the population variable, but less directly.[13] It might be that since GCP growth per capita is in percentages, it does not withdraw the significance of the population variable.

4.1.3 Hypothesis 3: Inequality and conflict

Looking at the most parsimonious specification (Table 6 – [1]), we can see that both deviations from the GDP are negative and significant. They remain significant under the second specification with the controls (Table 6 – [2]). Complementing the model with fixed effect and clusters (Table 7 – [1] and see above table main results model 3) causes the positive deviation to have a positive sign and the negative deviation to have a negative sign. Yet, both variables are insignificant.

Main variables

Both variables in the specification without fixed effects and clustering have a negative sign. This means that as the deviation from the average GDP increases, the probability of the onset of civil war decreases. This is inconsistent with hypothesis 3 - the relationship between the relative economic status of a region and the onset of civil war seems not to be u-shaped, but rather ∩-shaped. As the deviation from the average income becomes bigger, the likelihood of onset decreases. But this might be a specification error. Complementing the model with fixed effect and clusters in specification 3 (Tabel 7 – [1]) causes negative deviation to have a negative sign, and the positive deviation to have a positive sign.

The positive sign on the deviation where the GCP is higher than the GDP per gid indicates that, on average, richer gid cells are more prone to conflict. On the other hand, the negative coefficient in the deviation where the GDP per gid is higher than the GCP indicates that, if a gid cell is poorer than the average country level, the likeliness of conflict is smaller. This partly disproves hypothesis 3. Yet, both variables are insignificant. Since the model is build in a dichotomous way – if one of the

[12] GCP per capita = $\frac{GDP\ per\ country}{Popluation}$

[13] GCP growth per capita = $\Delta \frac{GDP\ per\ country}{Popluation}$

deviations is positive the other is, per definition, zero – it might be the case that they soak up each other's significance. But by regressing only one of the two variables of interest, this turns out not to be the case (Table 7 – [2] and [3]). The variables of interest remain insignificant.

Since the fixed effects model creates dummies for effects which are present in a country but change over time, there might be friction between the inequality variable and the included fixed effects. The GDP variable, fitted in the inequality variable, is also included in the fixed effect. This might cause multicollinearity. Therefore I have constructed two dummy variables, which contain the GDP deviation of the 20% richest, respectively the 20% poorest gid cells (Table 8 – [1], [2] and [3]). The corresponding change in significance level is positive, though the overall level is still insignificant.

One might argue that the previous regressions are not a perfect standard to measure the horizontal income inequality. Horizontal inequalities are based on inequalities between different groups. It may enhance both grievances and group cohesion among the relatively deprived and thus facilitate mobilization for conflict. To give a more precise measure of horizontal income inequality, I conducted the same regression, but with a restricted sample of only gid cells that contain one particular ethnical social group. By doing so we still have 285002 observations left. The insignificance declines, but still, the coefficients remain insignificant (Table 8 – [4]).

Therefore we can conclude that income inequalities between gid cells have a unknown effect on civil conflict regarding the most strict specification. There is no evidence that proves hypothesis 3.

Controls

Most control variables show approximately the same coefficients and significance levels as the previous growth model.

4.2 Robustness checks

4.2.1 Spatial correlation

If we cluster even stricter on country level and assume that the error term of the gid cells are not independent within one country, the results are getting, as expected less significant. In the poverty model (Table 9 – [1]) only the GCP per capita is still significant with the predicted negative coefficient sign. The variables of interest in the growth model (Table 9 – [2] and [3]) remain insignificant. Unsurprisingly, also the deviation variables in the inequality model (Table 9 – [4]) remain insignificant, although the significance from the negative deviation increases a bit. Still, regressing both deviations separately (Table 10 – [1] and [2]), gives us an insignificant result. Overall, this not alters the results much; albeit it demonstrates the fairly stable influence of the GCP per capita on the outbreak of civil conflict.

4.2.2 Fixed effects

Allowing gid cell specific fixed effects, alters the outcome of the three models completely. Since this level of fixed effects is less 'strict', as expected, all variables of interest in the three different models turn significant (Table 11). Regressing the deviations in the inequality model separately, gives us an interesting result (Table 12 – [1] and [2]). Both variables are significant and have a positive sign. Analogues to hypothesis 3, larger income deviations from the national average cause more conflict.

But we should be careful to not attach great importance on this result. The significance on growth and the positive deviation might be due to the relatively non-strict clustering of error terms on gid cell level. By clustering the error terms on gid cell level, the model does not make a difference between gid cells which are neighbours and gids cells which are positioned far away from each other. But, performing a regression with gid cell specific effects with clusters on country/time level is not possible since panels are not nested within clusters. To prove the above position that significance arises due to loose fixed effects modelling, I compared a regression clustered on gid cell level (Table 12 – [3] and [4], Table 13 – [1]) with a regression clustered on country/time level (Table 13 – [2] and [3]) without the use of fixed effects. It is seen that the level of clustering does fairly influence the model outcome; in the models with the clustering on country/time all variables turn insignificant. As we indeed already noticed in the parsimonious regression of the main model, factors such as income growth and deviation have a significant influence given that we don't take strict clustering into account.

Therefore the significant outcomes might be due to loose modelling and I will not make any strong claims concerning this outcome.

4.2.3 Reverse causality

To account for reverse causality, I conducted an IV-2SLS method advanced by Migual, Satyanath and Sergenti (2004). In the first stage regression (rainfall and income growth per capita) the current and lagged rainfall growth are negatively respectively positively related to income growth per capita (Table 14). Both are significant under a 90% significance level, and this relationship is robust to the inclusion of controls, country/time fixed effects and the restricted sample.

In the second stage we see that contemporaneous economic growth rates are negatively, but insignificantly, correlated with the incidence of civil wars (Table 14). Remarkable is the high coefficient of -1.587. The sign is correct and these results would be coherent with the findings in the OLS regression. Still, it might be due to the use of a restricted sample with average yearly temperature between 13 and 35 degrees Celsius and less than 5% area equipped for irrigation within each cell. But, adding this restriction to a regular OLS-regression does not seem to alter the results on GCP growth per capita much (Table 14 – [3]). Also, by using the complete dataset instead of only the sample restriction in the IV-2SLS regression does not seem to matter, the coefficient remains significant and negative (Table 15).

In the first-stage relationship without the restricted sample (Table 15), the current and lagged rainfall growth are both highly significantly related to income growth with a p-value of 0.000. This relationship is again robust to the inclusion of controls and country/time fixed effects. Both variables have positive coefficient as hypothesized. Higher levels of rainfall often leads to better agricultural production which is in most countries a proper measure for economic growth. Hence, the rainfall instruments are efficient to perform 2SLS.

