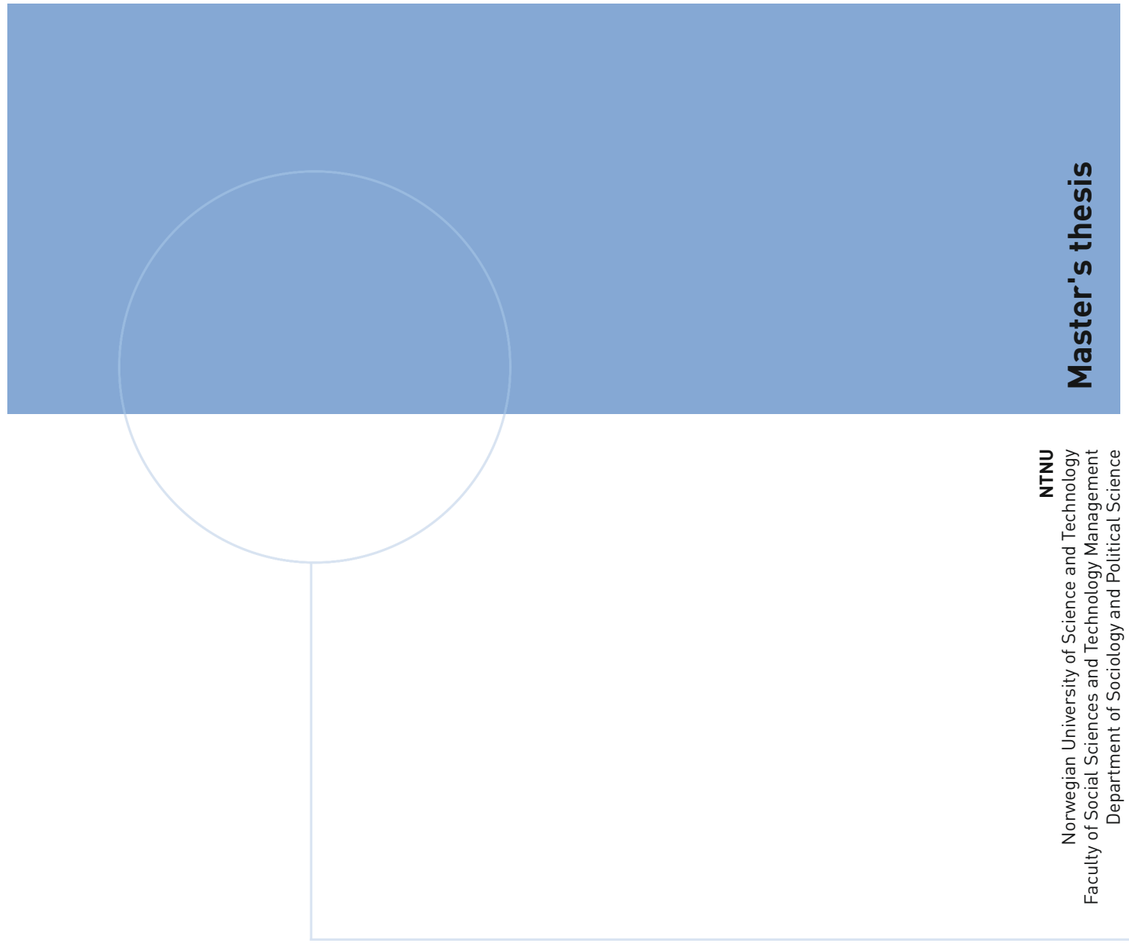

Maja Solem Pedersen

Horizontal Inequalities and Conflict

Using Nightlight as a Proxy for Local Wealth

Master's thesis in Political Science
Supervisor: Halvard Buhaug
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Abstract

Utallige årsaksmekanismer har blitt foreslått for den etablerte sammenhengen mellom fattigdom og konflikt og disse har primært skilt mellom mulighet- og motivasjonsbaserte forklaringer. Disaggregerte studier av disse forholdene på lokalt nivå har vist å være bedre i stand til fremme motivasjon som følge av ulikhet som en drivende faktor. Ved hjelp av satellittobservasjoner av nattlysdata på etnisk gruppe-nivå som mål på sosioøkonomiske forhold søker denne oppgaven gjennom kvantitativ metode å ta rede på om fordelingen av velstand påvirker gruppenes tilbøyelighet til å involveres i voldelig konflikt. Videre: om fattigdom eller ulikhet best forklarer konflikt, om økonomisk ulikhet har sterkere effekt på konfliktrisiko i kombinasjon med politisk ulikhet i tillegg til om effekten av både fattigdom og ulikhet er betinget av strukturelle forhold i landet som øker mulighetene. Jeg finner at verken fattigdom eller ulikhetsmål basert på nattlys per capita gir signifikante resultater på egen hånd, og at denne måten å operasjonalisere på samt kvaliteten på rådataene gjør at man bør være skeptisk til resultatene. Likevel finner jeg at nattlysbaserte ulikhetsmål kombinert med at gruppen tilhører et autokrati eller et land med voldelig historie har en negativ effekt på konfliktrisiko. Dette bekrefter forventningene om at effekten av ulikhet forsterkes av strukturelle forhold, selv om i en overraskende retning, og støttes delvis av robusthetstester med konvensjonelle økonomiske data.

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Despite the help I have received, any remaining errors are solely my own responsibility.

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Maja Solem Pedersen

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1. Introduction

Ethnic conflict is widespread and was termed the most serious threat to the world after the cold war era by Huntington (1993). A number of serious conflicts today are fought along ethnic lines such as the conflicts in South Sudan, the Central African Republic, and Iraq (Themnér & Wallensteen, 2014; Pettersson & Wallensteen, 2015; Marshall, 2016). However, the notion that it is not ethnicity in itself but rather low levels of economic development along ethnic lines that is conflict inducing has become prevalent (Elbadawi & Sambanis, 2000; Stewart, 2008). Suggested causal mechanisms of this link between low levels of development and civil conflict have been numerous, but have largely centered around opportunity and motivation based explanations, and the question of which is the primary driver of conflict is still unsettled.

The debate on opportunity and motivation or "greed versus grievance" as it was originally termed established itself as paramount to the civil war literature, with its separate strands of scholars rigorously arguing their case. The central question being whether favorable opportunity structures for rebels or an aggrieved population on account of poverty and inequality was the main explanatory factor for the connection between low development and civil war, and the debate established two different ways of understanding civil conflict. While common perception seems to indicate that countries with marginalized ethnic groups are more conflict prone than others, grievance based explanations of conflict were for a period largely dismissed on account of absent statistical evidence. Even though Gurr's (1970) relative deprivation theory for some time was deemed plausible in motivating the deprived to violence through comparison with others, it was asserted that economic opportunity for rebel leaders was a more realistic cause of armed conflict than was grievances among ethnic groups because of its omnipresence in poor countries. Also, grievance was often interpreted solely as a consequence and not as a reason for violent conflict. Based on the established effect of low levels of development, often interpreted as poverty, on conflict risk opportunity based explanations accentuated mechanisms such as low opportunity costs for the population and a weak state facilitating rebel uprisings as likely reasons for this connection and concluded with inequality having no statistically significant effect.

The horizontal inequality literature—encompassing inequality between groups as opposed to between individuals, termed vertical inequality—offered an explanation of this lack of findings in that inequality on the individual level is unable to have any effect on conflict risk and that the studies disregarding the effect of inequality needed better operationalization of the phenomenon. In the following, advocators of horizontal inequality managed to find a relationship between grievances and conflict onset, to a certain extent reinvigorating the relative deprivation theory. This development in the literature made the dispute between opportunity and motivation based explanations of conflict more evenly weighted, and while the debate has evolved from being heavily polarized, with the realization that both opportunity and motivation may have an influence, the combination of the two types of explanatory factors have not been investigated at large.

A further development in the literature has been the emergence of disaggregated studies, trying to capture the effect of different explanatory factors on geographic grid cell or group level making use of spatial data, facilitating the tracking of causal mechanisms as most conflict inducing mechanisms vary within countries. This is especially useful in the study of horizontal inequalities as these by definition take place between ethnic groups at a disaggregated level from the state.

Closely associated with the disaggregation of conflict studies is the introduction of nightlight emission observable from space as a proxy for economic development. This readily available source of spatial data has been used to measure economic development in a number of studies, also concerning conflict (e.g. Shortland et al., 2013; Ahrens, 2015), including several to investigate the relationship between economic inequality and civil conflict (Cederman et al., 2015; Kuhn & Weidmann, 2013; Alesina et al., 2012). Nighttime light data is a relatively new alternative proxy to measure economic output in countries with little or no official statistical data. In addition, it can tell us more about the geographic location of wealth than a standard GDP per capita measure can. Existing spatial datasets concerning economic performance such as the G-Econ dataset (Nordhaus, 2006) has experienced difficulties in collecting valid data from underdeveloped areas (Jerven, 2013), thus potentially making statistical research on the basis of these data uncertain. Additionally, the quality of the data is often negatively related to the frequency of conflict, as conflict tends to coincide with areas with poor statistical data. The strength of the nighttime light data is that it is measured

objectively for each region and compared to the static conventional economic data the nightlights capture the time dimension making it a more refined measure of local wealth, and it is considered obvious by a number of scholars that the use of electricity at night can be interpreted as a measure of wealth (Chen & Nordhaus, 2011). However, my research has revealed severe weaknesses with the use of these data including unexplainable fluctuations in the total sample suggesting that we should be suspicious as to how the data are collected, as well as problems with operationalizing nightlight as a per capita measure as a proxy for economic development. Thus, the nightlight data might not be as useful as it is tempting to assume.

Nevertheless, this theoretical and empirical backdrop serves as the foundation for this thesis. The overarching question goes back to the established link between poverty and conflict and whether or not this can be explained by inequality on ethnic group level as proposed by the theory of horizontal inequality. Combining this theory with a relatively new proxy for poverty in a disaggregated analysis was expected to be fruitful and provide stronger results. The central research question is thus:

Does the geographical dispersion of wealth between ethnic groups influence the risk of violent conflict?

In an extension of this the thesis takes on whether poverty or inequality better explains the occurrence of violent conflict on the ethnic group level; whether the effects of negative economic inequality on conflict risk is contingent on the groups' political status; as well as whether the effects of both poverty and inequality hinges on elemental structural conditions and in that way combines the formerly separated motivation and opportunity explanations. The analysis is based on time-varying data of nighttime light emission by ethnic group in Sub-Saharan Africa, and the dataset is aggregated from a grid cell structure. The use of this proxy on an already extensively researched theoretical question might provide new insight to the peace and conflict literature, and can possibly be a supplement to the sparse data that exist in the field of inequality and conflict. Earlier disaggregated research on poverty and inequality and conflict has been based on suboptimal disaggregated data with the measures being static, coarse, and not representative in areas of violence and turmoil. This thesis is motivated by the need for more precise disaggregated economic data that can help understand this connection.

While my contribution is primarily empirical through including this relatively new proxy for poverty and inequality and investigating to what degree it is successful, I also aspire to provide some theoretical implications through the combination of opportunity and motivation based explanations for the link between low development and conflict. For peacekeeping missions as well as preventative work in countries where ethnic fault lines are deep combined with low levels of development, it is crucial that these mechanisms are explored further. Moreover, a more precisely defined causal mechanism can help put conflict prevention on the agenda of politicians and policy makers in risk exposed countries. Hence, the perception of the possible explanatory factors as a dichotomy of opportunity and motivation must be overcome.

First, the definition of conflict in this thesis is in order. The term conflict refers to a conflict event and will in this thesis be defined as any act of violence by an organized actor towards another organized actor or civilians with at least one death as a consequence, confined to a specific location and a specific point in time in accordance with the UCDP Georeferenced Event Dataset 2.0 (Croicu & Sundberg, 2015). The definition includes state-based conflict, non-state conflict, as well as one-sided violence, and is any conflict event the ethnic group in question is involved in. Additionally, the aforementioned separation between vertical, individual level, and horizontal, group level, inequality is of importance in this thesis, with inequalities on group level being referred to when not specified.

As the relevant disaggregated data is only available on geographic grid cell level, I had to collect the group level variables from this whereupon I aggregated these data to ethnic group level. Consequently, numerous decisions had to be made on which groups to include, how to distribute the data to the various groups, as well as how to operationalize the variables to make the most sense on ethnic group level. As the use of satellite imagery of nightlight is a relatively new way to study conflict, the latter was particularly difficult. Thus, the process of constructing the dataset has been challenging and the amount of work was extensive.

The structure of the thesis is as follows. In Chapter 2 the theoretical framework, combined with previous research, is presented. The extensively documented link between low economic development, interpreted as poverty, and conflict is presented whereupon the various possible opportunity and motivation based explanations for this link are discussed. The discussion

leads to a revised theory of inequality and conflict, both substantiating the link between inequalities and conflict via grievances, and combining opportunity and motivation based explanations. The chapter concludes by presenting the hypotheses constructed on the basis of my overarching research question as well as the theoretical discussion.

Chapter 3 presents my methodological approach, starting out with a vindication of the quantitative method applied in the thesis. Subsequently, a discussion of the necessity of disaggregated data and a detailed description of how I constructed my dataset is included. Following this the dependent variable, independent variables, as well as control variables are presented consecutively. A more thorough presentation of the specific statistical method applied concludes this chapter.

The empirical analysis follows in Chapter 4. The various hypotheses are tested and the results of the main hypotheses are presented in models using nightlight data as a proxy for poverty and inequality. Following this the nightlight based poverty and inequality measures are tested in relation to various structural conditions, in an attempt to combine opportunity and motivation based explanations of civil conflict. The exact same models are subsequently run using poverty and inequality variables based on group gross product (GGP) per capita measures to check the robustness of the results. The chapter also includes a detailed evaluation of the use of nightlight as a proxy in my analysis. The results are discussed in Chapter 5 and a final conclusion is presented in Chapter 6.

The main findings in my analysis are that neither nightlight nor GGP based measures of inequality have a significant effect on conflict risk on ethnic group level on their own, whereas both yield significant and rather interesting results combined with structural conditions such as country regime type and history of violence. Overall it seems that absolute poverty has a greater effect on conflict risk than inequality, but this is only based on the results using the GGP measure, and the nightlight variables show no effects on its own. This leads me to my next finding, namely problems with the nightlight data as a proxy both on account of the operationalization's potentially poor fit with what we are measuring as well as the raw data itself potentially being poorly constructed. Nevertheless, this provides interesting results as well as implications for further research, such as the need to improve the calibration methods for the raw nightlight data and to develop more appropriate ways of operationalizing

the nightlight variables to be a more fitting proxy for local wealth. While the accurateness of this proxy on the local level has recently been confirmed when operationalizing it per square kilometer (Weidmann & Schutte, 2016), such an operationalization of nightlight has to my knowledge yet to be applied to a study of conflict on ethnic group level. The obvious weakness of using a nightlight per capita measure as in this thesis and in Cederman et al. (2015) can in this way be overcome. Theoretically, my results suggest that further investigation of the combined effects of structural conditions and poverty and inequality is in order, and that the opportunity and motivation theories should be considered as complementary.

2. Theory

2.1 Introduction

While several scholars have rejected the impact of inequalities and grievances on violent conflict, new conceptualizations and measurements have shown that inequalities on group level can in fact be a possible cause of civil war. This chapter sets out to delineate the theoretical foundation for the thesis focusing on the rejection of grievance-based arguments and the following emergence of the concept of horizontal inequalities as a way to account for group level differences. In contrast to the dichotomous perception of opportunity and grievance I will focus on these as complementary mechanisms working together, with the conjecture that the combination of the two is able to better explain the emergence of civil conflict than they do separately. First, the entrenched link between low levels of development and conflict needs to be addressed. The discussion results in a set of hypotheses.

2.1.1 Development and conflict

The connection between low levels of development, often interpreted as poverty, and conflict is well established on the country level (Braithwaite et al., 2016; Ward et al., 2010; Blomberg et al., 2006; Sambanis, 2004; Collier & Hoeffler, 2004; Fearon & Laitin, 2003). Elbadawi & Sambanis (2000) assert that contrary to popular belief the high occurrence of internal armed conflict in Africa is not due to ethnic and religious diversity, but rather a consequence of generally high levels of poverty. In a comprehensive study taking on a sensitivity analysis of several studies in the civil war literature, Hegre & Sambanis (2006) confirm the statistical link between poverty, measured by per capita income, and civil war. The literature has somewhat agreed on three plausible causal mechanisms, namely low state capacity, low opportunity costs, and grievances measured by horizontal inequalities (Jakobsen et al., 2013). The first represents an idea that poverty leads to low state capacity, which again facilitates insurgency. A weak state without the capacity to answer to rebellions increases the chances for civil war (Fearon & Laitin, 2003). Collier & Hoeffler (1998) find that higher per capita income in a country reduces the risk of civil war, and interpret this as being due to the fact that higher income increases the opportunity cost of rebellion. Alternatively, however, the statistical link between low levels of development and conflict may not mean that poverty is the mechanism

leading to conflict. In fact, the connection between poverty and conflict might as well be nonexistent, and looking specifically at poverty among the population and not at low levels of development as a proxy for this might lead to other results indicating no relationship. The connection between poverty and conflict may just as well be a spurious one and other features of poorly developed states might be the driving factors causing conflict, at the same time as they are causing poverty. For example, low levels of development can more intuitively be seen as a direct cause of low state capacity than can poverty among the citizens. Lastly, there may be other features of low development among the people that causes conflict, such as inequality and not poverty in itself. Inequality between groups within a country and the comparison and competition that comes from this has been substantiated as a possible explanation for the link between low levels of development and conflict, and the conflict driving mechanism is taken to be grievance as a cause of either absolute poverty or inequality within the country (Stewart, 2000). Thus, a low level of development is not synonymous with poverty, and the two concepts should be kept separate. In the following I will elaborate on these three plausible causes for this established connection between low levels of development or poverty and conflict; low opportunity costs, low state capacity, and horizontal inequality. First, the relative deprivation theory, which formed the backdrop of the debate, will be accounted for.