In the second stage we see that contemporaneous economic growth rates are negatively, and significantly, correlated with the incidence of civil conflict (Table 15). The instrument variable estimate yields point estimates of -2.314 on growth, which is significant at 99 percent confidence. The size of the estimated impact of economic growth on conflict is huge: it indicates that a one-percentage point decline in GCP increases the likelihood of civil conflict by approximately by over two percent points. Indeed, this IV-2SLS-estimate is in fact much higher in absolute terms than the analogous OLS-estimates. This suggests that bias due to measurement error in the per capita income growth measures is likely to be larger in magnitude than the endogeneity bias.

Why the restriction sample matters so much is unclear. The link between economic growth and rainfall growth is obvious weaker in area's with temperatures between 13 and 35 degrees and with less than 5% area equipped for irrigation. It might be due to the smaller sample (from 554795 observation to 165218 observation), but this cannot be proven statistically. Another reason could be that irrigation systems, which supply artificial application of water to the land or soil, ultimately also depend on rainfall.

Looking at the results without the restricted sample should be done with discretion. There might be some serious violations in the IV-2SLS regression. While it is intuitively plausible that the rainfall instruments are exogenous, they must also satisfy the exclusion restriction that these instruments *only* influence civil conflict through economic growth. Other, specific, and non-economic factors might play a role. High rainfall might make it difficult for parties to engage each other in combat – floods might cause other concerns then fighting. Another channel might be that, on average, low rainfall creates high temperatures. Heat waves might cause people to overreact, and therefore could provoke conflict.

Concluding, using rainfall growth as instrumental variables for economic growth, I find a huge causal impact on the likelihood of civil war. This might point to the fact that the OLS-regressions are not that reliable, and there seems to be a stronger influence of economic growth on civil conflict than previously assumed.

4.2.4 Poor countries

We can see that none of the interaction variables (with the Least Development Dummy) are significant (Table 16). It appears that economic activity has an insignificant impact on the onset of conflict within the least developed countries in comparison with the base case of the developed countries. There seems no difference

between poor and rich countries concerning the influence of economic activity on the onset of civil war.

SECTION 5: Conclusion

5.1 Conclusion

This thesis tries to demonstrate the influence of economic activity on the onset of civil war. Unlike most aggregate level studies, I use a conflict-specific spatially disaggregated dataset. Based on detailed information on every gid-cell, I was able to generate three measures of economic activity: (1) poverty, (2) economic growth and (3) inequality.

The first finding is that absolute poverty in terms of GCP per capita leads to an enhanced likelihood of conflict. The effect of GCP is rather ambiguous. A large economy might create both unrest about the distribution of resources, as well as stability due to the larger distribution pie. Therefore hypothesis 1 is partly demonstrated to be true. Furthermore, the assumed negative association between economic growth and the onset of civil conflict turned out to be insignificant in the OLS-regression. But, using an IV-2SLS regression with rainfall instruments, gives us a contrary result. The economic growth per capita was highly significant. The OLS-regression was not consistent with hypothesis 2, whereas the IV-2SLS regression was consistent with hypothesis 2. This hints at a possible methodological problem in measuring economic actors on gid cell level. Finally, I did not find strong evidence that intraregional inequalities are positively associated with conflict. This result is not consistent with hypothesis 3. All above results are robust and solid as expressed by the inclusion of controls, fixed effects and clusters. The simplest reading of my findings is that economic factor of poverty (GCP per capita) outdoes all others in determining the incidence of civil conflict and, in particular, that other (control) factors have minimal impact in mitigating the effect of poverty.

The robustness tests reinforce the outcome already given. GCP per capita seems to have a stable and significant influence on the onset of civil war. Keeping in mind that I used the strictest form of fixed effects and clustering, this outcome is very robust. Weakening the clustering conditions even shows that more variables of interest become significant.

5.2 Future research

Future research could take steps to improve the present analysis. First, it is difficult to determine the precise level of reliability of the data because agencies do not provide estimates of the reliability of their national accounts and seldom include reliability estimates of demographic data. For many low-income countries, as well as countries experiencing war or revolution, data on gross output are not available by states or countries, and even population data are of poor quality. A more reliable and detailed dataset would give more trustworthy outcomes.

Secondly, since the data on GCP and GCP per capita are only available for 5-

year interval, I was not able to give a precise stipulation of growth. Growth was determined by assuming a linear growth (or decline) rate. But, over a period of 5 years, there could be a tremendous variation in GCP. An abrupt decline in GCP could cause a civil unrest outbreak the next year. If the specific gid cell would recover from this eruption within 4 years, my model does not accurately relate these two events. Having a more precise dataset on the GCP and GCP per capita could alter and improve the outcome of this research. Another option is to use the given dataset but determine civil war and growth not every year, but each 5 years. This would lower the amount of observations tremendously, but since the disaggregate measurement on gid-cell level is used, one would still have enough data left for valid statistical analysis.

Thirdly, the unit of analysis, grid with a resolution of 0.5 x 0.5 decimal degrees (roughly 55 x 55 km), could be alternated. For instance, if the spatial unit system in a particular study was specified differently, we might observe different relationships. This is a problem referred to by Wringley et al. (1996) as the modifiable areal unit problem (MAUP). The term 'modifiable' is used because the choice of number of spatial units (the scale of the analysis) is not fixed or grounded in any literature, and therefore any scale choice can be made at random. I think it would be relevant to conduct a sensitivity analysis concerning the scaling effect. For example, would my results still hold if we consider a 200 x 200 km spatial unit analysis?

Finally, the data presented here enable future research to model the effects of regional welfare, growth and inequalities on both conflict duration and transition form conflict to peace. Since the PRIO-GRID dataset is recently available (2012), a lot over other interesting questions with the apparent data could be addressed.

The implications of this research are potentially important from a public policy perspective. If bad economic factors significantly increase the incidence of civil conflict, it may be possible to reduce the incidence through the design of better income insurance for unemployed young men during hard economic times. For instance, public work projects funded by international donors during recession that facilitate roads, transports and irrigation could serve to reduce local vulnerability to future economic decline. I would like to moderately note that further micro-empirical analysis is needed to illuminate the precise causal channels in which economics factors influence civil conflict to design more effective policy implications. My purpose was to settle some (econometric) relationships, but the underlying ultimate causes are something we still have to guess at.

SECTION 6: Appendices

Appendix 1

Ethnic differences

Though the reciprocity between ethnic diversity and civil war was first denied, the recent empirical results concerning ethnic divisions and civil war suggest an indirect, complicated relationship.

Fearon and Laitin (2001) performed a study concerning civil violence in the independent republics of the former USSR. They tested the relevance of long-standing cultural differences and found no statistical relationship between ethnic cleavages and the onset of violence. Though this non-existing correlation seems robust, there is a much more subtle relation between ethnic diversity and civil war.

Elbadawi and Sambanis (2000) argue there is a significant parabolic relationship between ethnic diversity and civil war onset. Thus, ethnically highly heterogeneous countries may be as undisruptive as ethnically undiversified countries. Collier and Hoeffler (2000) in turn found that not ethnic diversity, but ethnic dominance, is significant for increasing the risk of violence. Also Bates (1999) supports this point of view. He studies the relationship between ethnicity and in civil violence in 46 African countries during the period 1970- 1995 and found, confirming Collier and Hoeffler (2000), that ethnic dominance increases the risk of civil war, while diversity reduces that risk.