2.2 Explaining the low development-conflict link

2.2.1 Relative deprivation theory

Grievance in relation to conflict was initially introduced in the 1960's by Gurr's (1970) relative deprivation theory suggesting that the strain caused by the discrepancy between expected and received collective goods is what makes men inclined to violent behavior. Similarly, Davies suggested that following an economic decline the actual socioeconomic situation mattered less than the expectation that the former development would continue and that as a consequence people attain "a mental state of anxiety and frustration when manifest reality breaks away from anticipated reality" (1962: 6). Snyder & Tilly (1972) were critical of the theory of frustrations leading to aggression, questioning the causal mechanisms between the two, and thus argued for opportunity-based explanations of violent conflict.

2.2.2 Low opportunity costs

While initially coining the "greed" term in their earlier work, Collier & Hoeffler (2008) moderate it to "opportunity", and in a similar manner focus on the feasibility of conflict. Thus, the greed or opportunity literature emphasizes structural conditions that provide opportunities for rebels. Collier & Hoeffler (2004) find evidence for opportunity-based explanations such as the availability of finance for rebellion, low costs for participating in rebellion and military advantages, while inequality, political rights, ethnic polarization, and religious fractionalization yield no significant results, indicating that grievance is not a palpable explanation of armed conflict. Nonetheless, they do as mentioned find that higher income reduces the risk of civil war, and derives from this that lower opportunity costs for participating in conflict increases the chances. In a poor society participation in a rebellion means less income foregone than in a wealthy society and thus makes for greater opportunity associated with rebellion.

2.2.3 Low state capacity

Fearon & Laitin (2003) find state weakness caused by poverty, a large population, and instability to be the main determinants of civil war and claim that an aggrieved population makes little difference in the way of chances of conflict outbreak. They assert that grievances can motivate the non-rebelling population to facilitate the rebellion, but this is in no way necessary for insurgents to rebel. Most importantly the critique of grievance or motivation based explanations is that as grievances are found anywhere in the world, they cannot account for the outbreak of civil war some places, leaving opportunity as the only probable explanation. Cederman et al. (2013) sum up the arguments against grievances in the term ubiquity-of-grievances encompassing that grievances cannot account for the outbreak of civil war because it exists everywhere in contrast to large-scale civil violence. I will return to the ubiquity-of-grievances claim in the discussion of conditions that must be met for grievances to matter.

However, both Collier & Hoeffler (2004) and Fearon & Laitin (2003) acknowledge inequality as a possible explanation of conflict and include this as a variable in their analysis. As a proxy they use the Gini coefficient, defining inequality as a statistical dispersion representing the income distribution of citizens in a country and the Ethnic Fractionalization Index (ELF)

measure, extracted from the 1960 work of Soviet researchers at the *Miklukho-Maklai Ethnological Institute* and published in the *Atlas Narodov Mira.* The ELF indicates ethnic fractionalization with the probability of two citizens randomly drawn belonging to different ethnolinguistic groups (Easterly & Levine, 1997). None of these variables prove to be statistically significant and the possible connection between inequality and conflict is declined.

Thus, although not confident in the grievance mechanisms, studies advocating opportunity-based explanations of conflict do find a statistical link between absolute poverty and violent conflict. Nevertheless, while asserting this link between poverty and violent conflict, these authors dismiss the effect of inequality based on a measure of ethnic fractionalization, a finding leading to rigorous critique from other scholars. Subsequently, Collier (2007) accuses subscribers of grievance-based explanations of glorifying the role of rebels on the basis of political motivations and lacking statistical evidence. However, others have claimed that this lack of statistical evidence for the connection between grievances and conflict is the result of "inappropriate conceptualization and imperfect measurements, rather than reflecting a fundamental absence of any causal effect" (Cederman et al., 2011: 478), leading to the formation of a new set of conceptualizations.

2.2.4 Horizontal inequalities

Emerging from this debate was the introduction of the concept horizontal inequalities to conflict research. The reaction rests on this critique of the conceptualizations and measurements made by those who rejected the importance of grievances and asserts that inequality on the individual level is not sufficient as an explanation for a phenomenon that takes place on group level, as individuals do not rebel against each other. This ecological fallacy was corrupting the discussion from the outset, and separating between horizontal and vertical inequalities changes the premises for the whole debate.

Stewart defines horizontal inequality as "inequalities in economic, social or political dimensions or cultural status between culturally defined groups" (Stewart, 2008: 3). In contrast, vertical inequalities are found between individuals. The economic dimension of horizontal inequalities involves the possibility of owning assets, being employed, and having

an income. Political horizontal inequalities are apparent when participation at higher or lower levels of political institutions is unavailable for some groups, e.g. in the government, the army or the bureaucracy. Social horizontal inequality entails that groups are excluded from societal institutions such as education, health services, and access to water and housing. Inequality in cultural status encompasses that the group's cultural and religious practices and symbols are not recognized by the society as a whole (Stewart, 2008). Furthermore, Stewart (2008) emphasizes the fact that the presence of different types of horizontal inequalities is likely to increase grievances, and that e.g. cultural differences in themselves do not lead to violent conflict unless economic or political differences are present. The different types of horizontal inequalities are important in different parts of the process and to different actors, and mutually strengthen each other increasing the likelihood of grievances. This phenomenon is coined by Stewart as "multidimensional horizontal inequalities": "Both leaders and followers may become strongly motivated where there are severe and consistent economic, social, and political differences between culturally defined groups" (Stewart, 2008: 12). Horizontal inequality also entails that groups that originally should have the same economic, political, and social opportunities do in fact not.

Grievance based explanations of conflict claim that as a result of this, groups may participate in violent conflict. Thus inequality in relation to conflict should not be measured as the Gini coefficient or the ELF or by other individual level variables. Although the gini coefficient takes on measuring inequality in a country it can only indicate the economic inequality between citizens, which is not likely to spark conflict, as one individual rebelling against another does not cause armed conflict. Furthermore, the challenges associated with the ELF as a measure of inequality are numerous. For instance, the 1960 data used for the index are dated; one static measure does not take into account the dynamicity of ethnic groups; and encapsulating the diverse ethnic landscape of a country in a single quantity is unlikely to be very accurate (Posner, 2004). Moreover, the ELF and other demographic measures of fractionalization fail to pick up the political dimension that is just as important as cultural differences, making the Ethnic Power Relations dataset better equipped to address inequalities between groups. In addition, questions can be asked as to the ideological foundation for coding the ELF data as they were constructed for Soviet purposes (Easterly & Levine, 1997).

At the outset mostly qualitative studies were preoccupied with horizontal inequalities. Stewart (2000) investigates economic and social causes of conflict, suggesting that horizontal inequality is a driving factor leading to violent conflict. Stewart et al. (2005) argue that horizontal inequalities matter and can cause conflict, referring to group level inequalities as a contributing factor to the outbreak of civil conflicts in Côte d'Ivoire, Rwanda and Northern Ireland among others. Langer (2008) finds in a comparative study of Côte d'Ivoire and Ghana evidence for horizontal inequalities causing violent conflict, although only with the simultaneous presence of political horizontal inequality. The results suggest that the combination of socioeconomic and political horizontal inequalities is what causes grievances that furthermore result in violence. Even though not being able to generalize to a large extent, and being criticized for selecting cases on the dependent variable, the qualitative studies on horizontal inequalities have been invaluable for the study of grievances and conflict and paved the way for quantitative research on the topic.

Following this, some scholars conducting large-N studies also found evidence of inequality along ethnic cleavages being connected to violent conflict when operationalizing it differently than previous quantitative studies. Because of the difficulty of operationalizing grievances survey data was initially taken to be the most accurate way to measure the phenomenon. Østby (2008) finds in the first large-N cross-country analysis on the subject that social horizontal inequality increases the risk of conflict onset, while she finds no statistically significant results for economic horizontal inequality. Nevertheless, her findings oppose the claim that grievances should be disregarded as a reason for violent conflict. The study uses survey data from the Demographic and Health Surveys (DHS), and while it is problematic to generalize to a large extent on account of poor data coverage for a number of regions, these data have the advantage of being free from government bias and are likely to be uncontaminated as it was collected for other purposes than researching horizontal inequalities. However, although these data are subnational they rarely cover all regions of a country as well as being quite static. In addition the data are often added up to create country level measures of inequality, not making it the best data to research inequality on group level, which the theory of horizontal inequalities demands. This severe misconception has colored the debate, and while state capacity is measured appropriately on the country level, questions of opportunity costs for participants and grievances caused by poverty and inequality requires disaggregated region or group level data.

As a consequence of these empirical limitations disaggregated studies of civil war have become more frequent, investigating features that are less appropriate to study on country level on a sub-national level. Both economic inequality and conflict are examples of such features, as income varies across countries and between different groups and it is not arbitrary where violent conflict takes place geographically in a country (Buhaug et al., 2011). Horizontal inequality requires to be studied at a disaggregated level as it per definition takes place on group level. This might result in more refined data and can hopefully enable us to draw more precise conclusions.

Acting on this claim Cederman et al. (2011) found using disaggregated geocoded data on political and economic inequalities that groups that deviate from the country average have a higher propensity for experiencing civil war onset. In a quantitative analysis of the 75 districts of Nepal, Murshed & Gates (2005) find horizontal inequalities to be a driving force behind the civil war. Furthermore, in addition to finding evidence for the impact of their symmetric measure of horizontal inequalities, Cederman et al. (2011) find that groups deviating from the country average economically in both a positive and negative direction have higher risk of being involved in civil war, implying the usefulness of an asymmetric measure of horizontal inequality. Buhaug et al. (2014) find using disaggregated data that socioeconomic as well as political inequality increases the risk of civil war primarily when they coincide with ethnic groups cleavages.

These findings change the debate completely, and indicate that it is too early to reject the theory of grievances based on political and economic inequality leading to violent conflict. My analysis in this thesis rests upon the theory of horizontal inequality and this is the argument that I will build my hypotheses on the basis of. Although a statistically significant connection has been established between horizontal inequalities and conflict, the problem remains of defining the causal mechanisms between grievances and collective violence, starting out from horizontal inequalities. The following section will attempt to strengthen this causal mechanism theoretically.

2.3 A revised theory of inequality and conflict

2.3.1 From horizontal inequalities to grievances

For the revised theory of inequality and conflict I draw heavily on Cederman et al. (2013), and use their theory as the theoretical backdrop when it comes to the causal mechanisms leading from horizontal inequality to violent conflict. Subsequently, I attempt to broaden the theory through increasing the focus on opportunity structures, and to a further extent combining opportunity and grievance based explanations. As a result I give more credit to the opportunity aspects and structural conditions than Cederman et al. (2013). According to Cederman et al. (2013) the transition from group level inequalities into grievances goes through a process starting out with group identification and group comparison, moving on to the evaluation of injustice and furthermore "framing and blaming." These four steps merely suggest conditions that must be present for political and economic horizontal inequalities to lead to grievances. Regarding group identification, the theory of horizontal inequalities entails that there are preexisting ethnic groups with cleavages between them along which grievances emerge. Features such as a common language, history, and religion that are often not coinciding with territorial boundaries contribute to making ethnicity especially exposed to experiencing conflict. These traits make ethnicity a more salient identity than for example gender or age and makes it a more solid foundation for mobilization (Ellingsen, 2000). For grievances to matter at all, the precondition of perceived group identity must be present, both among group members and others.

When it comes to comparison between groups, social identity theory experiments by Tajfel and Turner (1979) have discovered that group loyalty and commonality quickly emerges based on random and forced differences from other groups. This indicates that there is nothing exceptional about ethnic group identity, and that other group identities may be just as salient and likely to be aggrieved. This finding strengthens the theory of grievances as an omnipresent phenomenon to a certain extent, through substantiating that any group anywhere has the possibility of becoming aggrieved. However, realistic group conflict theory, on the other hand, suggests that comparison based on real differences is more likely to cause actual conflict than are imagined and suspected inequalities (Sherif & Sherif, 1953; LeVine & Campbell, 1972). Nonetheless, Tajfel and Turners (1979) finding should also lead us away from the widespread perception that ethnic groups are static constructions that do not evolve

and suggests that they are as dynamic as other kinds of groups formations. This finding indicates that grievances can act as a strengthening tool for various groups and that the presence or absence of material goods respectively, can be what the group has in common and the mere expression of grievances may reinforce the group identity.

The third step in the process, evaluation of injustice, is crucial in the production of grievances, as differences between groups in themselves do not aggrieve without an interpretation of these. Groups that do not evaluate their economic or political situation in comparison to other groups in the country thus do not perceive the situation as unfair, and are unlikely to become aggrieved. The difference between mere dissatisfaction and grievance is emphasized by Williams' (2003) distinction, suggesting that deprivation is not conflict inducing without comparison revealing unjust distribution. This argument strengthens the claim that grievances do cause conflict and cannot be dismissed on account of its omnipresence. Identification of injustice is therefore paramount for the emergence of grievances from inequality, and is often fueled by political leaders. This indicates that the emergence of grievances hinges on the angling of inequalities from political leaders to a greater extent than it does on the real level of inequality. Interestingly, this can be used as an argument against grievance-based explanations, as critics accuse the theory of having too much confidence in the claims of rebels. Collier's (2007: 18) assertion that rebels use "a catalogue of grievances" to justify the rebellion which is initially opportunity based can benefit from this fact. In any case the awareness of inequality and the perception of it as unfair is crucial for grievances to emerge.

As a final step in the process Cederman et al. (2013) suggest the framing and attribution of blame. The fact that deprivation is perceived as unjust alone does not necessarily lead to grievances. Placement of the responsibility of the differences is of utmost importance, as grievances must be directed towards who persecutes the actual unfair treatment. Without someone to blame, there is no one to direct the aggression at, and organized violence and armed conflict is not likely to break out. Country level political leaders are likely to be the target when it comes to the attribution of blame by aggrieved groups. This is where grievances are made into a political matter, with claims being made to the highest political level (Goodwin, 1997). Through these four steps the mechanisms driving the process of horizontal inequalities forming into grievances are substantiated.

2.3.2 From grievances to violent behavior

Having corroborated the causal mechanisms leading from horizontal inequalities to grievances the task remains to define the channels through which grievances lead to organized violence and conflict. Whereas the link between horizontal inequalities and grievances involves more the politicization part of the process, the step from grievances to violence concerns mobilization to a greater extent. Two important steps in this process are according to Cederman et al. (2013) firstly, mobilization and secondly, rebel claims and state repression. Mobilization is key because all the preceding steps can be present without the people necessarily joining in. The link between the rebels' mobilization and the state's reaction can help explain why grievances in some cases lead to collective violence. Rebels' methods for overcoming the collective action problem such as offering material motivation (Weinstein, 2007), exploiting identity formation (Tilly, 1978), or punishing those who are reluctant to join (Goodwin & Pfaff, 2001) are likely to reinforce mobilization, despite repression from the state encouraging individuals to refrain.

Governments' reactions to the mobilization of aggrieved masses vary significantly between types of states, and is of great importance as to whether the protests end up in violence or not. While democratic regimes are more prone to consider the rebels' peaceful claims than authoritarian ones, the reaction will vary with the type of claim that is made. Where political leaders at the state level are perceived as supporting the unequal distribution of economic and social goods; keep excluding the mobilized groups politically leaving no peaceful alternatives for rebels achieving their goals; or go after the mobilized group with violence forcing them to take up arms the process is likely to lead to violence and possibly civil war (Goodwin, 1997). All of these mentioned potential responses from the state are likely to further enhance grievances felt by the group in question, and with the right mobilization tools of the rebel leaders the causal mechanism between grievances and collective violence can be plausible.

In a similar fashion Cederman et al. (2011) attempt to describe this link drawing on social psychology, substantiating feelings of grievance as a consequence of horizontal inequalities and relative deprivation, and these feelings furthermore leading to collective violence. The study indicates that more so as a tool to recruit rebels along ethnic lines, than a "pure grievance factor", inequality is likely to lead to collective violence mobilization. However, the feeling of being politically subjected to a group that has no right to be in a senior position

is a particularly important driver of group grievances. Similarly, Gurr (1970) attempted to clarify this link between relative deprivation and violent behavior. Although offering plausible psychological mechanisms leading from relative deprivation to violent behavior such as aggression as an "innate response activated by frustration" (Gurr, 1970: 31), these causal mechanisms are more theoretically than empirically based. This lack of evidence for the connection between grievances and collective violence is one of the fundamental critiques of grievance-based explanations of conflict, and can be a reason for condemnation of the theory from critics despite strong statistical evidences for the link between horizontal inequalities and violent conflict. Nevertheless, the fact that connections between inequalities along ethnic cleavages and conflict are found indicates that grievances in fact do matter despite the alleged presence of it everywhere.

There is, however, a possibility that grievance is not the primary causal link connecting inequalities to violent conflict and that grievances with the absence of a discussion of opportunity structures can not explain the emergence of violent conflict. For example, horizontal inequalities can be suspected to merely prepare the grounds for opportunity based rebellions, creating a large pool of potential participants with low foregone income and thus lower risks associated with participation (Cederman et al., 2013; Collier & Hoeffler, 2004). A number of potential causal chains running from horizontal inequality to armed conflict via other mechanisms than grievances are imaginable. Thus, in addition to the aforementioned problem of endogeneity, the effect of grievances measured by horizontal inequality could be spurious. I aspire to minimize these probabilities by including a number of control variables and by having substantiated the causal mechanism through grievances theoretically. In addition I will focus on the symbiosis between opportunity and grievances as opposed to the dichotomous relationship it has previously been granted, assuming that the combination of the two is able to explain the emergence of violent conflict better than they do separately.