Ellingsen (2000) makes the subtle delineation between ethnic diversity and ethnic division; the latter referring to the ethnic conflict through the creation of borders that pay little attention to the pre-existing socio-cultural, economic, political or religious structures. He argues that the ethnic divisions that resulted after the colonialism in the 18th and 19th centuries have an impact on development and growth-promoting policies, the provision of public goods and the overall political stability of a country. Reynal-Querrol (2002) follows this line of work. She looks specifically at ethnic wars and finds that religious cleavages are positively related with the prevalence of ethnic civil conflicts. Reviewing this literature is seems that not the amount of ethnic groups matter but more whether they live intermingled or not. Herbst (2000) argues that if ethnic groups live dispersed and are densely concentrated in regions protected by natural boundaries, they are less prone to civil violence.

Another element of ethnic differences is ethnic diasporas. Fearon and Laitin (2001) and Collier and Hoeffler (2000) have updated their models with rough indicators of possible diasporas support and have found that large diasporas increase the risk of civil conflict in the countries of origin. This relationship is frequently confirmed by the fact that diaspora communities finance political (- often radical) movements in their countries of origin.

But, with all this foregoing research we have to be critical and not assume a profound relationship too fast. Different periods and regions are covered. Also

differences in the operationalization of the dependent and independent variables are discernible whereby proper comparisons are difficult to make. Overall, there are components of ethnic differences that do play a role in the onset of civil war, although exact correlations are still yet to be determined.

Rough terrain

Recently, research has focused on the conditions, in particular geographical terrain, facilitating the operations of a rebel movement.

Fearon and Laitin (1999; 2001) state that rebels can hide in mountains and forests, whereas there is little cover in plains or deserts. They find a statistically significant relationship between the risk of civil war and the prevalence of rough terrain. This result may not be robust, as Collier and Hoeffler (2000) find no significant relationship between mountainous terrain and civil war onset. However, they do find a negative significant relationship between the degree of geographic dispersion of the population and war outbreaks. This might indicate that geographical terrain is important, since scattered inhabitation patterns can only be possible in open, livable areas.

However, the terrain environment can be correlated with another explanatory power: natural resources. Since some sorts of terrain are more suited to extract oil and other minerals I will consider the exploitation of natural resources below.

Natural resources

Some of the literature agrees on a positive correlation between natural resources and onset of civil war, though testing for the significance of natural resources is difficult,

Collier and Hoeffler (2002) argued that countries with a high proportion of primary commodity exports are more likely to be prone to civil war. They identified a significant parabolic relationship. They find that the risk of war onset is maximized when the share of primary commodity exports to GDP is around 25%. Berdal and Malone (2000) agreed with them and give us two possible explanations for the link. Natural resource predation can be pivotal in that it allows a rebel movement to finance their warfare. Secondly, they argue that countries rich in natural resources suffer from a resource curse. Leaders in resource rich countries do not have to tax the population and thus are less subject to electoral scrutiny, which results in bad leadership – creating a setting for more conflicts.

The former explanations hints at a more complex relation between natural resources and conflict. The first explanation refers to the natural and geographic characteristics of the natural resources. Following Varisco (2010), lootable, distant and diffuse natural resources have a strong interrelation with armed conflicts – indeed through the channel of rebel finance. The second explanation concerns the political, macro-economic and social characteristics of a country. The link between armed conflicts and natural resources is reinforced when a government does not have complete control over its natural resources, when the economy of a country is not diversified and when the degree of internal societal opposition in a state is high.

There are some critics on the link between natural resources and civil war. The proxy variable; primary commodity exports, that Collier and Hoeffler (2000) use does not capture the essence of all *lootable* resources. It includes agricultural commodities that are not easy to loot (Sambanis, 2002). Furthermore, Fearon and Laitin (2001) state that there are too many missing data in the total number of observations in most data sets. This may cause statistical bias if the reason that the data are missing is related to the dependent variable civil war.

Political system

In the literature there is no consensus on the relationship between the lack of democracy – which approximates political grievance and few political rights – and the likelihood of civil conflict.

Collier and Hoeffler (2000, p.26) and argue that 'most of the proxies for objective grievance are insignificant and the best-performing grievance model has very low explanatory power'. Also Fearon and Laitin (2001) seem to support this finding.

On the other hand there are some authors who state that political grievance is an important motive for civil war. Gurr (2000) conducts a research in which he classifies countries in four regime representations: old democracies, new democracies, transitional regimes and autocracies. Well-established 'old' democracies are less prone to grievance and violence. When he takes the number of ethnopolitical groups as given, he finds that ethnopolitical groups in democracies (old and new) are more likely to use protest instead of violent rebellion. This is exactly the other way around in non-democratic (transitional and autocratic) countries. Elbadawi and Sambanis (2000, 2002) provide statistical evidence for this argument. They find that, especially in African countries, democracy levels are significantly associated with lower risk of civil conflict. Sambanis (2001) also concludes that democratic societies are negatively correlated with the onset of ethnic conflict. He argues that this relationship is even more robust than the relation between ethnic conlict and economic variables. Hegre (2003) does not agree with this statement. He says that the effect of democracy is especially contingent upon the level of income. Thus, non-democratic systems have on average lower income – which is the most salient determinant of insurgency.

Others assert that in particular (partly) democratic societies have emerged as prima incubators of civil conflict. Following this argument, violent collective action occurs beause dissidents in a democratic system are free to organize, and non-violent political activism is typically ineffective (Hegre, Ellingsen, Gates, and Gleditsch, 2001).

Reynal-Querrol refines this vague relation between democracy and civil war by suggesting that representation is more important than the level of democracy per se. She goes beyond the use of democracy indices in demonstrating the explanatory power of different types polity, such as proportional representation and presidential systems. She finds that the design of political system is important: civil violence is less likely in proportional representation systems.

NGOs claim that not the political system as such has an influence, but more precisely the degree of political rights within the political system. Abuse of civil rights as monitored by Amnesty International is a leading indicator of violent conflict (Fearon, 2004). Furthermore, political rights and civil liberties reduce the taste for rebellion (Pezzini and MacCulloch, 2004).

Overall, there is no clear evidence yet on the effects of democratization and the likelihood of civil war. We should place democratization in the context of the specific country, whereas several factors, such as representation and civil rights, go beyond the use of the blanket proxy variable democracy. Several of these institutional characteristics have yet to be carefully defined and tested.

History of conflict

Collier and Hoeffler (2004) emphasize the importance of history. Countries with a history of conflict are more likely to experience renewed conflict. This risk is about 44% during the immediate five post-conflict peace years. Afterwards, this risk of conflict fades as the peace period continues by approximately one percent per year.