2.3.3 Motivation and opportunity combined

Following the discussion of mechanisms leading from inequality to conflict, the structural conditions present for grievances to matter needs to be discussed. Although the grievance literature to a certain extent solves the problem of how to operationalize inequalities and is able to repulse the premature rejection of grievances as an explanatory factor of civil conflict,

not sufficiently appreciating the importance of opportunity-based explanations is equally flawed. Although some authors have addressed the need to look at the two combined (Schock, 1996), this has been ignored for the last decade or so. As discussed in the previous section the mobilization aspect of the process is equally important as grievances in themselves. The ability to mobilize from a pool of citizens can be perceived as a structural condition and thus encompasses an opportunity-based explanation of civil conflict. It is the interaction between the opportunity and grievance factors that favors rebellion and violent conflict, not either or. The debate has been corrupted by the competitiveness between the two strands of scholars, where the motivation to strengthen the one side has been at the expense of discovering the symbiosis of the two mechanisms. Advocates of grievance-based explanations do not sufficiently acknowledge the mechanisms' contingency on certain structural conditions, and this connection needs to be addressed.

It is obvious that grievances and deprived groups are present in all societies, but this does not lead to violence everywhere. The question of which exact conditions must be present in a society to turn grievances into violence is as fundamental as it is difficult to answer empirically. The fact that mobilization along ethnic lines to collective violence does not happen as frequently in western democracies may be not because aggrieved groups do not exist, but because there are conditions present that prohibit grievances from accelerating into violent conflict. The following discussion on structural conditions addresses the ubiquity-of-grievances claim, and repulses this as an argument against grievances as a conflict inducing factor. What types of opportunity must be present then, for inequality and grievances to increase the risk of violent conflict? The discussion below separates between opportunity on group and country level.

Group level opportunity factors

Structural conditions specific for each group is undeniably of importance when it comes to for which groups inequality leads to conflict. Conditions such as group size may determine whether or not inequality will lead to conflict for a certain group. This assumption may be related to the well established country level theory of population size, which states that a larger population increases the chances of conflict simply because there are more people that fight for the same resources and can potentially initiate conflict (Malthus, 1798; Fearon &

Laitin, 2003; Collier & Hoeffler, 2004; Brückner, 2010). There may also be a possibility that smaller groups have greater opportunity to participate in conflict, because a more tightly knit smaller group facilitates mobilization, and the spread of information is easier. Furthermore, the groups' geographical location within the country may be of importance according to Buhaug's (2010) civil war application of Boulding's (1962) theory of a loss-of-strength gradient encompassing that the military strength of a state is greatest at the power center. Whether the group is located close to the political center or in the periphery may affect the likelihood that grievances lead to conflict, in both directions. Being geographically close the power center may increase groups' practical opportunities to rebel against the leaders, but may also increase the chances of the rebellion being forcefully struck down and thus decrease opportunity conditions. Conversely, groups in the periphery may not have the same opportunities to rebel against the state leaders, but on the other hand might be less likely to get defeated by the state. In a peripheral inter group situation, the structural conditions facilitating opportunity may make grievances more prone to lead to conflict on the cause of the government not having control in remote areas. Access to resources is a structural condition that has received a lot of attention and natural resource scarcity has been linked to civil war (Homer-Dixon, 1994) as well as resource abundance by e.g. oil production that has shown to increase conflict risk through the incentives it represents for rebel groups (Lujala, 2010). The presence of resources such as money, weapons or natural resources posing a potential for economic gains may all be conditions that make grievances more prone to lead to conflict. Moreover, spillover effects from neighboring conflicts providing resources through money or weapons as well as rebel backup may provide conditions that make grievances more likely to lead to conflict (Gleditsch, 2002; Salehyan, 2009). Other than group size and spillover effects, controlling for all of these factors is beyond the scope of this thesis. Notwithstanding, it is important to acknowledge that these group level structural conditions may affect inequality's ability to increase conflict risk.

Country level opportunity factors

On the country level there are evidently structural conditions that causes inequality to result in conflict in some countries and not in others. Regime type is of great importance as to the level of opportunity for rebel groups. Inequality may therefore increase the likelihood of conflict in an unstable authoritarian country because the opportunities are greater than in a stable

democracy. On the other hand, autocracies are more likely to answer harshly to a rebellion, and in that way decrease the opportunity of succeeding (Cederman et al., 2013). However, the theory of the democratic civil peace as a deterring factor for conflict risk suggests that a democratic country should reduce the effect of group level inequalities on conflict risk (Hegre et al., 2001). Similarly, inequality's effect on conflict risk may hinge on the level of economic development in the country. This can have many reasons, among others that the inequality is so extreme and the resources to mend it are not available, leaving violent conflict as the only option. Thus, in accordance with Collier & Hoeffler (2004) the aggrieved population has less to lose by rebelling than in a developed country where there are possible goods lost by engaging in a rebellion. Another country level structural feature that can be thought to influence inequality's likelihood to lead to conflict is regime history or culture of violence. While the cultural aspect can be difficult to measure, it can be assumed that an extensive history of violence may lower the thresholds for aggrieved groups to resort to violence. It is established that close to 50% of all civil conflicts are results of former conflicts reemerging (Collier et al., 2003), which substantiates that this might be a structural condition that increases the effect of group level inequality on conflict risk. Although some of these factors are easier to measure than others, I will include all three country level opportunity factors in my analysis.

2.4 Hypotheses

Having substantiated the link between horizontal inequalities and grievances and subsequently between grievances and collective violence, the task remains of delimiting horizontal inequalities reasonably to the scope of this thesis. The focus here will be on economic horizontal inequalities, and to some extent political ones through controlling for these in the analysis. Based on the previous discussion I expect to find a connection between economic horizontal inequalities and violent conflict. Subsequent hypotheses propose how inequality may be related to conflict, but first I present the most fundamental hypothesis about poverty and conflict. As conflicts generally more often take place in poor countries countless studies have investigated this link between low economic performance and violent conflict and robust empirical results have supported the connection on the country level (Collier & Hoeffler, 1998; Doyle & Sambanis, 2006; Hegre & Sambanis (2006); Elbadawi & Sambanis, 2000). Following Collier & Hoeffler (2004) and Fearon & Laitin (2003) absolute poverty

along ethnic lines can be thought to lead to conflict through preparing the grounds for rebel recruitment because of low male secondary education enrollment or low income forgone for participating in rebellion, facilitating the exploitation of citizens by rebel leaders. Based on this theoretical foundation I suspect there to be a relationship between absolute poverty and violent conflict and thus construct my first hypothesis:

H1 *The poorer the ethnic group the higher the risk of the group experiencing violent conflict onset.*

Further developing the empirical finding of a link between absolute poverty and conflict, the connection between relative poverty and armed conflict has been investigated, moving away from opportunity based explanations and making grievances a more likely driving force. The theory of horizontal inequalities asserts that poverty relative to neighboring groups can lead to grievances. Stewart et al. (2008), Cederman et al. (2011), Cederman et al. (2015), and Murshed & Gates (2005) among others find a connection between socioeconomic horizontal inequalities and conflict, leading me to construct the following hypothesis:

H2 *Ethnic groups that differ from the country average economically have a higher risk of experiencing violent conflict onset.*

Based on the second hypothesis the question arises as to whether richer or poorer groups than the country average are more prone to experience conflict onset. Cederman et al. (2011), Buhaug et al. (2014), and Cederman et al. (2015) find that groups that are far from the country average economically, both positively and negatively, experience a higher risk of participating in civil war. The discussion on grievances as the mechanism through which horizontal inequalities lead to violent rebellion has sufficiently substantiated why poorer groups than the country average is expected to experience violent conflict. The connection between relatively richer groups and violent conflict, on the other hand, has yet to be discussed. Horowitz (1985) asserts that relatively richer groups in richer regions can feel aggrieved when it is their perception that the rest of the country is exploiting their wealth and that they are participating more than other groups. Privileged groups may initiate violence "fearing a loss of power and position" (Stewart, 2008: 12). In Indonesia, conflict has occurred not on account of aggrieved poorer regions, but by richer regions frustrated that the wealth

generated in their region is used by the state to subsidize poorer regions, leading to disintegration and the richer regions aiming for secession (Tadjoeddin, 2003). Thus, my expectation is finding an increased risk of violent conflict onset for both richer and poorer groups than the country average. The expectation is captured by the following hypotheses:

H2a *Ethnic groups substantially wealthier than the country average have a higher risk of experiencing violent conflict onset.*

H2b *Ethnic groups substantially poorer than the country average have a higher risk of experiencing violent conflict onset.*

Returning to the discussion of further conditions that make inequality and grievances matter, neither inequality nor multiethnicity in itself leads to conflict. This is substantiated by the fact that there are numerous peaceful multiethnic states. In addition to grievances, there must be underlying structural conditions that make multiethnic societies war ridden (Stewart, 2008). Pairing grievances and ethnicity in the way the concept of horizontal inequalities does, narrows it down in the sense that grievances along ethnic lines are more potent and likely to escalate than grievances overall. The other way around, multiethnic societies with low levels of grievances may be peaceful as long as the other component is not present. Hence, horizontal inequalities entail that a common identity must be present for grievances to matter, but the question is what other conditions make economic horizontal inequalities more war prone.

Adding political horizontal inequalities to the equation is the obvious first step, potentially making us able to better explain the outbreak of violence as a consequence of inequalities. The combination of negative economic inequality and political discrimination is especially potent. Schock finds that economic inequalities' effect on violent political conflict probability on the national level is contingent on political opportunity structures, encompassing political features of the state as well as political discrimination through: "actions against specific individuals or groups, such as the removal of government officials because of their political beliefs, the banning of specific political organizations, and the arrest, exile, or deportation of individuals for engaging in dissident activity against the state" (1996: 113-114). A combined effect of economic and political horizontal inequalities through political discrimination is

therefore expected, as political and economic grievances along ethnic lines have shown to be mutually strengthening (Stewart. 2008; Cederman et al., 2011). This leads me to construct the following hypothesis:

H3: *Ethnic groups experiencing negative economic inequality have a higher risk of experiencing violent conflict onset when political discrimination is present.*

Still there might be additional structural conditions that must be in place for the situation to reach violence. Bringing in the opportunity side of the debate, I argue that both opportunity and grievances must be present for conflict to emerge. To research this I will test for the effect of poverty and inequality where certain structural conditions are met. Traits that will be tested in this analysis are the country's economic situation, the regime type, and the degree of acceptance for use of violence or history of violence. I expect the theorized effects of poverty and inequality in the preceding hypotheses to be stronger where these conditions are met. This discussion is an important addition to my main hypotheses and consequently results in a separate hypothesis testing for the effect of poverty and inequality on conflict risk in interaction with country level variables such as autocracy, especially poor countries, as well as whether the country has experienced conflict within the last 10 years to see if the results are stronger. The hypothesis is formulated as follows:

H4: *The expected effect of poverty and economic inequality on conflict risk is greater when elemental opportunity factors are present.*

All preceding hypotheses involve, as mentioned, a broad definition of conflict, namely state-based, non-state, as well as one-sided violence as opposed to many other studies focusing solely on civil conflict or one of the other two. This means that my approach to the conflict "target" is rather agnostic, and I am aware that the decision of attacking a neighboring group as opposed to attacking the state might be driven by other factors than poverty and inequality. Nevertheless, I want to include all types of conflict because when studying conflict on the ethnic group level non-state violence in particular is bound to be of importance. The comparison between groups, which the horizontal inequality concept encompasses, I assume to be just as likely to spark conflict between groups as between an ethnic group and the state. For example, non-state conflicts are likely to have ethnic connotations such as the conflict

between the Hausa-Fulani and various ethnic groups in Nigeria (Eck et al., 2003). Regarding one-sided violence this inclusion is more questionable, but also the attack of rebel groups on civilians goes under this definition, and is often executed along ethnic lines. An example is the 2009 series of massacres of Kivu civilians by the Hutu based FDLR movement in DR Congo in 2009 (Martin, 2009). Although it is not likely that civilians are attacked by the state because of grievances caused by horizontal inequality, the location and context of the group is likely to be of relevance in determining the type of conflict as well as the target when opportunity and motivation increases. In addition, the fact that this type of conflict might align with ethnic divisions makes it relevant to include in the analysis.

3. Methodology

3.1 Quantitative method

The nature of my research question is of such a general character that the use of a quantitative method is in order. I aspire to be able to generalize about social phenomena to a larger selection and to be able to say something about the relationship between poverty and horizontal inequalities and conflict risk on a general level. The strength of the quantitative method is that by studying certain aspects of different phenomena in large quanta, it is able to derive a general description of the world at large (King et al., 1994). Even though qualitative methods are useful to do more comprehensive studies of certain ethnic groups and the causal mechanisms I am assuming, which is invaluable in the horizontal inequality field of research, the aim of this thesis is to investigate the general relationship between poverty, inequality, and conflict on group level. My research design is thus quantitative and consists of disaggregated data to be able to infer about the selected phenomena on ethnic group level. The process of constructing the disaggregated dataset will in the following be dissected, whereupon the various variables included to test my hypotheses are presented, and finally the appropriate statistical method for my research question is discussed. First, my decision to use disaggregated data will be clarified.

3.2 Why disaggregate?

The horizontal inequality literature's use of survey data can as mentioned in the theory chapter be subjected to a number of criticisms. Although it offers a detailed insight in peoples' perceptions that statistical data does not, the data are highly exposed to measurement errors on account of dishonest respondents or inaccurate questions (Moses & Knutsen, 2012). Furthermore, survey data does not constitute a random sample and is often biased by not being executed in areas with high conflict propensity on account of security issues. Subsequently, although the reliability of the survey data in itself might be good, the constructed indicators of horizontal inequalities based on household questions are not necessarily accurate (Østby, 2008). In addition to the use of survey data, the preliminary large-N studies of horizontal inequality and conflict can be criticized on the basis of using unreasonable country level proxies for horizontal inequality, aggregating the group level data to indicators of the country's inequality. Østby (2008) uses the difference in wealth between

the two largest groups in the country as an overall measure of horizontal inequality in the country, which is questionable, as it does not separate between the potential grievances of the different groups. Also the use of country level conflict data can be criticized as investigating the link between group grievances as a cause of horizontal inequalities and conflict on country level makes it harder to narrow down the possible explanations and lead to less certain causal connections (Buhaug et al., 2008; Buhaug & Rød, 2006). The country level studies of horizontal inequalities are less precise than they have the potential to be, and the survey data are potentially erroneous sources for this field of research. Thus, my study of horizontal inequalities is conducted on a disaggregated level to better be able to explain the causal mechanisms potentially leading to violent conflict.

3.3 Constructing the dataset

My research question concerning violent conflict and poverty and inequality between ethnic groups thus compelled me to use ethnic group as the unit of analysis. Consequently, the necessary group level information had to be aggregated from grid cell level geospatial datasets, containing geographically referenced information on features such as nightlight, conflict event locations, and population dispersion. PRIO-GRID provides the grid structure through cells of 0.5 x 0.5 decimal degrees, and the data have global coverage (Tollefsen et al., 2012). Various datasets were combined to include all relevant information on both group and country level. Thus, the structure of my constructed dataset is made up by hierarchical time-series cross-section data, with ethnic group year as the unique unit of analysis. The aggregation process forced me to make several difficult decisions on how to assign geographical information to various ethnic groups in the area, particularly difficult concerning the distribution of conflict events and nightlight emission. Limiting the dataset to the largest groups with clear geographical boundaries, however, helped make the decisions to assign different features on grid cell level to ethnic groups less questionable. The challenges related to the aggregation from grid cell level to ethnic group level will be elaborated on in the following.

PRIO-GRID 1.01 (Tollefsen et al., 2012) was used as the basis of my new dataset whereupon variables were extracted from PRIO-GRID 2.0 (Tollefsen et al., 2012), UCDP Georeferenced Event Dataset (Sundberg & Melander, 2013), Ethnic Power Relations 2014 (Vogt et al., 2015), POLITY IV 2015 (Marshall et al., 2016), and the World Development Indicators 2014

(World Bank, 2014). Grid cell level data from PRIO-GRID and UCDP-GED were combined initially, after which the data were aggregated to ethnic group level and the observation unit was altered to ethnic group year. The aggregation was executed by combining (in the appropriate way for each variable) the various values for all grid cells inhabited by the respective ethnic groups. Following this procedure several country level variables were added. More on this process will follow as the different variables are discussed. The completed dataset consists of 165 ethnic groups for 21 years in the period of 1992-2012, which equals 3465 observation units in total. A map of the geographical distribution of the groups included in the analysis can be found in Appendix A.

More precisely, the Geo-EPR attribute table of PRIO-GRID 1.01 serves as the starting point of my newly constructed dataset as this contains georeferenced information on all politically relevant ethnic groups in the world from 1946 to 2008 (Wucherpfennig, et al., 2011). Politically relevant is defined as in the EPR 2014 codebook as "if *either* at least one significant political actor claims to represent the interests of that group in the national political arena *or* if group members are systematically and intentionally discriminated against in the domain of public politics. 'Significant' political actor refers to a political organization (not necessarily a party) that is active in the national political arena" (Vogt et. al., 2015). On account of data on nightlight that is only available for a limited period my dataset includes data from 1992 to 2012. I assume the information on group type and cell area occupied by groups from the Geo-EPR and PRIO-GRID dataset to be unchanged in the years from 2008 to 2012 and the time series is thus expanded to be able to include the latest nightlight and conflict data. Based on observations from the previous years I can be quite certain that this assumption is unproblematic.