Appendix 2

The general methodology for calculating GCP is the following:

$$GCP_{by\ gid\ cell} = (Population_{by\ gid\ cell}) \times (\frac{GCP}{population})_{by\ gid\ cell}$$

The approach is particularly attractive because demographers and quantitative geographers have recently constructed a detailed set of population by gid cell. The Nordhaus (2006) dataset generally estimates GCP by using population and developing estimates of the second term of the formula, per capita output by gid cell.

Appendix 3

The income inequality is computed in the following way:

First I computed the GDP per capita by summing all the gid cell GCP's of a country. Secondly we divided this GDP by the amount of gid cells of that particular country; now we find the GDP per gid cell – which is similar to the average GCP. Thirdly, we compounded the deviations. The negative deviations are those where the GDP per gid cell was higher than the GCP, thus the particular gid cell is poorer than the country average. The positive deviations are those where the GDP per gid cell was lower than the GCP, indeed these gid cells are richer than the country average. To avoid the influence of absolute numbers I evaluated the deviation in percentages.

$$GDP_i = \frac{SUM(GCPc)}{\#\ gid\ cells\ per\ country}$$

$$Posdev_{i,c,t} = GCP_i - GDP_i$$

$$Negdev_{i,c,t} = GDP_i - GCP_i$$

Appendix 4

PRIO- GRID dataset

Control variables:	
bdist1	Distance to the border of nearest contiguous neighbouring country
capdist	Distance to national capital city in corresponding country
ttime	Estimated cell-average travel time from the nearest major city
pop	Population size for each populated cell in the gid
perc_mnt	Percentage of mountainous terrain within each cell
perc_forest	Percentage of forest terrain within each cell
nrgrps	Number of different ethnical groups within each cell
HF_area	The Herfindahl index: it can range from 0 to 1.0, moving from a huge number of
	very small ethnical groups to a single dominant ethnical group
amountgid	Amount of gid cells in the corresponding country
warhis	If the gid cell has experienced a civil war the previous 3 three years
Dependent variables:	
Onsetsf	If there is a onset (start) of civil war in the corresponding year. Dichotomous
	1= Civil war onset. 0= No civil war onset. Missing=Civil war duration
Onsetsflead	Same as above, only lead one year forward.
Variables of interest:	
gcppc	Gross cell product per capita
gcp	Gross cell product
gdpdevneg	Absolute difference if the gid cell income is smaller than the average
	country income
gdpdevpos	Absolute difference if the gid cell income is larger than the average
	country income
gdpdevboth	The deviation from the average country income; close to 0 for gid cells
	that approach the average wealth
gcppgrowth	Percentage of growth in gcp per capita related to the previous year

Time series identifiers:

Gid	Is the gid cell identifier, a unique code for each gid cell in the grid
Country	Denotes the numerical country code for the country to which the cell is allocated
Year	Gives the calendar year of observation

Appendix 5

This Herfindahl index is computed manually with the given data of the PRIO-GRID dataset. It combines both the number of groups and the group's settlement as a proportion (percent) of the cell's total land area.

The following information was given: (1) regionally based: a group located in at least one particular region which is easily distinguishable on a map, (2) regional and urban: a group located both in cities and in at least one particular region, (3) aggregate: a particular group, which is aggregated from several sub-groups, or (4) dispersed: non of the previous, group members do not inhabit any particular city/cities or region/regions and are not migrant.

SECTION 6: Bibliography

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TABLE 1 - Model (1) Onset of conflict by poverty

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**	**[3]**	**P-value3**	**[4]**	**P-value4**
Distance to neighboring conflict			0,0032	0,0000	0,0027	0,0000	0,0033	0,0000
Distance to international border			-0,0026	0,0000	-0,0020	0,0000	-0,0026	0,0000
Distance to capital city			-0,0026	0,0000	-0,0032	0,0000	-0,0026	0,0000
Travel time to nearest major city			0,0005	0,0580	0,0009	0,0000	0,0004	0,0950
Population size			0,0005	0,0020	0,0030	0,0000	0,0007	0,0000
Number of ethnical groups			0,0000	0,9600	-0,0001	0,0920	0,0000	0,9720
Percentage forest cover			-0,0001	0,0000	-0,0001	0,0000	-0,0001	0,0000
Proportion mountainous terrain			0,0036	0,0000	0,0036	0,0000	0,0037	0,0000
Ethnic fractionalization			0,0000	0,7520	-0,0002	0,0980	-0,0001	0,7320
War history			0,1631	0,0000	0,1644	0,0000	0,1631	0,0000
GCP	0,0013	0,0000	0,0002	0,2760	-0,0021	0,0000		
GCP per capita	-0,0120	0,0000	-0,0040	0,0000			-0,0038	0,0000
GCP growth per gid								
GCP growth per capita								
Postive income deviation from GDP								
Negative income deviation from GDP								
Constant	0,1267	0,0000	0,0532	0,0000	-0,0043	0,1080	0,0503	0,0000
Country/time fixed effects	no		no		no		no	
Country fixed effects	no		no		no		no	
Gid cell fixed effects	no		no		no		no	
Clustering	no		no		no		no	
R^2	0,0186		0,1014		0,1009		0,1014	
Observations	929.488,0		636.789,0		636.853,0		636.853,0	

TABLE 2 - Model (1) Onset of conflict by poverty

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**	**[3]**	**P-value3**	**[4]**	**P-value4**
Distance to neighboring conflict	-0,0018	0,4310	-0,0019	0,4090	-0,0017	0,4400	-0,0015	0,4970
Distance to international border	0,0035	0,1250	0,0035	0,1310	0,0035	0,1260	0,0032	0,1550
Distance to capital city	-0,0009	0,4440	-0,0012	0,3440	-0,0010	0,4110	-0,0012	0,3160
Travel time to nearest major city	0,0001	0,9190	-0,0002	0,6830	-0,0001	0,8380	-0,0010	0,0620
Population size	0,0002	0,2500	0,0007	0,0140	0,0005	0,0010		
Number of ethnical groups	0,0013	0,0240	0,0014	0,0260	0,0013	0,0230	0,0013	0,0210
Percentage forest cover	0,0000	0,0100	0,0000	0,0170	0,0000	0,0120	0,0000	0,0360
Proportion mountainous terrain	0,0022	0,1070	0,0026	0,0630	0,0023	0,0980	0,0025	0,0580
Ethnic fractionalization	-0,0002	0,3350	-0,0002	0,3140	-0,0002	0,3280	-0,0002	0,3780
War history	0,1002	0,0000	0,1005	0,0000	0,1002	0,0000	0,1004	0,0000
GCP	0,0005	0,0080	-0,0002	0,5790				
GCP per capita	-0,0031	0,0080			-0,0027	0,0230	-0,0029	0,0170
GCP growth per gid								
GCP growth per capita								
Postive income deviation from GDP								
Negative income deviation from GDP								
Constant	0,0319	0,0030	0,0015	0,8660	0,0256	0,0230	0,0379	0,0010
Country/time fixed effects	yes		yes		yes		yes	
Country fixed effects	no		no		no		no	
Gid cell fixed effects	no		no		no		no	
Clustering	yes		yes		yes		yes	
R^2	0,0267		0,0265		0,0267		0,0266	
Observations	636.789,0		636.789,0		636.789,0		653.291,0	