As I am only interested in ethnic groups that are geographically concentrated, I have retained only groups that are regionally based, regional and urban groups, and statewide residing groups. Furthermore I have focused on the largest group in each grid cell and removed all other, except in cells where there are two equally sized groups that constitute the majority. I will return to how I handle this in the following sections of this chapter. Some groups are left out because of their lack of political relevance whereas a few groups simply lack recorded data before a certain point in time because the level of identity has changed e.g. a formerly conceived ethnic group is divided into subgroups, causing the former group to become

irrelevant in the dataset or vice versa. In periods of state breakdown all groups are also coded as irrelevant. Because of this a total of 275 group years from the relevant time period were initially missing in my dataset. The groups that lacked more than half of the relevant years or lacked years for a period in the middle were dropped, while I chose to keep groups missing only the first couple of years as this has often been the case because of discrimination and further involvement in violent conflict and they are thus of major relevance to the research question in hand. This decision resulted in a total of 27 group years missing in the finished dataset.

3.4 Dependent variable

The dependent variable in the analysis, conflict onset, is constructed on the basis of the conflict event variable from the UCDP-GED 2.0 and is a dummy indicating whether the year is the first of subsequent years with at least one conflict onset for the ethnic group in question. The variable has the value 1 for years when a conflict starts and 0 otherwise. To be coded as a new onset there has to be observed at least two years without conflict events since the last conflict.[1] The presumption that consecutive years with conflict events can have one common onset year is probable because it is unlikely that an ethnic group in a specific area is involved in several different conflicts the same or following years.

The original conflict event variable is measured as any act of violence by an organized actor towards another organized actor or civilians with at least one death as a consequence, confined to a specific location and a specific point in time. The UCDP-GED offers data on state-based conflict, non-state conflict, and one-sided violence, and disaggregates the information both spatially and temporally. The dataset comprises a total of 103 665 events from the regions of Asia, Africa and the Middle East not including Syria for the time period 1989 – 2014 (Croicu & Sundberg, 2015). To assign the original UCDP-GED conflict events to the various ethnic groups I had to make a decision to allocate the total number of events in each cell to all groups in grid cells inhabited by several groups of the same size. This decision was made on the theoretical assumption that the biggest groups in the grid cell participated in all violent conflict events that took place in the given year. As the UCDP-GED dataset offers

[1] It has come to my attention that the conflict onset variable should have taken into account that not all groups experiencing conflict the first year should be coded as onset, as the conflict might have started before the scope of my dataset. Thus the year 1992 is coded with more onsets than what is likely to be the case. However, I have no strong reasons to believe that this affects my results to a great extent.

a variable that ties the events to the relevant PRIO-GRID cells, the inclusion of the events from the dataset was unproblematic and the variable was hence added on grid cell level before the aggregation to ethnic group level. All cells with no observations in the UCDP-GED were coded as 0 conflict events. For descriptive purposes variables concerning the number of conflict events and casualties are added to the dataset. Following my decision to assume that all large groups in a given grid cell participated in all conflict events I divide the number of casualties equally between the groups where there is more than one as all groups in the cell cannot have suffered the total number of casualties. The conflict event count and conflict onset dummy variable are the same for all ethnic groups in the same grid cell.

Figure 1 displays the sum of ethnic groups that experienced conflict in the years from 1992 to 2012. 1998 is the peaking year with 62 ethnic groups experiencing conflict events. The countries with the highest frequency of conflict-involved groups are DR Congo, Uganda, Ethiopia, Angola and Sudan. In the case of Sudan the second Sudanese civil war is likely to account for the 10 groups involved in a conflict in 1998, and the second Congo war is likely to contribute to the peak with 8 groups in DR Congo experiencing conflict in the given year (Jok & Hutchinson, 1999; Reyntjens, 1999).

Figure 1: Distribution of conflict event dummies 1992-2012

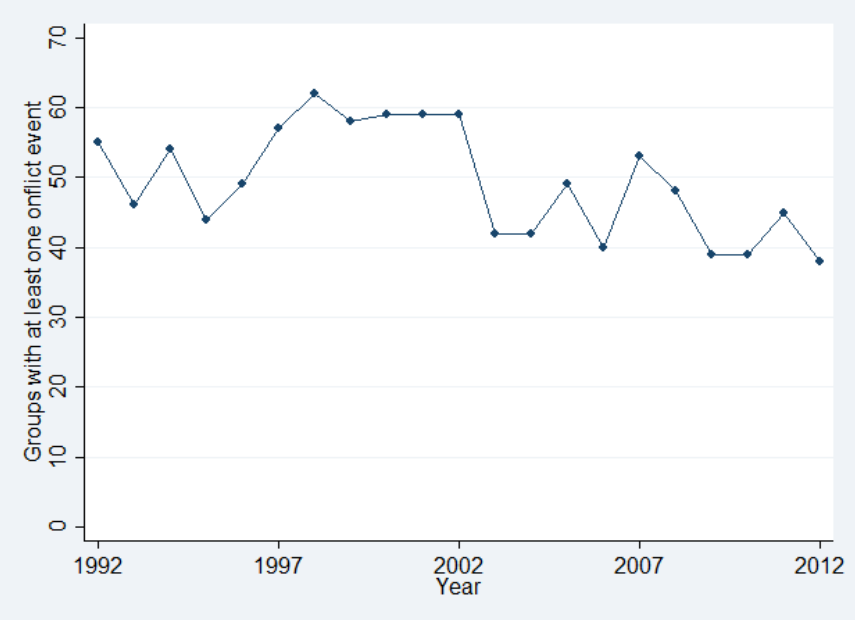


Figure 2 shows the distribution of the total number of conflict events for all groups in my selection as well as the overall sum of casualties, respectively. It must be taken into account that some of the same conflict events are registered for several groups and the count variable thus cannot act as a total measure of conflict events in Sub-Saharan Africa in 1992-2012. Nevertheless, the amount of these cases is relatively miniscule and the graph still gives an indication as to how many conflict events the ethnic groups were involved in in the time period. Contrary to the conflict event dummy graph, the peak year is 2009, which might accordingly be due to conditions in Sudan and DR Congo, with ongoing communal conflicts in the former and the offensives by both rebel groups and the government in the latter (Brosché & Elfversson, 2012; Dagne, 2011). Concerning the casualties distribution it is interesting to note that while the peak year is clearly 2000, the fatality of the conflicts is remarkably lower in the years after this. Comparing this to the distribution of conflict events we get the indication that conflict events after 2000 have been less lethal, as there were an average of 507 conflict events each year before and in 2000 while the number after 2000 was 563 conflict events per year in average. There may also be reason to suspect that some of the wars the conflict events pertain to were grave civil wars that ended around the change of the millennium, such as the extremely deadly Ethiopian-Eritrean war (Straus, 2012). The figure corresponds to the perception of the first decade of the 2000s as a relatively peaceful period, involving fewer casualties than the preceding period (Themnér & Wallensteen, 2013).

Figure 2: Comparing the distribution of total number of conflict events and casualties for all ethnic groups 1992-2012

3.5 Independent variables

Nightlight emission

The aim of this thesis is to investigate regional poverty or inequality between groups in regard to violent conflict. My main independent variable is therefore nightlights emission, as it is a measure that can be thought to act as a proxy for poverty and inequality. This is a variable that is particularly suited for disaggregated studies as it is geographically observable to a very fine grain. The original variable from the PRIO-GRID 2.0 dataset reports nighttime light emission with data from the DMSP-OLS Nighttime Lights Time Series Version 4 (Average Visible, Stable Lights, & Cloud Free Coverages). The data is calibrated to take into account "intersatellite differences and interannual sensor decay" (Elvidge et al., 2014). Hence, while the reliability of the data is supposedly good as this is a strictly objective measure, the validity of nightlight measuring poverty and inequality is very debatable. This will be discussed in the consecutive section.

The nightlight information was added to the dataset on grid cell level before the data was aggregated to ethnic group level. In my analysis calibrated nightlights per capita acts as a proxy for the wealth of a given group, or the lack thereof. The decision to construct a per capita measure was based on an assumption that this was the most meaningful way to assign nightlight emission to different groups, as well as the need for a variable that approximated the conventional GDP per capita measure to be better equipped to compare the two. Cederman et al. (2015) are somewhat unclear as to whether they apply a per capita measure of the nightlight or raw values per group, but I interpret their variable to be a per capita version. Kuhn & Weidmann (2013) and Alesina et al. (2012) use nightlight per capita as well. In any case, the group's measured nighttime light emission per capita indicates the group's absolute poverty, while the nighttime light emission per capita compared to the country average nighttime light emission per capita will act as a measure of the group's relative poverty; in other words a measure of economic horizontal inequality. I have made two different measures of the latter—a logged symmetric and a nonlogged asymmetric measure respectively. Both are constructed as a combination of the group and country level nightlight variables, where the first acts as a combined measure of inequality and the second takes the form of two separate variables indicating whether the group is poorer or richer than the country average per group, and by how much. The former will throughout the thesis be referred to as the symmetric inequality and the latter as asymmetric inequality. The process of constructing

these measures will be elaborated on shortly. The use of both relative and absolute measures can help point us in a direction as to whether it is poverty in itself or the economic inequality between groups in the same area that has the strongest effect on conflict. First, the use of satellite imagery of nightlight emission as proxy for poverty and inequality needs to be discussed.

When it comes to measuring group level inequalities geospatial data have been revolutionary, as it facilitates disaggregation of data to group level. While disaggregated economic data have been used with success in this field of research (Hegre et al., 2009; Buhaug et al., 2011; Cederman et al., 2011) there are reasons to search for alternative measures of economic activity, especially in countries with little or no official statistical data. Nighttime light data is a relatively new alternative proxy to measure economic output that has the ability of telling us more about the location of wealth than a standard GDP per capita measure. Existing spatial datasets concerning economic performance such as the G-Econ dataset's difficulties in collecting valid data from certain areas of the world can make statistical research on the basis of these data uncertain. The strength of the nighttime light data is that it is measured objectively for each region, and it has been suggested by a number of scholars as an accurate measure of wealth (Henderson et al., 2009; Chen & Nordhaus, 2011; Elvidge et al., 2012). Especially in economically underdeveloped areas such as Sub-Saharan Africa, which is the scope of this study, satellite data on nightlights emission may serve as a useful alternative measure. The fact that this area for the most part does not have extensive public nighttime light, little infrastructure, as well as a limited amount of industry areas make the nighttime light data more appropriate as a proxy for group level wealth as opposed to economic output on the state level. Nighttime light emission may in this area in fact be a quite credible measure of the population's wealth. Chen & Nordhaus (2011) find by comparing nighttime light data to existing statistical data that nighttime light is a fitting proxy for economic output in countries with poor statistical data, such as Sub-Saharan Africa, in contrast to as a proxy in well developed countries. Moreover, in a recently published study Weidmann & Schutte (2016) finds nightlight emission to be highly accurate to predict wealth on a local level, although using nightlight per square kilometer which might be a superior operationalization to my nightlight per capita measure.

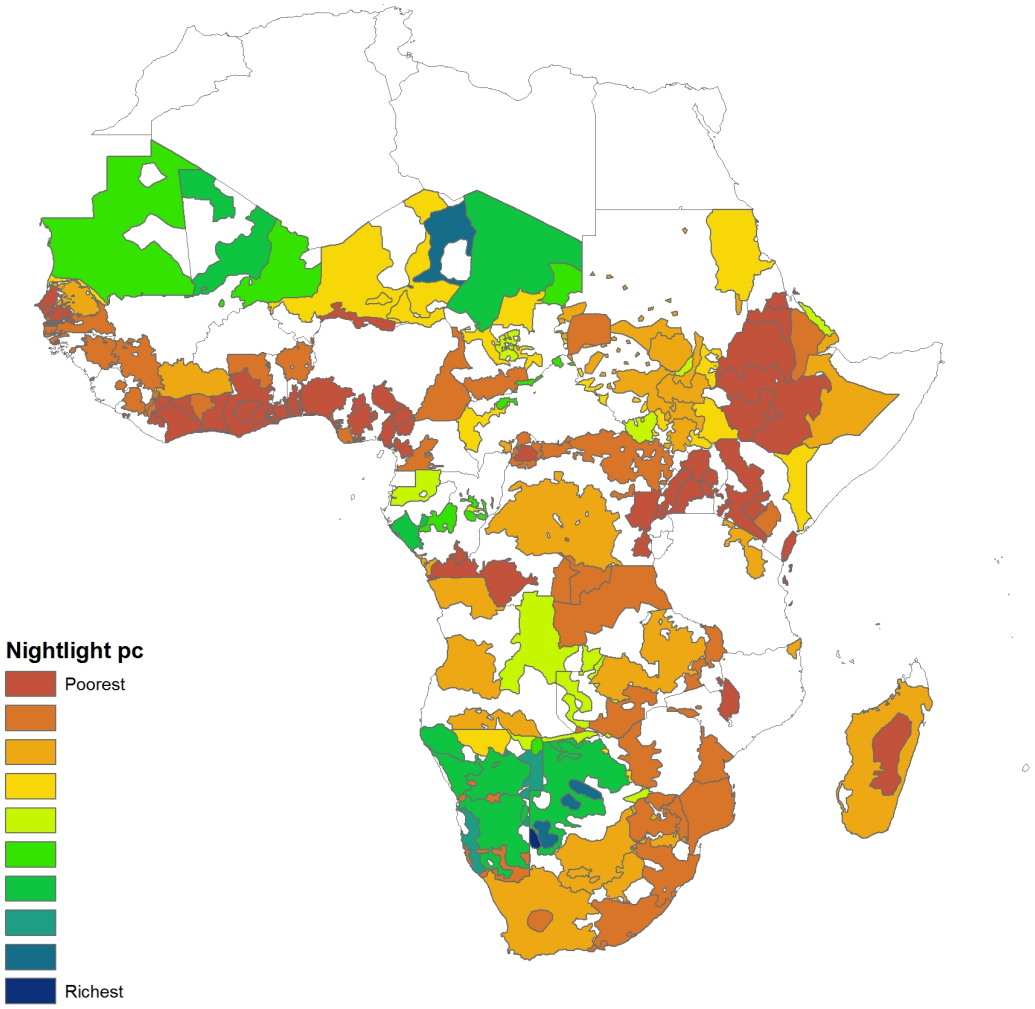
Several studies have been performed using nighttime light emission as a proxy for economic development or wealth in relation to effects of Somali piracy (Shortland, 2012), urban expansion (Liu et al., 2012), and US military activity in Iraq (Agnew et al., 2008) among others. In the civil war literature Ahrens (2015) investigates the link between weather conditions, economic shocks, and civil conflicts in Africa, using satellite information on nighttime light data in an attempt to predict growth. The study is disaggregated to the sub-national level of first-order administrative units. Ahrens finds no significant effects of economic growth shocks as measured by nightlight data on civil conflict, but rather that effects of armed conflict can be observed in the satellite data. This is an interesting observation, further emphasizing the need to control for endogeneity when dealing with nightlight data and armed conflict. Nevertheless, the author's concluding remarks state that using satellite imagery of nighttime light emission and the methodology in question is a great asset to researching political and economic processes at a disaggregated level.

Cederman et al. (2015) construct a triangulated measure of horizontal inequalities consisting of both GDP per capita, nightlight emissions data from satellites, and survey data in an attempt to create a more accurate measure of the phenomenon. This study strengthens the former findings that horizontal economic inequality causes civil war, and offers stronger results allegedly as a result of the new combined measure. However, this study yields no statistically significant results when considering nightlight emissions alone. Nevertheless, the nightlight emissions data are used as a supplement to reported economic data in areas where the latter are of poor quality, indicating that pure nightlights data are more appropriate for my study of Sub-Saharan Africa than for Cederman et al.'s (2015) world covering study. The results of the weighted variable with a larger proportion of nightlights data to G-Econ data for underdeveloped countries and vice versa is, on the other hand, statistically significant and strong. This backdrop warrants my use of satellite imagery of nighttime light emission and reveals the need for further research on the use of this readily available resource as a proxy for socioeconomic conditions at group level and its possible effects on the propensity for violent conflict.

The original calibrated nightlight variable in PRIO-GRID 2.0 has standardized values from 0 to 1, 0 representing the lowest observed value for the particular grid cell over time, and 1 representing the highest. As the nightlight is reported per grid cell and each group's cells are

added together I found it more useful to sum up this 0 – 1 measure, in addition to making it easier to create a nightlight per capita measure. Before collapsing the data to group level the registered nightlight was divided equally in grid cells with more than one ethnic group. As with the conflict event casualties variable I make the somewhat questionable assumption that nighttime light emanate equally from each group in the same grid cell where there are more than one group that makes up the majority. Nevertheless, this is a necessary assumption to make, as each group cannot account for the total amount of nighttime light in the area by itself. After aggregating the data to ethnic group level, summing up the calibrated nightlight measures, I constructed the per capita measure per ethnic group. As a result the values were very low and the variable was multiplied with 1 000 000 000 to make for more interpretable results. The variable was not remotely normally distributed and had skewness and kurtosis values of 10.095 and 139.794, respectively, indicating that the original variable was very skewed and extremely pointy. Hence, the variable was log transformed. The process resulted in the variable that serves as a proxy for the groups' absolute poverty. Figure 3 shows the spatial distribution of absolute nightlight on all ethnic groups in the analysis, ranging from low levels to high levels proxying poorer and richer groups, respectively. The figure depicts nightlight data from 2009 as one specific year had to be chosen for the graphic presentation and this year's values seem not to be affected by unexplainable fluctuations (see Figure 4).

Figure 3: Map of nightlight per capita per ethnic group 2009



The distribution of poorer and richer groups is at first glance suspicious, as it seems like the supposed richer groups are located in areas with low population levels, such as the Sahel, where I have no reason to believe that rich groups could be found. Additionally, some of the poorest groups are located in the southern part of western Africa, which is one of the most densely populated regions in Sub-Saharan Africa, and especially Nigeria. This might suggest that nightlight per capita as a measure of wealth is flawed, and that using nightlight per area might be more accurate. I will return to this discussion in the succeeding chapter. The inequality variables are nevertheless constructed on the basis of the absolute nightlight per capita variable.

When it comes to the variables measuring relative poverty I initially constructed a country level nightlight per capita variable, collapsing data from group level. This was equally multiplied with 1 000 000 000 for the same reasons. To create the two measures of horizontal inequality mentioned above I used Cederman et al.'s (2011) two formulas used on statistical spatial economic data. The first results in a logged symmetric variable that stipulates horizontal inequality as the square of the logged difference between the nightlight emission per capita of the group and the country average nightlight emission per capita. Where *g* is the nightlight per capita of the group and *G* is the country average nightlight per capita:

$$ln\_nlight\_ineq2 = [\log(g/G]^2$$

This creates a variable that indicates deviations from the country average in either direction, where zero means that the group is on the country average.

The second measure of relative poverty or horizontal inequality is constructed as two different nonlogged asymmetric variables that are both positive numbers greater than one. The variables indicate whether the groups are poorer or wealthier than the country average and are constructed as follows:

$$nlight\_low = \begin{cases} G/g & \text{if } g < G, \\ 1 & \text{otherwise;} \end{cases}$$

$$nlight\_high = \begin{cases} g/G & \text{if } g > G, \\ 1 & \text{otherwise.} \end{cases}$$

The nlight_low variable indicates how many times less nightlights the group emanates (how many times poorer) than the country average, while the high variable is set to 1 for poorer groups. The nlight_high variable indicates how many times more nightlights the group accounts for (how many times richer) than the country average, and the low variable is likewise set to 1 for richer groups.

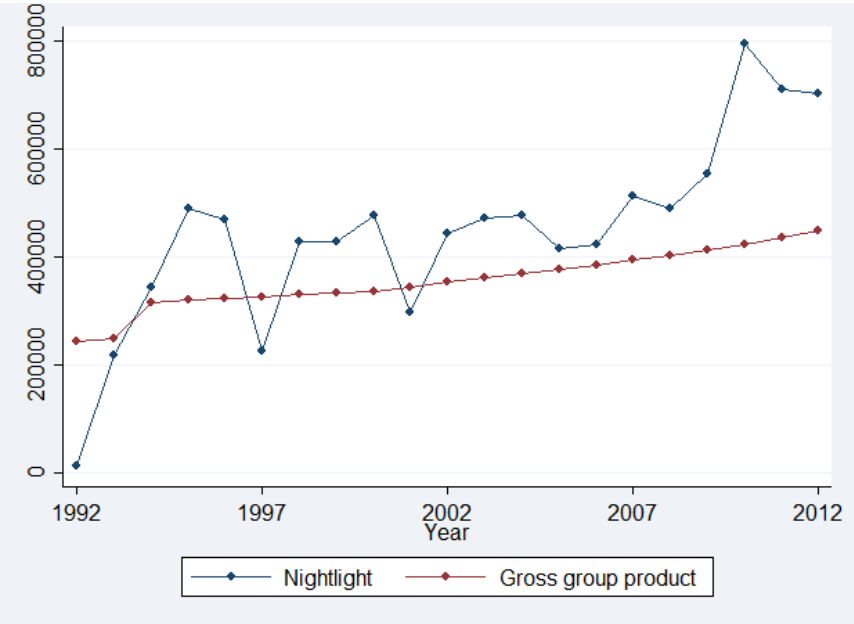
Gross group product per capita

An alternative and more conventional proxy for poverty and economic inequality, which I try to capture with my main independent variable, is GDP per capita. I use the purchasing power parity version of the gross cell product in the Nordhaus data from PRIO-GRID 2.0 incorporated in the dataset on grid cell level (Nordhaus, 2006). The variable was aggregated to group level and summed up for all grid cells where the group in particular was located (equally divided as the nightlight data in cells with more than one residing groups), then adjusted to per capita for the group, multiplied with 1 000 000 000 to offer interpretable results, and log transformed. This variable corresponds to the nightlight measure of absolute poverty. I repeated the procedure of Cederman et. al. (2011) to make a logged symmetric variable as well as the two nonlogged asymmetric variables defining groups that are richer and poorer than the country average respectively, serving as a measure of relative poverty. Data on gross cell product purchasing power parity is only available in the years 1995, 2000, and 2005, so the variable is interpolated as well as extrapolated. After the data was aggregated the variable contains information on the gross group product and the variable is referred to as GGP per capita.

Figure 4 shows the distribution of total GGP per capita compared to total nightlight per capita for all group years. The graph shows that nightlight emission and GGP per capita develop in roughly the same direction over the years, which is reassuring for my use of nightlight emission as a proxy. However, the recurring fluctuations in the nightlights data are somewhat concerning. The fluctuations, with 1997 and 2001 as particularly low observations, are hard to explain and lead me to suspect that there might be something off with the data collected from satellites or the calibration procedure, which is intended to remove the problem of data collection errors as a consequence of different satellites or decay over the years. Thus, the data might not be as reliable as presumed. I will return to the discussion of these fluctuations in the empirical analysis.

All independent variables are lagged by one year in the models as the causal mechanisms between poverty and conflict are prone to go in both directions. The one-year lag strengthens the feasibility that the effect of the poverty or inequality variable has had time to affect the various groups and their potential involvement conflict onset, and not the other way around.

Figure 4: Distribution of total sum of nightlights and GGP per capita 1992-2012



3.6 Control variables

3.6.1 Group level variables

Group population size

Group population size is included as a control variable substantiated by the aforementioned country level theory of population size, which states that a larger population is connected to higher conflict risk, and is reasonable to control for on group level (Malthus, 1798; Fearon & Laitin, 2003; Collier & Hoeffler, 2004; Brückner, 2010). The group population data was first added from PRIO-GRID 1.01. for the years 1995, 2000, and 2005 (CIESIN, 2005). Data for 2010 was included in PRIO-GRID 2.0 and were added when this version of the dataset became available. As I only had data with five-year intervals the variable was interpolated as well as extrapolated.

Political status

Whether the group is included or excluded politically is possibly a major determinant of conflict risk and thus has to be controlled for. The variable is constructed on the basis of the political status variable from the EPR 2014 dataset. This variable was included in the dataset after the aggregation from grid cell level, and assigned to each group. The original variable

has the values monopoly, dominance, senior partner, junior partner, powerless, discriminated, and self-exclusion in addition to irrelevant and state collapse. The excluded variable in my dataset is a dummy of this variable indicating whether the group or representatives of the group is excluded or not, where senior and junior partner is coded as 0, powerless and discriminated are coded as 1 and the last three are coded as missing. Groups with political status monopoly or dominance are dropped from the analysis because these groups by definition cannot initiate rebellions against themselves. Even though these groups just as well can be involved in non-state and one-sided violence conflicts, these constitute the most privileged and are in any case more likely to be the target than the conflict initiator.

Downgraded

Another variable drawn from the EPR 2014 dataset is the downgraded variable, which is a dummy indicating whether or not representatives of the ethnic group in question has been downgraded politically and lost power with regard to the EPR categories in the previous year. The loss of political power can be presumed to increase the risk of conflict and should be controlled for.

Peace years

Time-series cross-section data analyzed with ordinary logistic regression potentially violates the statistical method's assumption of independence in time. This may lead to deceptive results, and has to be controlled for (Beck et al., 1998). Peace years is a count variable denoting how many years has passed since the last conflict the group was involved in, and the risk of conflict is expected to decrease with the number of years. This variable is constructed through summing up the years since the last year in conflict, with a threshold of two peaceful years between conflict years for a new onset to be defined as a new conflict. Thus, these years are not coded as peace years. As it is commonly presumed that peace years have a non-linearly effect on conflict onset risk, with the difference in risk being greater for each of the first years and then diminishing after a certain time, the variable is log transformed. The function of this variable is that it controls for temporal autocorrelation through including the potential explanatory power of former conflict on the risk of conflict onset.

3.6.2 Country level variables

Country population size

The country population control variable was added after the aggregation to group level, and assigned to all groups of the respective countries. This variable is included for the same reason as mentioned regarding group size as this theory applies to both group level and country level population size. The original variable from the World Development Indicators 2014 dataset contains GDP per capita values for all years in my dataset, and the inclusion was unproblematic.

Country GDP per capita

As extensively discussed in the previous chapter the economic situation at the country level may influence the residing groups conflict propensity and is therefore controlled for (Braithwaite et al., 2016; Ward et al., 2010; Blomberg et al., 2006; Sambanis, 2004; Collier & Hoeffler, 2004; Fearon & Laitin, 2003). Whereas the GGP variable was included at the grid cell level and aggregated to ethnic group level, the country level variable was added from the World Development Indicators 2014 dataset later in the process, and contained values for all years.

Democracy

Likewise, whether or not the country is a democracy may be of importance for the group's likelihood of being involved in violent conflict and is therefore included as a control variable. The data is collected from the POLITY IV dataset, which contains information on the country level and was added after the aggregation process of the data. The original variable ranges from -10 (strongly autocratic) to 10 (strongly democratic). The democracy variable in the completed dataset is a dummy coded 1 for democracy, being observations with values ranging from 5 to 10 on the original variable scale, and 0 for all others.

Group in country experiencing conflict

In addition to handling temporal autocorrelation, analyses making use of geospatial data also need to control for spatial autocorrelation. Spatial autocorrelation challenges the independent observations assumption in that the values of a variable correlate solely as a consequence of the geographic proximity of the various values (Griffith, 2013). In this thesis this means that the potential spillover effect from other groups in the area experiencing conflict needs to be

controlled for. Thus the group in country experiencing conflict variable is a dummy encompassing whether or not another ethnic group in the same country was involved in a conflict the previous year.

In addition, three variables are included in the models testing for contingent effects on various country level structural conditions. The autocracy dummy variable is constructed to be able to be included in a statistical interaction variable with the various inequality measures and is coded 1 for countries with values between -5 and -10 on the original POLITY IV variable, and 0 for all other values. Likewise, the GDP per capita dummy variable is designed to generate a boundary between countries with higher and lower levels of GDP per capita in my selection and is reversed to be included in an interaction variable with the inequality variables. The boundary is simply drawn on the median GDP per capita value in the selection with the poorer half getting the value 1 and the richer half 0. The country conflict last 10 years variable is denoting whether or not the country the various groups reside in has experienced conflict within the last ten years.

I expect peace years, country GDP per capita, and democracy to have a negative effect on conflict risk, whereas group and country population, excluded, downgraded, group in country experiencing conflict, autocracy, the GDP Dummy, and country conflict within the last ten years is expected to increase the risk of conflict.

3.7 Data summary

Table 1 displays descriptive statistics for the dependent as well as all independent variables used in the analysis.

Table 1: Descriptive statistic for dependent and independent variables

	N	Mean	Std.Dev	Min	Max
Group level variables					
Conflict onset	2636	0.891	0.285	0	1
Nightlight per capita (log)	3438	6.222	1.761	-1.345	12.254
Inequality nightlight	3438	1.002	2.630	0	31.263
Low nightlight	3418	1.648	3.557	1	138.217
High nightlight	3418	3.091	13.691	1	268.108
GGP per capita (log)	3417	7.033	1.087	4.362	10.277
Inequality GGP	3304	0.622	1.038	0	12.517
Low GGP	3304	2.076	2.075	1	34.398
High GGP	3304	1.105	0.422	1	6.369
Group population (log)	3438	13.826	1.712	7.129	17.466
Excluded	3299	0.381	0.485	0	1
Downgraded	3299	0.015	0.123	0	1
Peace years (log)	3438	0.813	0.841	0	3
Country level variables					
Country population (log)	3483	16.364	1.258	13.348	18.940
GDP per capita (log)	3325	7.514	0.943	5.479	9.793
Democracy	3292	0.507	0.500	0	1
Group in country exp. conflict	3287	0.554	0.497	0	1
Autocracy	3465	0.134	0.341	0	1
GDP per capita dummy	3325	0.544	0.498	0	1
Country conflict last 10	3438	0.976	0.151	0	1

3.8 Statistical method

As the dependent variable in my analysis is dichotomous, with 0 meaning no conflict onset and 1 being conflict onset I apply a logistic regression. The results of the models thus give the probability of the dependent variable being 1 and the group experiencing conflict onset.

In certain types of analyses observations tend to cluster on different features of the data, often making the observations within each cluster correlate. In analyses like this, using time-series cross-section data where the same units are observed over time and in addition consist of multilevel data where observations cluster both on group and country level, this tends to be the case. Mixed effects logistic regression is a method that accounts for the difference in baseline conflict risk for groups within one country compared to another, and likewise among different group years within one group. The mixed effects logistic regression method makes for the most precise model for each observation, and thus offers a stronger model than one with just country-clustered standard errors and this method should be expected to be the most appropriate for my analysis (Everitt, 2002). I initially tested my hypotheses with mixed effects logistic regression models and applied a two-level random-intercept model, assuming that the baseline conflict risk for observations between clusters on both levels is different, while the effect of poverty and inequality is expected to be the same. The reason for this latter assumption is that while controlling for a potentially different effect of poverty and inequality across different levels through applying a random slope has the ability to provide for a better model, I have no theoretical foundation to substantiate in what way the effects of poverty or inequality should be different for different groupings and the application of such a method would not have been worthwhile.

However, the use of a mixed effects logistic regression method turned out to add nothing to my models, and the chi-tests indicated that the mixed effects models were not better than an ordinary logistic model for my data. In addition the constant per country equaled 0 indicating that there is no difference in baseline conflict risk between countries. See Appendix B for a model estimated with mixed effects logistic regression. Although I assumed this method to be appropriate for my data, this turned out not to be the case and I ended up with a simple logistic regression model with country clustered standard errors to allow for arbitrary correlation among observations within the same country.

4. Empirical analysis

This chapter is divided in three main parts, starting out with the presentation and discussion of the results of testing the hypotheses with the nightlight versions of the poverty and inequality variables, leading on to a discussion of the use of nightlight emission as a proxy, whereupon the last section presents the results of the same models using gross group product (GGP) per capita data. All models are run using logistic regression analysis with country clustered robust standard errors to control for dependence within countries and all time-varying independent variables are lagged one year to reduce the risk of reverse causality. A selection of the variables are log-transformed to handle the variables not being normally distributed, however, only the nightlight per capita variable had extreme skewness and kurtosis values.

4.1 Results

First, all hypotheses are tested with the nightlight versions of the poverty and inequality variables with the conflict onset dummy as the dependent variable. The results of Hypotheses 1-3 are presented in Table 2. Model 1 tests Hypothesis 1 concerning whether higher levels of absolute poverty increases the risk of conflict onset. The main independent variable is the log of calibrated nightlight emission per capita, lagged one year. The absolute nightlight variable is not remotely significant and points in the direction of an increased risk of conflict at higher levels of nightlight emission. Conversely to the hypothesis that expects there to be a connection between low levels of wealth proxied by nightlight emission and risk of conflict onset, Model 1 indicates that no such connection can be found, and suggests that Hypothesis 1 should be rejected.

Table 2: Explaining group level conflict onset (nightlight)

VARIABLES	Model 1	Model 2	Model 3	Model 4
Nightlight (log, *t*-1)	0.00230			
	(0.116)			
Inequality nightlight (*t*-1)		0.00595		
		(0.0384)		
Low nightlight (*t*-1)			0.0486	0.0862
			(0.135)	(0.113)
High nightlight (*t*-1)			-0.00622	-0.00654
			(0.00753)	(0.00754)
Low nightlight*excluded				-0.164
				(0.182)
Group population (log)	0.154	0.158*	0.124	0.126
	(0.105)	(0.0940)	(0.1000)	(0.0976)
Excluded (*t*-1)	0.780***	0.781***	0.782***	1.003***
	(0.240)	(0.235)	(0.239)	(0.332)
Downgraded (*t*-1)	1.619***	1.619***	1.611***	1.808***
	(0.494)	(0.487)	(0.493)	(0.495)
Country population (log)	0.0173	0.0145	0.0418	0.0409
	(0.0902)	(0.0946)	(0.107)	(0.105)
Country GDP per capita (log, *t*-1)	-0.185*	-0.184*	-0.186**	-0.182**
	(0.103)	(0.0943)	(0.0938)	(0.0925)
Democracy	-0.263	-0.264	-0.259	-0.260
	(0.215)	(0.220)	(0.222)	(0.218)
Peace years (log)	4.774***	4.778***	4.784***	4.801***
	(0.515)	(0.527)	(0.510)	(0.503)
Peace years squared	-1.828***	-1.829***	-1.833***	-1.838***
	(0.210)	(0.213)	(0.207)	(0.206)
Group in country exp. conflict (*t*-1)	0.824***	0.823***	0.813***	0.825***
	(0.285)	(0.282)	(0.290)	(0.285)
Constant	-6.617***	-6.626***	-6.633***	-6.753***
	(1.793)	(1.155)	(1.135)	(1.091)
Observations	2,297	2,297	2,285	2,285

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Logistic regression of ethnic groups' conflict risk.

The fact that I find no statistically significant link between absolute nightlight per capita and conflict onset might be because this link does not exist at a local level. This finding contradicts the well-established link between low levels of development and violent conflict through the mechanisms of low opportunity costs and low state capacity as discussed in the theory chapter. The theory that low income foregone when participating in conflict is what makes poverty conflict inducing is challenged by this model, as there is no significant connection between higher levels of local wealth measured by nightlight emission and conflict onset. The GDP per capita measure being significant and negative while the local measure of wealth is not suggests that there are other mechanisms through which the effect of

country level economic indicators works on conflict risk than through low income foregone for the population.
Moreover, if the extensively empirically documented link between low GDP per capita and conflict is in fact due to low state capacity and not poverty among the population as discussed earlier, that can be substantiated by this non finding as local nightlight per group is unlikely to encapsulate information on state capacity. In other words the state can be strong and prevent conflict although the regional ethnic groups are poor and emanate low levels of nightlight, and potentially vice versa. This might indicate a need to question the interpretation of the effect of low country development levels as analogous to poverty among the population. Alternatively, this non-finding may indicate that the nightlight data are of poor quality or do not capture what we hope to measure. I will return to the discussion of this potential problem later in this chapter.