TABLE 3 - Model (1) Onset of conflict by poverty

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**	**[3]**	**P-value3**
Distance to neighboring conflict			0,0016	0,0020		
Distance to international border	0,0018	0,0000				
Distance to capital city			-0,0011	0,3610	-0,0013	0,2310
Travel time to nearest major city	-0,0002	0,5390	-0,0001	0,8190		
Population size	0,0002	0,1990	0,0001	0,4690	-0,0001	0,3220
Number of ethnical groups	0,0013	0,0260	0,0012	0,0280	0,0012	0,0250
Percentage forest cover	0,0000	0,0070	0,0000	0,0130	0,0000	0,0030
Proportion mountainous terrain	0,0020	0,0680	0,0025	0,0610	0,0018	0,1430
Ethnic fractionalization	-0,0003	0,2670	-0,0002	0,3140	-0,0002	0,4610
War history	0,1016	0,0000	0,1004	0,0000	0,1018	0,0000
GCP	0,0005	0,0030	0,0004	0,0090	0,0005	0,0060
GCP per capita	-0,0033	0,0060	-0,0031	0,0080	-0,0025	0,0240
GCP growth per gid						
GCP growth per capita						
Postive income deviation from GDP						
Negative income deviation from GDP						
Constant	0,0288	0,0010	0,0355	0,0010	0,0415	0,0010
Country/time fixed effects	yes		yes		yes	
Country fixed effects	no		no		no	
Gid cell fixed effects	no		no		no	
Clustering	yes		yes		yes	
R^2	0,0271		0,0264		0,0266	
Observations	691.038,0		691.038,0		691.038,0	

TABLE 4 - Model (2) Onset of conflict by economic growth

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**	**[3]**	**P-value3**	**[4]**	**P-value4**
Distance to neighboring conflict			0,0023	0,0000	0,0018	0,0010	0,0022	0,0000
Distance to international border			-0,0021	0,0000	-0,0019	0,0010	-0,0021	0,0000
Distance to capital city			-0,0025	0,0000	-0,0023	0,0000	-0,0024	0,0000
Travel time to nearest major city			0,0036	0,0000	0,0037	0,0000	0,0037	0,0000
Population size			0,0020	0,0000	0,0023	0,0000	0,0022	0,0000
Number of ethnical groups			-0,0001	0,0690	-0,0004	0,0000	-0,0003	0,0000
Percentage forest cover			-0,0001	0,0000	-0,0001	0,0000	-0,0001	0,0000
Proportion mountainous terrain			0,0021	0,0000	0,0016	0,0000	0,0020	0,0000
Ethnic fractionalization			-0,0009	0,0000	-0,0009	0,0000	-0,0009	0,0000
War history			0,1603	0,0000	0,1612	0,0000	0,1606	0,0000
GCP								
GCP per capita								
GCP growth per gid	0,3074	0,0000	0,0387	0,0000	-0,0549	0,0000		
GCP growth per capita	-0,3360	0,0000	-0,1065	0,0000			-0,0704	0,0000
Postive income deviation from GDP								
Negative income deviation from GDP								
Constant	0,0132	0,0000	-0,0048	0,0690	-0,0052	0,0510	-0,0053	0,0460
Country/time fixed effects	no		no		no		no	
Country fixed effects	no		no		no		no	
Gid cell fixed effects	no		no		no		no	
Clustering	no		no		no		no	
R^2	0,0000		0,1003		0,0999		0,1002	
Observations	691.038,0		691.038,0		691.038,0		691.038,0	

TABLE 5 - Model (2) Onset of conflict by economic growth

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**	**[3]**	**P-value3**	**[4]**	**P-value4**
Distance to neighboring conflict	-0,0009	0,6750	-0,0009	0,6650	-0,0009	0,6720	-0,0007	0,7450
Distance to international border	0,0023	0,2610	0,0023	0,2590	0,0023	0,2610	0,0020	0,3210
Distance to capital city	-0,0009	0,4740	-0,0009	0,4780	-0,0009	0,4750	-0,0012	0,3610
Travel time to nearest major city	-0,0002	0,6870	-0,0002	0,6820	-0,0002	0,6840	-0,0012	0,0300
Population size	0,0006	0,0010	0,0006	0,0010	0,0006	0,0000		
Number of ethnical groups	0,0018	0,0040	0,0018	0,0040	0,0018	0,0040	0,0018	0,0030
Percentage forest cover	0,0000	0,0210	0,0000	0,0200	0,0000	0,0200	0,0000	0,0630
Proportion mountainous terrain	0,0023	0,0920	0,0023	0,0930	0,0023	0,0920	0,0026	0,0550
Ethnic fractionalization	-0,0003	0,2360	-0,0003	0,2360	-0,0003	0,2360	-0,0002	0,2560
War history	0,0954	0,0000	0,0954	0,0000	0,0954	0,0000	0,0955	0,0000
GCP								
GCP per capita								
GCP growth per gid	0,0028	0,8130	-0,0001	0,9880				
GCP growth per capita	-0,0048	0,6840			-0,0021	0,8460	-0,0006	0,9580
Postive income deviation from GDP								
Negative income deviation from GDP								
Constant	0,0011	0,9040	0,0010	0,9120	0,0010	0,9050	0,0130	0,0920
Country/time fixed effects	yes		yes		yes		yes	
Country fixed effects	no		no		no		no	
Gid cell fixed effects	no		no		no		no	
Clustering	yes		yes		yes		yes	
R^2	0,0242		0,0242		0,0242		0,0241	
Observations	691.038,0		691.038,0		691.038,0		691.038,0	

TABLE 6 - Model (3) Onset of conflict by economic inequality

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**	**[3]**	**P-value3**	**[4]**	**P-value4**
Distance to neighboring conflict			0,0005	0,3240	0,0006	0,2430	0,0005	0,3350
Distance to international border			-0,0002	0,7470	-0,0002	0,6490	-0,0002	0,7550
Distance to capital city			-0,0034	0,0000	-0,0036	0,0000	-0,0034	0,0000
Travel time to nearest major city			0,0042	0,0000	0,0040	0,0000	0,0043	0,0000
Population size			0,0019	0,0000	0,0021	0,0000	0,0019	0,0000
Number of ethnical groups			-0,0002	0,0000	-0,0002	0,0000	-0,0002	0,0000
Percentage forest cover			-0,0001	0,0000	-0,0001	0,0000	-0,0001	0,0000
Proportion mountainous terrain			0,0024	0,0000	0,0024	0,0000	0,0024	0,0000
Ethnic fractionalization			-0,0006	0,0000	-0,0006	0,0000	-0,0006	0,0000
War history			0,1663	0,0000	0,1663	0,0000	0,1663	0,0000
GCP								
GCP per capita								
GCP growth per gid								
GCP growth per capita								
Postive income deviation from GDP	0,0000	0,0000	0,1663	0,0000	0,0000	0,0020		
Negative income deviation from GDP	-0,0002	0,0000	0,0000	0,0000			0,0000	0,0000
Constant	0,0244	0,0000	-0,0016	0,5200	-0,0020	0,4090	-0,0018	0,4590
Country/time fixed effects	no		no		no		no	
Country fixed effects	no		no		no		no	
Gid cell fixed effects	no		no		no		no	
Clustering	no		no		no		no	
R^2	0,0031		0,0979		0,0989		0,0979	
Observations	766.000,0		766.000,0		766.000,0		766.000,0	