Model 2 introduces the squared and logged symmetric nightlight inequality measure as the main independent variable, testing for the second hypothesis suggesting that economic inequality in either direction should increase the risk of conflict onset. The symmetric nightlight inequality variable suggests that for groups further away from the country average economically there is a higher risk of experiencing conflict onset, but the effect is not significant. In contrast to the results from Model 1 the inequality measure shows the expected direction and is in accordance with Hypothesis 2 even though it does not offer the hypothesis full support.

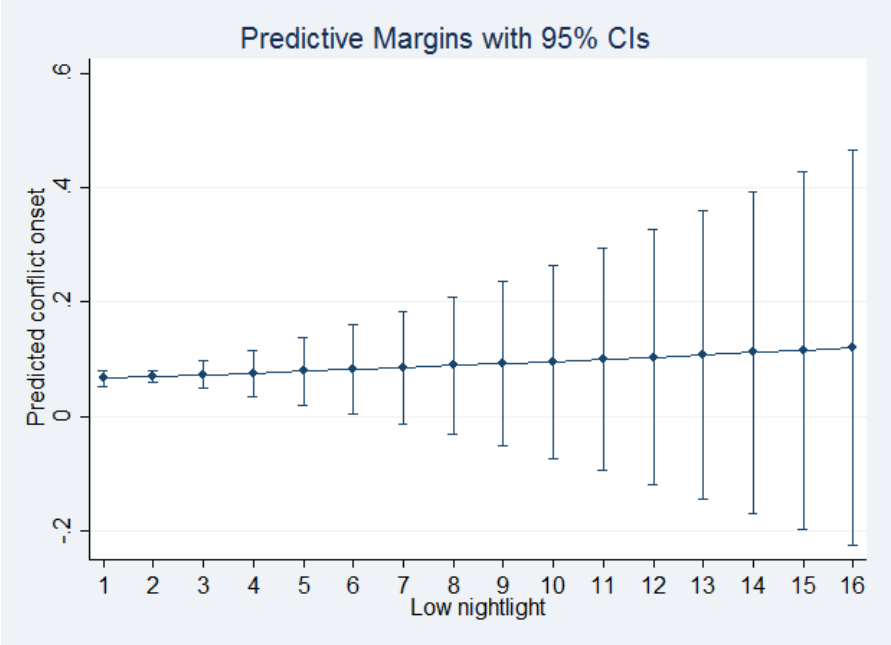
This finding indicates that there is at best a very weak link between economic horizontal inequality and conflict onset, contrary to the theory underpinning this thesis. The mechanisms postulated by relative deprivation theory in that the discrepancy between expected and received collective goods is what makes people inclined to violent behavior does not seem to hold up based on this model as economic inequality and violent conflict seem to be unconnected. When investigating the theorized process leading from inequality through grievances to the outbreak of violence the missing effect of inequality on conflict risk could be ascribed to a number of steps. Firstly, it can be thought that these inequalities do not lead to grievances because of weak group identification in the selected groups or the groups might not be as disposed to intergroup comparison because most of the groups in the selection inhabit separate geographical areas. Furthermore, the sense that the unequal distribution of

wealth is unfair may because of several reasons be weak or non-existent, and the placement of blame may be unclear or not obvious in the presence of grievances. Should the observed inequalities in fact lead to grievances, they may still not lead to violence and actual conflict onset on account of lacking mobilization, unrealistic rebel claims and the state either responding to these claims or repressing them. Thus, the presence of horizontal inequalities does not necessarily lead to conflict onset, which may be supported by my findings. As Cederman et al. (2013) accentuate, the causal mechanisms leading from horizontal inequalities to violent conflict presented are not fixed and unavoidable but rather represent necessary preconditions in cases where horizontal inequality actually leads to conflict. The reason disregarded, Model 2 does not offer any support to the theory of horizontal inequality as a driver of conflict.

Model 3 tests Hypotheses 2a and b, claiming that both poorer and wealthier groups than the country average have a higher risk of experiencing violent conflict onset. The independent variables are the lagged asymmetric inequality measures of nightlight emission, indicating how many times poorer and richer than the country average the groups are, respectively. The most theoretically substantial expectation is captured by Hypothesis 2b expecting relative poverty to be a driver of conflict. The results are, as in the preceding models, not significant but the negative inequality variable shows the expected relationship to conflict onset risk and indicates that the poorer the group is than the country average, the higher risk of conflict onset the group experiences. The positive inequality nightlight measure is, however, negative and suggests that positive economic inequality reduces the chances of groups being involved in conflict onset. Thus, this finding suggests a rejection of Hypothesis 2a is in place and is not able to support Hypothesis 2b; and the expectation that positive or negative economic inequality increases the risk of violent conflict onset cannot be confirmed. The plot in Figure 5 shows the predicted probability of the group experiencing conflict onset at different levels of negative inequality. The effect of being poorer than the country average does not seem great, but the increase in risk with the times poorer the group is than the country average is clearly visible. The confidence intervals are extensive at higher levels because the number of observations with high values on the variable is extremely few, even though the observations included in the model only range from 1 to 16. Also, the values within the 95th percentile range from 1 to 10.

The predicted risk of conflict onset is 2.6 percentage points higher for a group that is ten times poorer than the country average than a group that is twice as poor. Thus, the effect is palpable even if it is not significant within conventional levels.[2]

Figure 5: Predicted probability of conflict onset by negative inequality



This finding as well is contrary to theory, and while Hypothesis 2b builds on the two preceding hypotheses and the lack of support for this reinforces the critique of the theories discussed above, Hypothesis 2a rests on another theoretical foundation. The finding in Model 3 is not in accordance with Horowitz (1985) assertion that relatively richer groups in richer regions might be aggrieved when it is perceived that the rest of the country is exploiting their wealth and that they are participating more to the community than other groups. However, the fact that the positive inequality measure shows the opposite direction than expected and neither of them is significant may be on account of problems with the construction of the inequality measures.

[2] The reason why the confidence interval implies negative likelihood is that the margins command in Stata does not take into account that confidence intervals should be bounded between 0 and 1, only the predicted values. Thus, when the confidence interval is vast, it is bound to show predictions below zero. Still, the predictive margins are correctly specified.

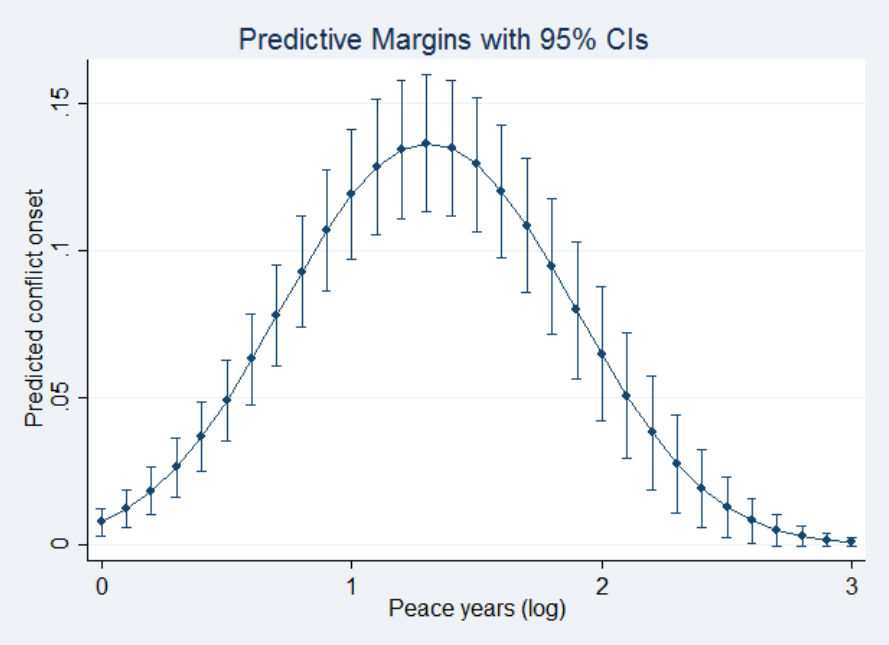
To investigate the relationship between horizontal inequalities and conflict further, Hypothesis 3 concerning whether the effect of economic inequality on conflict risk is contingent on the group's political status is tested in Model 4. Here a statistical interaction variable of negative inequality and politically excluded is incorporated, to see whether the effects of these two variables strengthen each other. The inclusion of the interaction variable yields no significant results. The excluded variable is still strongly significant and positive and the negative inequality variable remains insignificant and positive. This implies that the group level effects of economic and political factors operate separately, and does not offer any support to Hypothesis 3 in a model using nightlight emission as a proxy for economic inequality.

Likewise Model 4 does not affirm Stewarts (2008) concept of multidimensional horizontal inequalities and the theory that different kinds of horizontal inequalities combined increases the level of grievances. The inequality variables still do not show any significant effect on conflict risk, and the politically excluded variable has a greater effect on its own. Nonetheless, the assumption that the combination of economic and political inequality can increase grievances cannot be rejected based on this model, on the cause of potential operationalization problems as well as the dependent variable being conflict onset, containing no information about potential grievances being present without leading to violence.

Concerning the control variables their significance level and effect are largely the same over all four models. The variable indicating whether the group has been politically excluded in the last year, politically downgraded in the last year, peace years, and the spatial autocorrelation control variable are significant at the 0.01 level in all four models. The excluded variable as anticipated has a positive coefficient suggesting that the risk of conflict onset is higher for groups that are politically excluded. The downgraded variable is positive suggesting that being politically downgraded increases the risk of experiencing conflict onset, as is intuitively and theoretically expected. The peace years variable on the other hand should be expected to decrease conflict risk the higher the number of years since last conflict. The fact that the variable on its own shows the opposite effect and is consistently significant in all models suggests that the expected relationship on country level does not necessarily hold true on a disaggregated level. However, the inclusion of a quadratic term of the variable shows that peace years has a curvilinear effect on conflict onset risk, positive at first then negative. In

addition to being interesting on its own the inclusion made for stronger estimated effects of the nightlight variables and a better specified model. The plot in Figure 6 shows that conflict risk, while starting out low after a previous conflict, increases the first couple of years before it starts to decrease. As the variable is log transformed, the plot is hard to interpret substantially, but the original peace years variable spans from 0 to 20, with the value 1 encompassing 2 to 6 peace years, placing the conflict risk peak at 3 years.

Figure 6: Predicted probability of conflict onset by peace years (log)



The reason for this curvilinear effect might be that shortly after a conflict ends, the risk of conflict onset is very low whereupon the conflict risk increases somewhat in the following years before it is once again decreasing and stays low for subsequent years. The fact that my dataset only encompasses the timespan 1992-2012 may make it harder to encapsulate the theorized long term decreasing effect on conflict risk of former conflict. Nevertheless, the variable is significant and helps explain the risk of conflict onset for ethnic groups.

Not unexpectedly, the variable controlling for spatial autocorrelation denoting whether at least one other group in the country experienced conflict the previous year has a positive coefficient and shows that neighboring groups in conflict the previous year explains a lot of the risk of conflict for the group in question. Furthermore, country GDP per capita is

somewhat significant showing the expected direction in all four models, seemingly reducing ethnic groups' risk of experiencing conflict onset. Group population is only slightly significant in Model 2, but indicates that a large population increases the risk of conflict onset as expected. The only other variables than the various nightlight measures that are nowhere near being significant in any of the models are country population and democracy although both show the expected effect namely positive and negative, respectively. This may be because the country level population and regime type does not affect the conflict propensity on the group level. All four models have a pseudo R-squared of around 0.15 indicating that none of the models fit the data better than the others.

Consequently, in the first four models none of the nightlight variable versions are remotely significant and the absolute nightlight measure points in the opposite direction than what I expected. Still, the control variables are significant to a large extent and are all, except the somewhat surprising finding concerning peace years, indicating the expected relationship to conflict onset, leading me to believe that the models are strong and well specified. The following section will present an expansion of the existing models allowing me to test for the influence of certain structural conditions on the effect of poverty or inequality proxied by nightlight emission on the risk of conflict onset as theorized by Hypothesis 4.

When investigating the various versions of Hypothesis 4 concerning structural conditions present for grievances to matter, all versions of the nightlight variables were tested in relation to the three chosen structural country level conditions that could be thought to affect the relationship between poverty or inequality and conflict, namely autocracy, low GDP per capita, and history of violence operationalized as violent conflict in the country within the last 10 years. All combinations were tested through statistical interaction as well as in a subsample of observations with the respective features to provide robust results. Conversely to the preceding models the nightlight variables are now occasionally significant, and assuming a conditional effect of certain country level features does in fact offer some improvement of the models and a few interesting findings. Table 3 presents a selection of models resulting from testing the different versions of the hypothesis as well as nightlight variables. The remainder of the models can be found in Appendix B. As in the preceding section all models are estimated through logistic regression analysis with country clustered standard errors and the conflict onset dummy as the dependent variable.

Model 5 presents the results of the regression analysis testing for a potential conditional effect of asymmetric inequality measures and autocratic states on conflict onset risk and features a statistical interaction variable of the negative inequality variable and an autocracy dummy variable. None of the asymmetric inequality variables prove to be significant, however, the included interaction variable is slightly significant and negative. This indicates that negative inequality only has an effect for groups in autocratic countries, and that here the poorer the group is than the country average the less risk it has of experiencing conflict onset. Although this is contrary to theory poorer groups in autocracies might be thought to be less motivated as well as having less opportunity to rebel because of regime repression. I will return to the discussion of this finding in the following sections. The same conditional effect is subsequently tested for in a subsample of groups solely residing in autocratic countries. This pattern of interaction variables and subsamples is repeated for all combinations of nightlight variables and structural conditions variables.

Table 3: Explaining group level conflict onset (nightlight and structural conditions)

VARIABLES	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Low nightlight (*t*-1)	0.108	0.0249				
	(0.109)	(0.200)				
High nightlight (*t*-1)	-0.00670	-0.543***				
	(0.00747)	(0.152)				
Low nightlight*autocracy	-0.334*					
	(0.177)					
Nightlight per capita (log, *t*-1)			-0.260	0.130		
			(0.190)	(0.153)		
Nightlight per capita*GDP			0.0430			
			(0.0280)			
Inequality nightlight (*t*-1)					0.575***	0.00703
					(0.124)	(0.0385)
Inequality*country conflict 10					-0.602***	
					(0.130)	
Group population (log)	0.128	-0.238	0.203*	0.199	0.151	0.161*
	(0.0968)	(0.155)	(0.113)	(0.127)	(0.0955)	(0.0935)
Excluded (*t*-1)	0.850***	1.997***	0.755***	1.100***	0.799***	0.808***
	(0.231)	(0.613)	(0.230)	(0.310)	(0.239)	(0.233)
Downgraded (*t*-1)	1.655***	Omitted	1.617***	1.756***	1.655***	1.634***
	(0.459)		(0.486)	(0.665)	(0.500)	(0.490)
Country population (log)	0.0143	-0.307*	0.0349	0.00424	0.0201	0.0130
	(0.0998)	(0.177)	(0.0925)	(0.0951)	(0.0960)	(0.0954)
Country GDP per cap (log, *t*-1)	-0.203**	3.439**	-0.476**		-0.192*	-0.180*
	(0.0978)	(1.530)	(0.240)		(0.100)	(0.100)
Autocracy	0.309					
	(0.552)					
Democracy			-0.285	-0.214	-0.244	-0.218
			(0.222)	(0.231)	(0.226)	(0.226)
Country conflict last 10 years					-0.133	
					(0.790)	
Peace years (log)	4.989***	4.789**	5.201***	4.358***	5.402***	4.810***
	(0.511)	(1.994)	(0.602)	(0.648)	(0.599)	(0.530)
Peace years squared	-1.919***	-1.412	-1.972***	-1.649***	-2.043***	-1.853***
	(0.202)	(0.918)	(0.231)	(0.278)	(0.232)	(0.215)
Group in country exp. conf.(*t*-1)	0.898***	1.949***	0.834***	0.999***	0.870***	0.855***
	(0.264)	(0.714)	(0.285)	(0.265)	(0.294)	(0.290)
Constant	-6.497***	-24.69**	-6.083***	-9.184***	-6.859***	-6.733***
	(1.068)	(12.38)	(1.580)	(2.436)	(1.383)	(1.174)
Observations	2,352	227	2,291	1,112	2,297	2,216

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Logistic regression of ethnic groups' conflict risk. Model 6: subsample of autocratic states, Model 8: subsample of groups in countries with low GDP per capita, Model 10: subsample of countries with conflict within last 10 years.

Model 6 shows that the positive inequality measure tested in a subsample of autocratic states now yields significant results, and the coefficient points in the same negative direction as in Model 3. Thus indicating that in autocratic states the effect of positive inequality on conflict risk for ethnic groups is negative, and that the richer the group is than the country average the

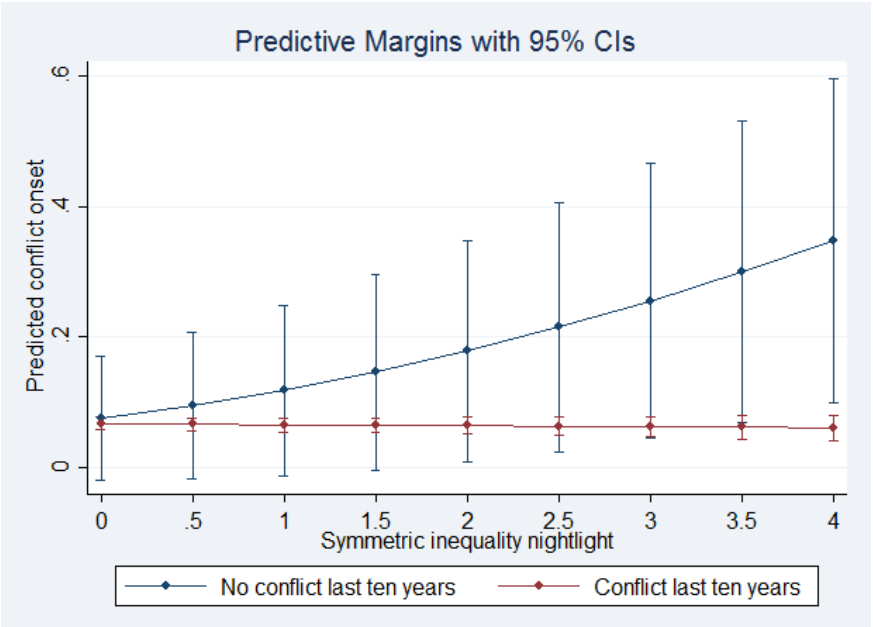
lower the risk of experiencing violent conflict onset. This finding can be thought to make sense because richer groups in autocratic states often have power and constitute the elite giving them less reason to be aggrieved and less incentives to spark conflict, and possibly more means to repress attempts at violence by other groups. Nevertheless, this finding is contrary to theory and previous empirical findings. However, the fact that the country GDP per capita variable is suddenly positive may increase the credibility of this finding and suggest that in general money is conflict inducing in autocracies.

Moving on to country GDP per capita as a structural condition that may influence nightlight levels' effect on conflict risk I test this relationship in the two succeeding models. The main independent variable in Model 7 is absolute nightlight per capita and the model introduces an interaction variable between this and country GDP per capita. Comparably to Model 1 the absolute nightlight per capita measure is not significant, but now indicates a negative effect on conflict onset risk. The interaction between nightlight and GDP per capita is nowhere near significant indicating that there is no connection between the effects of absolute nightlight per capita and the country level GDP per capita on conflict risk. To investigate this potential link further the variable was tested in a subsample of the poorest half of the groups in the selection. These results are presented in Model 8 and show an absolute nightlight per capita variable again with a positive coefficient and not the least statistically significant supporting the finding from Model 7 that the effect of nightlight per capita on conflict risk is seemingly no stronger for ethnic groups in poorer countries.

Furthermore, the country's history of violence as an opportunity factor potentially influencing the effect of economic inequality on conflict onset is tested. In Model 9 the main independent variable is the symmetric inequality measure, and a statistical interaction variable between symmetric inequality and a dummy variable indicating whether the country has experienced conflict during the last 10 years or not is included. In contrast to Model 2 the symmetric inequality measure now yields a strongly statistically significant result which is also positive and according to theory, indicating that the more economically unequal the group is than the country average the higher the risk of experiencing conflict onset. In addition, the statistical interaction between symmetric inequality and history of violence is significant and has a negative coefficient. This indicates that the effect of economic inequality on conflict risk is negative for groups in countries that have experienced conflict during the last ten years. The

country conflict last ten years variable, on the other hand, has a negative coefficient and is not significant suggesting that this variable alone has no significant effect on conflict risk except for when it is working together with the effect of economic inequality. When predicting the combined effect in the plot in Figure 7 the interaction becomes interpretable. The plot only consists of symmetric inequality observations within the 95th percentile with values in the range 0 – 4 and the few observations with values between 4 and 31 are excluded. In countries without conflict the last ten years the risk of conflict onset is 27 percentage points higher for a group with a deviation of four than a group at the country average economically. The negative effect of symmetric inequality on conflict risk for groups in countries that have experienced conflict within the last ten years is barely visible in the plot. However, groups with a deviation from the country average of four have a 0.05 percentage point lower risk for experiencing conflict onset than a group at the country average economically. Thus, there is an effect and the overall risk is clearly lower for these groups. Although the symmetric inequality deviation is hard to interpret substantially, it acts as a general measure of horizontal inequality and indicates the difference of being on the country average economically as opposed to not.

Figure 7: Predicted probability of conflict onset by symmetric inequality for groups in countries with and without conflict within the last ten years



The reason for this somewhat unexpected conditional effect of symmetric inequality and history of violence is far from obvious. One can speculate that in countries ridden by war in the last ten years the level of economic inequality for groups is not the prime grievance factor, and that there are other features that increase the risk of conflict, as we know that groups with a medium level of peace years experience increased conflict risk. In addition the finding can point in the direction of history of violence as a deterrence factor rather than making groups more inclined to turn to violence. In that case, my motivation for including history of violence as a structural condition is challenged. The fact that the effect is slightly negative and suggests that the more unequal the group is the lower the risk of conflict onset might indicate that more unequal groups are more afraid of returning to violence, and less prone to take up arms than groups at the country average in countries with a history of violence. Nevertheless, the high discrepancy between the effect of symmetric inequality on conflict risk for groups in countries with a history of violence and without is peculiar and might be due to spurious causes.

When testing for this relationship in a subsample solely of groups in countries that have had conflict in the last ten years the symmetric inequality measure is not significant as initially and has the same positive coefficient. The control variables in the models in Table 3 show for the most part the same results as in Table 2, with the most notable exception in Model 6 being due to the subsample of autocracies changing or removing their effect.

The main results from the rest of the models testing for Hypothesis 4 using nightlight data is supporting the findings from models 5 and 9 in that symmetric inequality has a negative effect on conflict risk in autocracies as well as negative inequality having a negative effect on conflict risk in countries with history of violence as can be seen in the model in Appendix B.

Hypothesis 4 was largely based on my revised theory of inequality and conflict setting out to combine the formerly often segregated motivation and opportunity explanatory factors. In sum, the results of models 5 through 10 as well as some of the models in Appendix B are that various opportunity based structural conditions postulated as determinants for the effect of poverty or inequality on conflict risk does indeed seem to have some effect in an analysis using nightlight emission as a proxy for poverty and inequality. The strongest implications are produced by the interaction between symmetric as well as negative inequality and history of

violence and the negative effect of symmetric, as well as both negative and positive inequality in autocracies. These results indicate that on the one hand structural conditions such as low country GDP per capita does not influence the effect of poverty and inequality on conflict risk. On the other hand the nightlight measures of inequality seem to be contingent on structural conditions such as the country being an autocracy and the history of violence. Thus, Hypothesis 4 is confirmed to a certain extent in that the effect of inequality is greater where some elemental opportunity factors are present. However, both country level features influence the nightlight variables' effect in the opposite direction than what is intuitively expected. The fact that the statistically significant findings are all somewhat surprising and hard to explain as well as the absolute nightlight variable still not being significant in any of the models may be suspected to be on account of my operationalization of the nightlight data being poorly qualified as a proxy for poverty and inequality in such an analysis, or even problems with the collection of the raw data. Hence, we should be skeptical of the results and investigate them further. Nevertheless, the significant effect of both types of inequality measures for groups in either autocracies or countries with a history of violence is an interesting finding, and the theoretical suggestion of a symbiosis of motivation and opportunity factors should not be disregarded.

Interestingly, when not including the spatial autocorrelation control variable, as well as not lagging any of the independent variables in the initial models, some nightlights variables become significant and all effects go in the hypothesized directions (except for the nightlights high variable). See Appendix B for Models 1 – 3 without controlling for spatial autocorrelation and with contemporaneous excluded variable, nightlight variables, as well as country GDP per capita variable. This high discrepancy between the results of the simple model and the better specified model included in this analysis may imply that earlier findings in this field of research should be taken a closer look at. The models in Appendix B show that a higher level of absolute nightlight per capita decreases the risk of the group experiencing conflict onset. When exchanging the absolute nightlight per capita measure with the symmetric inequality measure this too yields significant results. Although substantially less significant, the coefficient indicates that the further away from the country average the group is economically, the higher the risk of experiencing conflict onset. Also the negative inequality measure is significant and shows a positive effect on conflict onset risk.

Although the models needs to control for spatial autocorrelation through including the dummy variable of groups in the same country experiencing conflict the previous year the fact that near all nightlight variables take the expected direction and are strongly significant in a simpler model is interesting. The reason might be that areas with little nightlight that experience conflict often coincide with having a neighboring conflict, and that the effect of these take away the explanatory power of the actual levels of nightlight. However, the importance of controlling for spatial autocorrelation has been accentuated in the methodology chapter and all results from models not including this variable should be disregarded on account of the high degree of influence from nearby conflicts on the risk of conflict onset for ethnic groups.

Returning to the various time-varying control variables that are not lagged in the models in the model in Appendix B, this operation is inevitable to get well-specified models and control for reverse causality. It is interesting then, to note that Cederman et al. (2015) neither lag the excluded variable nor the inequality variables in their analysis. Although not getting significant results from their pure nightlight measure of inequality, they get strong results from their combined measures including statistical and survey data in addition, indicating that both negative and positive economic inequality increases the risk of conflict onset for ethnic groups. Considering my strongly significant and hypothesized findings when applying a simpler model, these results may be questioned. Ignoring the need to lag certain time-varying control variables makes the analysis exposed to endogeneity, and the results less robust.

4.2 Nightlight as proxy

The preceding models might indicate that there is no relationship between poverty or inequality proxied by nightlight emission and violent conflict, except the possibility that inequality has a negative effect on the risk of conflict for groups in autocratic countries and countries with a history of violence. Still, there is reason to suspect that the use of nightlight data as a proxy for ethnic groups' wealth is problematic. The fact that none of the nightlight variables are significant in the main models and that the absolute nightlight measure indicates the opposite direction than theorized is dubious and advocates that the data should be taken a closer look at.

Firstly, the process of aggregating the data and assigning the nightlight to different groups could have affected the quality of the nightlight data. Dividing nightlight emission between groups on the basis of geographic grid cells might be a problematic operation and while selecting the largest ethnic group from each grid cell is reasonable, the possibility that some nightlight emission may come from a smaller but richer group in the same cell is present. Furthermore, in grid cells with two ethnic groups of the same size where both are kept in the dataset, dividing the nightlight emission equally between the two, although the best option may be severely flawed. In addition, nightlight emission could come from external sources to the ethnic group citizens such as industry or infrastructure, although this is thought to be less of a problem when dealing with data from Sub-Saharan Africa. Nevertheless, such intricate data will always be subject to numerous decisions that are made on a theoretical foundation and may not always reflect the reality. An example of such is the ethnic group San inhabiting South-Africa which initially was an outlier in my dataset influencing the nightlight values to the extreme, while the group in reality leads a rather primitive life seemingly not utilizing electricity in any form. Thus, the nightlight in these grid cells is likely to have come from other sources. What additionally contributed to the perverted nightlight values was the conspicuous discrepancy between population size and the total nightlight value assigned to the group, giving them a thoroughly unrealistic nightlight per capita value compared to other ethnic groups that seem far more advanced. This leads me to the next potential problem with my dataset, namely the creation of the nightlight per capita measure.

The disaggregation of nightlight per capita is perhaps questionable and whether or not this is an accurate use of nightlight emission data can be discussed. The variation on this variable is very much driven by “capita”, as most regionally residing groups in Sub-Saharan Africa have little nightlight whereas the population size varies greatly. In reality it might be that none of the groups actually have much light at night. Additionally, for rurally residing groups in Sub-Saharan Africa if there is use of electricity at all it is perhaps most likely to be centered in the village for common use by all members of the group, and at early levels of development the amount of electricity can be thought to have a standard magnitude regardless of the size of the population. With economic development electricity is more likely to spread to private households and possibly making nightlight emission more proportional to the population size. This might mean that the use of a nightlight per capita measure holds up well for some groups while not capturing the level of wealth as good for other groups. In addition the possibility of

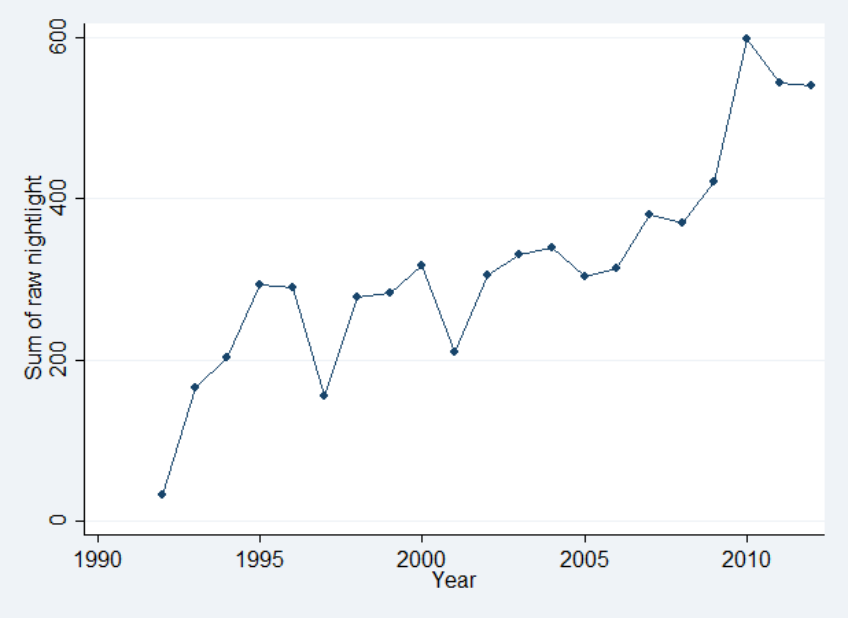
economic inequalities within a group is evident, but controlling for this is beyond the scope of this thesis. However, these problems with the data can to a certain extent be said to be valid for traditional economic development data as well.

As a further matter, the accuracy of nightlight emission data as a measure of the wealth of the population is highly uncertain. The experienced standard of living and how wealthy the citizens feel may be totally disconnected from the amount of lights the villages emanate at night. Although nightlight data can be used as an indicator of level of development, a comparison of these and survey data from underdeveloped regions would be fruitful to test the validity of the data.

Moreover, the amount of grid cells each group in the aggregated dataset is made up of varies to a great extent. Groups that consist of several grid cells have higher chances of being assigned additional nightlight and the chances for this is thus very different for the various ethnic groups. The decision to sum up the calibrated nightlight values in the aggregation process instead of using the mean of the calibrated measure ranging from 0 to 1 could possibly also be questioned. However, I have tested the mean variant of the aggregated nightlight variable and found that it gives roughly the same results and does not improve the models. Besides the possible flaws caused by my aggregation of the data, I suspect that the raw data from the DMSP-OLS Nighttime Lights Time Series dataset might be faulty.

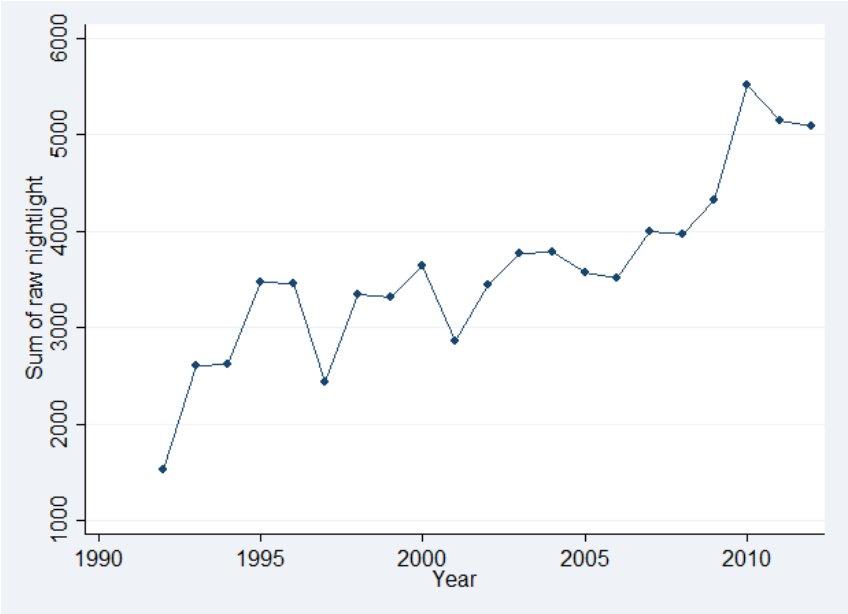
As mentioned in the methods chapter and shown in Figure 4 the absolute nightlight variable showed some suspicious recurring fluctuations that deviated from the GDP per capita data although showing the same slightly upward direction. When investigating the raw data a graph of the sum of raw nightlights for all grid cells in Sub-Saharan Africa show the contours of the exact same pattern as shown in Figure 8.

Figure 8: Sum of raw nightlights all grid cells in Sub-Saharan Africa 1992-2012



This finding makes it reasonable to suspect some kind of problem with the measurement of the nightlight emission data, as there is no theoretical way to explain these strong and recurring fluctuations in development. The graph in Figure 9 of the sum of raw nightlight data for all grid cells in the world as feared uncover the same pattern, and explaining it reasonably on a global level is near impossible.

Figure 9: Sum of raw nightlights all grid cells in the world 1992-2012



When looking at the raw calibrated nightlights data for all grid cells at the country level the amount of observations with low values is extensive and the mean calibrated nightlight value is very low for most countries. What is more is that while the mean of raw nightlight values for all cells are similar for most countries, the mean population per cell varies greatly adding momentum to my argument against using nightlight per capita. See Appendix C for descriptive statistics of raw nightlight and population for all countries included in my analysis. This further suggests that the nightlight per square kilometer measure applied by Weidmann & Schutte (2016) would have been better able to denote poverty and inequality levels, or perhaps the use of the absolute nightlight values per group.