TABLE 7 - Model (3) Onset of conflict by economic inequality

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**	**[3]**	**P-value3**
Distance to neighboring conflict	-0,0023	0,2590	-0,0022	0,2770	-0,0023	0,2600
Distance to international border	0,0043	0,0460	0,0042	0,0490	0,0043	0,0470
Distance to capital city	-0,0010	0,3630	-0,0011	0,3190	-0,0010	0,3570
Travel time to nearest major city	-0,0001	0,9050	-0,0002	0,7030	-0,0001	0,9060
Population size	0,0003	0,0430	0,0005	0,0010	0,0003	0,0390
Number of ethnical groups	0,0016	0,0070	0,0016	0,0070	0,0016	0,0070
Percentage forest cover	0,0000	0,0100	0,0000	0,0070	0,0000	0,0090
Proportion mountainous terrain	0,0029	0,0200	0,0029	0,0190	0,0029	0,0200
Ethnic fractionalization	-0,0002	0,5530	-0,0001	0,5810	-0,0002	0,5540
War history	0,1030	0,0000	0,1031	0,0000	0,1030	0,0000
GCP						
GCP per capita						
GCP growth per gid						
GCP growth per capita						
Postive income deviation from GDP	0,0000	0,7300	0,0000	0,6750		
Negative income deviation from GDP	0,0000	0,1580			0,0000	0,1530
Constant	0,0010	0,9030	-0,0004	0,9660	0,0011	0,8940
Country/time fixed effects	yes		yes		yes	
Country fixed effects	no		no		no	
Gid cell fixed effects	no		no		no	
Clustering	yes		yes		yes	
R^2	0,0254		0,0254		0,0254	
Observations	766.000,0		766.000,0		766.000,0	

TABLE 8 - Model (3) Onset of conflict by economic inequality

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**	**[3]**	**P-value3**	**[4]**	**P-value4**
Distance to neighboring conflict	-0,0022	0,2770	-0,0022	0,2760	-0,0022	0,2790	-0,0026	0,3520
Distance to international border	0,0042	0,0480	0,0042	0,0480	0,0042	0,0500	0,0052	0,0630
Distance to capital city	-0,0012	0,3070	-0,0012	0,3070	-0,0011	0,3120	-0,0015	0,3340
Travel time to nearest major city	-0,0002	0,7160	-0,0002	0,6910	-0,0002	0,7200	0,0001	0,9070
Population size	0,0005	0,0010	0,0005	0,0010	0,0005	0,0000	0,0002	0,5610
Number of ethnical groups	0,0016	0,0070	0,0016	0,0070	0,0016	0,0070	0,0000	
Percentage forest cover	0,0000	0,0070	0,0000	0,0070	0,0000	0,0070	0,0000	0,3880
Proportion mountainous terrain	0,0029	0,0200	0,0029	0,0200	0,0029	0,0190	0,0054	0,0050
Ethnic fractionalization	-0,0001	0,5910	-0,0001	0,5860	-0,0001	0,5840	-0,0001	0,8100
War history	0,1031	0,0000	0,1031	0,0000	0,1031	0,0000	0,0819	0,0000
GCP								
GCP per capita								
GCP growth per gid								
GCP growth per capita								
Postive income deviation from GDP								
Negative income deviation from GDP								
Inequality dummy postive deviation	-0,0005	0,6890	-0,0004	0,8030			0,0000	0,4980
Inequality dummy negative deviation	-0,0004	0,8300			-0,0002	0,9080	0,0000	0,2510
Constant	-0,0001	0,9910	-0,0002	0,9790	-0,0002	0,9810	0,0109	0,2740
Country/time fixed effects	yes		yes		yes		yes	
Country fixed effects	no		no		no		no	
Gid cell fixed effects	no		no		no		no	
Clustering	yes		yes		yes		yes	
R^2	0,0254		0,0254		0,0254		0,0774	
Observations	766.000,0		766.000,0		766.000,0		285.002,0	

TABLE 9 - Robustness checks Spatial correlation

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**	**[3]**	**P-value3**	**[4]**	**P-value4**
Distance to neighboring conflict	-0,0018	0,4690	-0,0009	0,4820	-0,0009	0,4860	-0,0023	0,4550
Distance to international border	0,0035	0,2330	0,0023	0,1750	0,0023	0,1800	0,0043	0,2560
Distance to capital city	-0,0009	0,5160	-0,0009	0,5250	-0,0009	0,5230	-0,0010	0,4060
Travel time to nearest major city	0,0001	0,9250	-0,0002	0,7140	-0,0002	0,7160	-0,0001	0,9170
Population size	0,0002	0,4180	0,0006	0,0370	0,0006	0,0340	0,0003	0,2450
Number of ethnical groups	0,0013	0,0620	0,0018	0,0170	0,0018	0,0160	0,0016	0,0570
Percentage forest cover	0,0000	0,0230	0,0000	0,0440	0,0000	0,0400	0,0000	0,0250
Proportion mountainous terrain	0,0022	0,2380	0,0023	0,1690	0,0023	0,1680	0,0029	0,0890
Ethnic fractionalization	-0,0002	0,3890	-0,0003	0,3050	-0,0003	0,3050	-0,0002	0,6410
War history	0,1002	0,0010	0,0954	0,0000	0,0954	0,0000	0,1030	0,0000
GCP	0,0005	0,1050						
GCP per capita	-0,0031	0,0220						
GCP growth per gid			-0,0001	0,9910				
GCP growth per capita					-0,0021	0,8710		
Postive income deviation from GDP							0,0000	0,3440
Negative income deviation from GDP							0,0000	0,2040
Inequality dummy postive deviation								
Inequality dummy negative deviation								
Constant	0,0319	0,0140	0,0010	0,9340	0,0010	0,9290	0,0010	0,9400
Country/time fixed effects	yes		yes		yes		yes	
Country fixed effects	no		no		no		no	
Gid cell fixed effects	no		no		no		no	
Clustering on country/time	no		no		no		no	
Clustering country	yes		yes		yes		yes	
R^2	0,0267		0,0268		0,0242		0,0231	
Observations	636.789,0		596.263,0		596.203,0		766.000,0	

TABLE 10 - Robustness checks Spatial correlation

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**
Distance to neighboring conflict	-0,0022	0,4680	-0,0023	0,4560
Distance to international border	0,0042	0,2590	0,0043	0,2570
Distance to capital city	-0,0011	0,3590	-0,0010	0,3990
Travel time to nearest major city	-0,0002	0,7370	-0,0001	0,9180
Population size	0,0005	0,0850	0,0003	0,2390
Number of ethnical groups	0,0016	0,0570	0,0016	0,0580
Percentage forest cover	0,0000	0,0230	0,0000	0,0240
Proportion mountainous terrain	0,0029	0,0880	0,0029	0,0890
Ethnic fractionalization	-0,0001	0,6690	-0,0002	0,6420
War history	0,1031	0,0000	0,1030	0,0000
GCP				
GCP per capita				
GCP growth per gid				
GCP growth per capita				
Postive income deviation from GDP	0,0000	0,2780		
Negative income deviation from GDP			0,0000	0,2010
Inequality dummy postive deviation				
Inequality dummy negative deviation				
Constant	-0,0004	0,9800	0,0011	0,9350
Country/time fixed effects	yes		yes	
Country fixed effects	no		no	
Gid cell fixed effects	no		no	
Clustering on country/time	no		no	
Clustering on country	yes		yes	
R^2	0,0254		0,0254	
Observations	766.000,0		766.000,0	

TABLE 11 - Robustness checks Fixed effects

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**	**[3]**	**P-value3**	**[4]**	**P-value4**
Distance to neighboring conflict	-0,0289	0,0360	0,1076	0,0040	0,1072	0,0040	-0,0200	0,1510
Distance to international border	0,0308	0,0250	-0,1374	0,0010	-0,1365	0,0010	0,0212	0,1270
Distance to capital city	-0,0003	0,8760	-0,0080	0,0000	-0,0076	0,0000	0,0002	0,9040
Travel time to nearest major city								
Population size	0,0228	0,0000	-0,0150	0,0000	-0,0144	0,0000	-0,0084	0,0000
Number of ethnical groups	-0,0002	0,5950	-0,0001	0,7470	-0,0001	0,7430	-0,0003	0,4260
Percentage forest cover								
Proportion mountainous terrain								
Ethnic fractionalization	-0,0013	0,6880	-0,0018	0,5840	-0,0018	0,5850	-0,0011	0,6810
War history	-0,0331	0,0000	-0,0181	0,0000	-0,0181	0,0000	-0,0266	0,0000
GCP	-0,0330	0,0000						
GCP per capita	0,0240	0,0000						
GCP growth per gid			-0,0770	0,0000				
GCP growth per capita					-0,0588	0,0000		
Postive income deviation from GDP							0,0000	0,0160
Negative income deviation from GDP							0,0000	0,0030
Inequality dummy postive deviation								
Inequality dummy negative deviation								
Constant	-0,4467	0,0000	0,3783	0,0000	0,3665	0,0000	0,0907	0,0020
Country/time fixed effects								
Country fixed effects								
Gid cell fixed effects	yes		yes		yes		yes	
Clustering on country/time	no		no		no		no	
Clustering on country	no		no		no		no	
Clustering on gid	yes		yes		yes		yes	
R^2	0,0025		0,0015		0,0012		0,0014	
Observations	636.789,0		596.263,0		596.203,0		766.000,0	

TABLE 12 - Robustness checks Fixed effects

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**	**[3]**	**P-value3**	**[4]**	**P-value4**
Distance to neighboring conflict	-0,0200	0,1520	-0,0200	0,1500	0,0017	0,0010	0,0020	0,0000
Distance to international border	0,0212	0,1270	0,0212	0,1260	-0,0018	0,0000	-0,0020	0,0000
Distance to capital city	0,0002	0,8960	0,0002	0,8930	-0,0041	0,0000	-0,0042	0,0000
Travel time to nearest major city					0,0068	0,0000	0,0067	0,0000
Population size	-0,0082	0,0000	-0,0084	0,0000	0,0038	0,0000	0,0036	0,0000
Number of ethnical groups	-0,0003	0,4300	-0,0003	0,4270	-0,0006	0,0000	-0,0004	0,0000
Percentage forest cover					-0,0001	0,0000	-0,0001	0,0000
Proportion mountainous terrain					0,0019	0,0010	0,0023	0,0000
Ethnic fractionalization	-0,0011	0,6800	-0,0011	0,6810	-0,0011	0,0000	-0,0010	0,0000
War history	-0,0266	0,0000	-0,0266	0,0000	0,1184	0,0000	0,1180	0,0000
GCP								
GCP per capita								
GCP growth per gid					-0,0580	0,0000		
GCP growth per capita							-0,0650	0,0000
Postive income deviation from GDP	0,0000	0,0160						
Negative income deviation from GDP			0,0000	0,0030				
Inequality dummy postive deviation								
Inequality dummy negative deviation								
Constant	0,0892	0,0020	0,0907	0,0020	-0,0165	0,0000	-0,0157	0,0000
Country/time fixed effects								
Country fixed effects								
Gid cell fixed effects	yes		yes		no		no	
Clustering on country/time	no		no		no		no	
Clustering on country	no		no		no		no	
Clustering on gid	yes		yes		yes		yes	
R^2	0,0014		0,0014		0,0005		0,0005	
Observations	766.000,0		766.000,0		596.263,0		596.203,0	

TABLE 13 - Robustness checks Fixed effects

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**	**[3]**	**P-value3**	**[4]**	**P-value4**
Distance to neighboring conflict	0,0005	0,3340	-0,0009	0,6650	-0,0009	0,6740	-0,0023	0,2570
Distance to international border	0,0002	0,6720	0,0023	0,2600	0,0023	0,2640	0,0043	0,0460
Distance to capital city	-0,0054	0,0000	-0,0009	0,4800	-0,0009	0,4760	-0,0010	0,3660
Travel time to nearest major city	0,0084	0,0000	-0,0002	0,6990	-0,0002	0,7020	0,0000	0,9280
Population size	0,0043	0,0000	0,0006	0,0000	0,0006	0,0000	0,0003	0,0400
Number of ethnical groups	-0,0004	0,0000	0,0018	0,0040	0,0018	0,0040	0,0016	0,0070
Percentage forest cover	-0,0002	0,0000	0,0000	0,0200	0,0000	0,0190	0,0000	0,0090
Proportion mountainous terrain	0,0035	0,0000	0,0023	0,0940	0,0023	0,0940	0,0029	0,0200
Ethnic fractionalization	-0,0010	0,0000	-0,0003	0,2380	-0,0003	0,2380	-0,0002	0,5540
War history	0,1065	0,0000	0,0957	0,0000	0,0957	0,0000	0,1033	0,0000
GCP								
GCP per capita								
GCP growth per gid			-0,0006	0,9470				
GCP growth per capita					-0,0030	0,7760		
Postive income deviation from GDP	0,0000	0,0000					0,0000	0,7300
Negative income deviation from GDP	0,0000	0,0000					0,0000	0,1580
Inequality dummy postive deviation								
Inequality dummy negative deviation								
Constant	-0,0232	0,0000	0,0230	0,0060	0,0230	0,0060	0,0260	0,0010
Country/time fixed effects	no		no		no		no	
Country fixed effects	no		no		no		no	
Gid cell fixed effects	no		no		no		no	
Clustering on country/time	no		yes		yes		yes	
Clustering on country	no		no		no		no	
Clustering on gid	yes		no		no		no	
R^2	0,0013		0,0242		0,0242		0,0254	
Observations	766.000,0		596.203,0		596.203,0		766.000,0	

TABLE 14 - Robustness checks 2SLS

Explanatory variables	first stage	P-value	Second stage	P-value2	[3]	P-value3
Distance to neighboring conflict	0,0015	0,0030	-0,0037	0,3270	-0,0065	0,0690
Distance to international border	-0,0017	0,0010	0,0070	0,0810	0,0099	0,0080
Distance to capital city	-0,0044	0,0000	-0,0086	0,2470	-0,0017	0,5110
Travel time to nearest major city	-0,0048	0,0000	-0,0070	0,3910	0,0005	0,6520
Population size	-0,0022	0,0000	-0,0021	0,5690	0,0013	0,0710
Number of ethnical groups	-0,0009	0,0000	-0,0024	0,1160	-0,0011	0,5200
Percentage forest cover	0,0000	0,0000	-0,0001	0,3760	0,0000	0,9530
Proportion mountainous terrain	-0,0002	0,4220	0,0007	0,5370	0,0010	0,8130
Ethnic fractionalization	0,0000	0,6260	-0,0004	0,0560	-0,0004	0,2690
War history	-0,0006	0,0470	0,0765	0,0000	0,0774	0,0000
GCP						
GCP per capita						
GCP growth per gid						
GCP growth per capita			-1,5879	0,3460	-0,0312	0,0690
Postive income deviation from GDP						
Negative income deviation from GDP						
Inequality dummy postive deviation						
Inequality dummy negative deviation						
Rainfall growth t	-0,0004	0,0620				
Rainfall growth t-1	0,0004	0,0720				
Constant	0,0991	0,0000	0,1595	0,3400	0,0054	0,7760
Country/time fixed effects	yes		yes		yes	
Country fixed effects	no		no		no	
Gid cell fixed effects	no		no		no	
Clustering on country/time	no		no		yes	
Clustering on country	no		no		no	
Clustering on gid	no		no		no	
If 13<temp<35 and 5% irrigation	yes		yes		yes	
R^2 (whitin)	0,0105		0,0217		0,0161	
Observations	165.218,0		165.218,0		165.458,0	

TABLE 15 - Robustness checks 2SLS

Explanatory variables	first stage	P-value	Second stage	P-value2
Distance to neighboring conflict	0,0139	0,0000	0,0310	0,0000
Distance to international border	-0,0140	0,0000	-0,0296	0,0000
Distance to capital city	-0,0034	0,0000	-0,0087	0,0000
Travel time to nearest major city	0,0007	0,0000	0,0015	0,0000
Population size	0,0007	0,0000	0,0022	0,0000
Number of ethnical groups	-0,0016	0,0000	-0,0020	0,0000
Percentage forest cover	-0,0001	0,0000	-0,0002	0,0000
Proportion mountainous terrain	0,0006	0,0000	0,0036	0,0000
Ethnic fractionalization	0,0000	0,3360	-0,0002	0,0700
War history	-0,0008	0,0020	0,0932	0,0000
GCP				
GCP per capita				
GCP growth per gid				
GCP growth per capita			-2,3141	0,0000
Postive income deviation from GDP				
Negative income deviation from GDP				
Inequality dummy postive deviation				
Inequality dummy negative deviation				
Rainfall growth t-1	0,0011	0,0000		
Rainfall growth t-2	0,0021	0,0000		
Constant	0,0394	0,0000	0,0908	0,0000
Country/time fixed effects	yes		yes	
Country fixed effects	no		no	
Gid cell fixed effects	no		no	
Clustering on country/time	no		no	
Clustering on country	no		no	
Clustering on gid	no		no	
If 13<temp<35 and 5% irrigation	no		no	
R^2 (whitin)	0,0509		0,0066	
Observations	554.795,0		554.795,0	

TABLE 16 - Robustness checks Least development countries

Explanatory variables	**[1]**	**P-value**	**[2]**	**P-value2**	**[3]**	**P-value3**	**[4]**	**P-value4**
LCD dummy	0,0170	0,7830	0,0028	0,2060	0,0020	0,3230	0,0046	0,2300
Distance to neighboring conflict	-0,0019	0,4050	-0,0009	0,6570	-0,0009	0,6650	-0,0023	0,2590
Distance to international border	0,0035	0,1140	0,0024	0,2540	0,0023	0,2610	0,0042	0,0480
Distance to capital city	-0,0010	0,4280	-0,0009	0,4770	-0,0009	0,4760	-0,0011	0,3240
Travel time to nearest major city	0,0001	0,7970	-0,0003	0,6390	-0,0003	0,6200	-0,0001	0,8800
Population size	0,0002	0,2380	0,0005	0,0010	0,0006	0,0000	0,0003	0,0440
Number of ethnical groups	0,0013	0,0250	0,0017	0,0040	0,0017	0,0040	0,0016	0,0070
Percentage forest cover	0,0000	0,0110	0,0000	0,0190	0,0000	0,0200	0,0000	0,0100
Proportion mountainous terrain	0,0022	0,1260	0,0023	0,0870	0,0023	0,0870	0,0029	0,0210
Ethnic fractionalization	-0,0002	0,3280	-0,0003	0,2320	-0,0003	0,2370	-0,0002	0,5480
War history	0,1002	0,0000	0,0953	0,0000	0,0954	0,0000	0,1029	0,0000
GCP	0,0004	0,0370						
GCP * LCD	0,0009	0,3190						
GCP per capita	-0,0033	0,0120						
GCP per capita * LCD	-0,0022	0,7830						
GCP growth per gid			0,0067	0,4540				
GCP growth per gid * LCD			-0,0319	0,1780				
GCP growth per capita					0,0039	0,6610		
GCP growth per capita * LCD					-0,0266	0,3640		
Postive income deviation from GDP							0,0000	0,6460
Postive income deviation from GDP * LCD							0,0000	0,4790
Negative income deviation from GDP							0,0000	0,2690
Negative income deviation from GDP * LCD							0,0000	0,4040
Constant	0,0332	0,0100	0,0011	0,9010	0,0012	0,8950	0,0015	0,8560
Country/time fixed effects	yes		yes		yes		yes	
Country fixed effects	no		no		no		no	
Gid cell fixed effects	no		no		no		no	
Clustering on country/time	yes		yes		yes		yes	
Clustering on country	no		no		no		no	
Clustering on gid	no		no		no		no	
R^2	0,0268		0,0243		0,0243		0,0255	
Observations	636.789,0		596.247,0		596.187,0		765.860,0	