The fact that the original calibrated nightlight variable has the value 0 or close to 0 for a substantial amount of inhabited cells further supports the suspicion that there might be a measurement problem present. The reason for low nightlight output density observations getting the value zero is partly that when human nightlight emissions are low it is problematic distinguishing it from the "background noise" or natural light sources that is removed in the preparation of the data. The cells thus get the value zero when nightlight emission is very weak. This makes nightlight data poorly fit as a proxy for economic activity in low-density regions, which is problematic as this is the area it is expected to be most valuable (Chen & Nordhaus, 2011). For my analysis purely consisting of regionally based ethnic groups in Sub-Saharan Africa, this is especially problematic and undermines my use of nightlight as a proxy thoroughly.

As discussed in the methods chapter the most critical problems with measuring nightlight emission is differences between satellite sensors and the decay of these measurement instruments over time, potentially misreporting the real emission values systematically. Another problem is saturation, making it hard to differentiate between high levels of nightlight emission, but this is only problematic in cells with big cities. In addition, cloud coverage, auroral activity, and forest fires are potential erroneous sources (Henderson et al., 2009). However, this is supposed to be taken care of by the calibration method. Substantiated by the graphs of raw nightlight data above, I suspect there to be a problem with the calibration method, and the algorithms used seem not to work as they should. In addition, the practical conversion of wealth into nightlight emission is thus far not accounted for (Cederman et al., 2015) and the use of this proxy is highly disputable. Even though spatially disaggregated

GDP per capita measures might be just as imprecise, it is worthwhile to test the hypotheses with the use of these to see if it offers stronger results.

4.3 Gross group product per capita

In order to compare the use of nightlight emission as a proxy for poverty and inequality to conventional statistical GGP data regression models identical to those in Table 2, substituting only the poverty and inequality variables, were run. Table 4 presents the results.

Table 4: Explaining group level conflict onset (GGP per capita)

VARIABLES	Model 11	Model 12	Model 13	Model 14
GGP per capita (log, *t*-1)	-0.339*			
	(0.180)			
Inequality GGP (*t*-1)		0.0959		
		(0.0957)		
Low GGP (*t*-1)			0.0651	0.110
			(0.0472)	(0.0929)
High GGP (*t*-1)			-0.280	-0.269
			(0.192)	(0.184)
Low GGP*excluded				-0.0646
				(0.101)
Group population (log)	0.147*	0.156**	0.134	0.138*
	(0.0842)	(0.0794)	(0.0839)	(0.0829)
Excluded (*t*-1)	0.755***	0.772***	0.760***	0.882***
	(0.252)	(0.243)	(0.248)	(0.277)
Downgraded (*t*-1)	1.587***	1.616***	1.619***	1.703***
	(0.493)	(0.489)	(0.492)	(0.513)
Country population (log)	0.0138	0.0221	0.0215	0.0221
	(0.0875)	(0.0921)	(0.0877)	(0.0887)
Country GDP per capita (log, *t*-1)	0.133	-0.181*	-0.207**	-0.197**
	(0.199)	(0.0932)	(0.0929)	(0.0971)
Democracy	-0.311	-0.262	-0.274	-0.297
	(0.233)	(0.235)	(0.226)	(0.233)
Peace years (log)	4.793***	4.796***	4.824***	4.802***
	(0.533)	(0.535)	(0.541)	(0.528)
Peace years squared	-1.836***	-1.846***	-1.850***	-1.842***
	(0.218)	(0.217)	(0.220)	(0.215)
Groups in country exp. conflict (*t*-1)	0.781***	0.826***	0.806***	0.811***
	(0.280)	(0.294)	(0.284)	(0.285)
Constant	-6.408***	-6.779***	-6.047***	-6.265***
	(1.179)	(1.110)	(1.261)	(1.329)
Observations	2,279	2,279	2,279	2,273

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Logistic regression of ethnic groups' conflict risk.

The models presented here are evidently quite similar to the preceding nightlights models, except the obvious difference with the absolute GGP per capita measure. Model 11 suggests a statistically significant and negative effect of absolute wealth measured by group gross product per capita on conflict onset risk. Thus the GGP per capita data indicate that the richer the group is, absolutely, the lower is the risk of experiencing conflict onset. In other words Hypothesis 1 can be confirmed when making use of statistical economic data in the analysis, affirming the theory that absolute poverty leads to greater risk of conflict onset. When it comes to the inequality variables constructed on the basis of this absolute GGP per capita measure none of the variables yield significant results, even though the positive coefficients indicate the expected effect on conflict risk with higher levels of inequality increasing the risk.

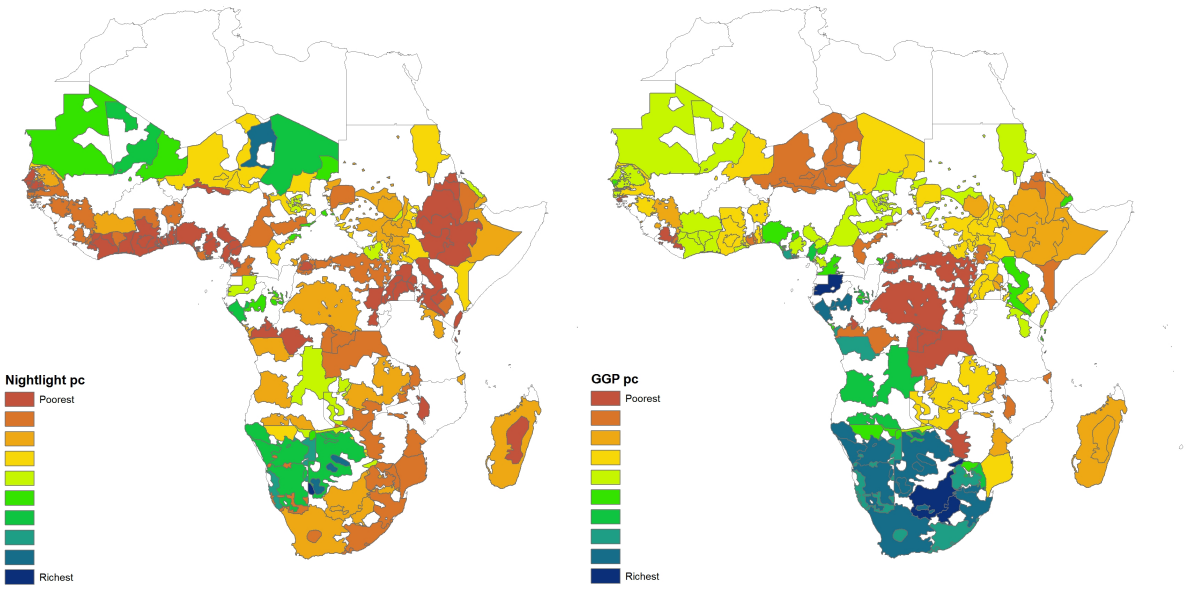
The control variables act roughly the same as in models 1 through 3, all showing the expected relationship to conflict onset risk as in the preliminary models. All control variables are significant at different levels except country population and democracy. However, now group population is significant in several of the models. Country GDP per capita is not significant and changes direction in Model 11, but this is likely due to the fact that the GGP per capita variable takes away the explanatory power at the country level.

When running the complete set of models testing for Hypothesis 4 with GGP per capita data there are also here a few significant and interesting results. The most interesting findings are that both the symmetric inequality and the negative inequality GGP measures show the same interaction with history of violence as the nightlight variables indicating a negative effect of both for groups in countries that have had conflict within the last ten years. This supports the findings from the nightlights models and strengthens the confirmation of Hypothesis 4 in that the effect of inequality is contingent on country violent history as a structural factor. Conversely to the nightlight models the GGP versions find that GGP per capita has a negative effect on conflict risk in richer countries whereas the overall effect is positive. This indicates that the negative effect of GGP per capita found in model 11 is valid only for groups in richer countries. Interestingly, the GGP per capita versions do not have significant effects in autocracies contrary to the nightlight measures. Overall, the significant results of the GGP versions of the inequality variables offer some support to the findings on the influence of structural conditions using the nightlight versions.

What we can read out of these models is that the statistical economic data might be more suitable to research the relationship between absolute poverty and conflict than nightlight data. When it comes to the inequality variables neither the nightlight nor the GGP versions have any significant effect on conflict onset risk on their own, which might further suggest that the constructed inequality measures are inaccurate. However, several of these variables have a contingent effect on certain structural conditions and offers some support to the theory of horizontal inequality as a driver of conflict when combined with opportunity factors.

When it comes to GGP data as opposed to nightlight data to measure local wealth Figure 10 shows the geographical distribution on ethnic groups. The absolute nightlight map presented in Figure 3 is compared with the GGP version of absolute wealth, and the differences are striking.

Figure 10: Maps of nightlight per capita and GGP per capita per ethnic group 2009



Intuitively, the GGP per capita based map looks more correct, with the largest area of richer groups in the southern parts of Sub-Saharan Africa and the poorest around DR Congo. The richer groups in the nightlight based map to a certain extent overlap with the GGP map, although groups in South Africa are suggested to be relatively poor. Additionally, the

suspicion concerning the location of richer groups in areas with low population levels such as the Sahel, and poorer in densely populated Nigeria, is confirmed by the comparison with the GGP map. This adds to the argument that nightlight per capita is not a reasonable measure for wealth, and supports the suggestion to use absolute nightlight per area instead. The maps show very clearly that the two measures do not correlate well, and could have advised me to construct the nightlight measure in a different way. The GGP measure thus seems like a better indicator of group level poverty in this analysis.

5. Discussion

The results of the four main nightlight models are somewhat discouraging when it comes to the theory of horizontal inequalities in itself, not to mention the hypothesis about absolute poverty. Although this is likely to be due to problems with the nightlight data and the operationalization of this and potentially other variables, the inequality variables show an interesting relationship to certain structural conditions on the country level, which are backed up by the GGP versions of the variables. The main findings will be discussed in the following.

The only hypothesis that is partially confirmed is H1 concerning absolute poverty, but this is only when using the GGP per capita based measure. The lack of support for Hypothesis 1 in the nightlight model is surprising and in addition to challenging the theoretical foundation for the link between low levels of development and conflict risk contradicts the findings of numerous studies. The reason that the results do not match Collier & Hoeffler (2004) and Fearon & Laitin (2003) among others may well be because of the disaggregated data. Recall the country level GDP per capita variable was significant and negatively related to conflict onset in virtually all models. In such a way the non-finding on group level indicates that the effect of country level economic development on conflict risk should not be interpreted as the effect of population poverty. Thus, the partial rejection of Hypothesis 1 is an interesting finding. However, the results not being in accordance with former studies using disaggregated economic data such as Buhaug et al. (2014) finding a negative effect of higher absolute wealth undermines this critique of the poverty-conflict theory. There is a possibility of the short time span used in my analysis affecting the results and causing me not to find the connections found in former disaggregated studies. Notwithstanding, rather than meaning that my results suffer from this it may be that the results from studies with a selection over 40-60 years are forced to make a greater number of questionable assumptions, and using static measures, are less accurate than my analysis. What is more, a longer time-span was no alternative in this analysis as nightlight data were only available for the period 1992-2012. Additionally, the reason why my findings somewhat contrast the findings of earlier disaggregated studies might very well be on the cause of my inclusion of state-based, non-state, and one-sided conflicts combined, whereas most similar studies have concentrated on

civil war exclusively. However, the fact that the same model using GGP per capita as a proxy for absolute wealth shows the expected negative effect on conflict risk in accordance with former research, once again suggests that the nightlight data I use are not an accurate proxy for what I am trying to measure.

Furthermore, most of my expectations formulated through Hypotheses 2, 2a, 2b, and 3 cannot be confirmed. This contradicts the affirmed connection between different types of inequality and conflict by previous studies that are based on more conventional proxies for socioeconomic inequality (Tadjoeddin, 2003; Murshed & Gates, 2005; Stewart et al., 2008; Stewart, 2008; Cederman et al., 2011; Buhaug et al., 2014; Cederman et al., 2015).

The fact that the symmetric inequality variable both based on nightlight data and GGP per capita points in the direction of no connection to conflict onset offers a stronger critique of the theory of horizontal inequality than does the partial rejection of Hypothesis 1 of the poverty-conflict theory. Nonetheless, the lack of findings using the formerly successful formula of Cederman et al. (2011) might indicate that the construction of the inequality measures in this analysis has been flawed, even though they bear more fruitful results in the models testing for conditional effects. Still there are other, and more likely, reasons for the discrepancy between my findings and earlier research, which will be elaborated on shortly.

Moreover, the testing of the asymmetric inequality measures of both nightlight and GGP per capita not only suggests that there is no connection with conflict risk but the models even suggest a lower risk for richer groups of experiencing conflict onset indicating that the formerly found positive effect of positive inequality on conflict risk does not hold true for ethnic groups in Sub-Saharan Africa. The fact that none of the negative inequality measure versions yield any significant results strengthens the suspicion that the construction of the inequality measure is flawed. The non-finding of a relationship between negative and positive inequality and conflict onset contradicts earlier research, but the lack of significant results based on the former is more surprising than the latter, which was based on a weaker theoretical foundation.

Besides, the finding that there still does not seem to be a connection between inequalities and conflict when these are combined with political inequality was somewhat surprising. Other

than overall problems with the operationalization of the data the fact that the negative inequality measure has proved to be ineffective in most models might be a reason why a combined effect of the two is not picked up. In addition, a more refined measure of negative political inequality than merely being excluded could perhaps have lead to different results.

When it comes to the testing of conditional effects, all significant results indicate the opposite effect than expected. My expectation was that the presence of certain elemental structural conditions on the country level would increase the effects expected in the first hypotheses. The main findings in the analysis indicated a significant effect of several nightlight inequality measures combined with the country being an autocracy; and both nightlight and GGP inequality measures yielded significant results in combination with history of violence. The results are all contrary to my theoretically based expectations, and may be interesting findings. However, my aforementioned skepticism concerning several of the variables used in this analysis obliges me to be very careful in accepting these findings.

Consequently, the results of this analysis are either unable to confirm my hypotheses and do not support the theoretical assumptions they are based on; or present surprising relationships between poverty and conflict. The reason for this substantial lack of findings, and the surprising ones, might be numerous, although three stand out in particular. First, the use of nightlight as a proxy or the operationalization of this variable is an obvious potential source of error. The suspicion that the per capita measure of nightlight data is not optimal has been confirmed by investigating the map of nightlight distribution compared to population size as well as descriptive statistics per country showing approximately the same mean nightlight values and vastly varying population sizes among the cells. Furthermore, the fact that other and more finely disaggregated studies have found the use of this proxy for wealth to be accurate when using nightlight per square kilometer (Weidmann & Schutte, 2016), is a clear indicator that the use of nightlight per capita was severely flawed and has most likely influenced my results to a great extent. However, the problems with the raw nightlights data clarified by looking at the distribution for a larger selection, still indicates a basic problem with the use of the data and not only with my operationalization. Second, the shorter time-span in my analysis than in many former studies may have influenced the findings and led to my hypotheses not being confirmed. Third, and even more likely to have influenced my findings or lack thereof is the inclusion of several different types of conflicts studied as one.

Even though this is justified by the presence of ethnic dimensions in both state-based, non-state, and one-sided conflict, and opportunity and motivation factors being relevant in all three, this is not common and is very likely to explain why my hypotheses largely are rejected.

Hence, with the exception of Hypothesis 1 tested with GGP per capita data, all hypotheses based on conventional theories are rejected. The statistically significant findings concerning the conditional effect of inequality variables on certain structural conditions are without exception unexpected. This either means that we are left with very interesting results or that these findings simply ascribe to the nightlight emission measure and other operationalizations in this thesis being severely flawed.

6. Conclusion

The aim of this thesis has been to investigate whether the geographical dispersion of wealth between ethnic groups influences the risk of violent conflict; if poverty or inequality better explains the occurrence of violent conflict on the ethnic group level; whether the effects of negative economic inequality on conflict events is contingent on the groups' political status; as well as whether the effects of both poverty and inequality hinge on elemental structural conditions. My expectations were that the poorer the ethnic group the higher the risk of conflict; that unequal groups from the country average economically, both poorer and richer groups than the country average, are more at risk of conflict; as well as the effect of negative economic inequality being contingent on political discrimination. Furthermore elemental structural conditions on the country level were expected to influence the effect of poverty and inequality in the expected direction. Features such as the country being an autocracy, the country being among the poorer half of the selection, as well as the country having experienced conflict within the last ten years were expected to constitute structural conditions that make grievances matter some places and not others. In addition the ability of the nightlight data to act as a proxy for poverty and inequality has been a central focus in this thesis.

The analysis has shown that local poverty explains conflict onset better than inequality for ethnic groups although this is only based on the GGP per capita data. Group level economic inequality as operationalized in this thesis offer no explanation on conflict onset on its own, whether based on nightlight data or GGP per capita data. The combination of opportunity and motivation based theories tested through interactions and subsamples of the poverty and inequality measures and the various structural conditions indicated that inequality has an effect pending certain conditions. The negative effect of both symmetric and negative inequality in autocratic countries as well as countries with a history of violence, is contrary to my expectations and somewhat surprising, but are still plausible.

Although the nightlight versions of the inequality variables produced a few significant results that were in accordance with the GGP per capita based variables, the fact that none were

significant in the first four models, and the nightlight per capita measure showed a positive effect on conflict risk may imply that nightlight is not suitable as a proxy for poverty and inequality. What is more, the distressing finding regarding the quality of the nightlights data further implies that we should be skeptical in the use of these. An empirical implication for further research is thus that the calibration process of the raw nightlight data should be investigated and improved, to make these data more appropriate to use as a proxy for economic development. Furthermore, for future application of nightlight data in a similar context the procedure for constructing the variable needs to be reconsidered. Important lessons from this analysis has been that the use of nightlight per capita is not necessarily always meaningful, and can lead to extremely inaccurate estimation of wealth. For this proxy to be meaningful in a sample such as Sub-Saharan Africa a more accurate measure of local wealth is presumably nightlight per square kilometer. Additionally, the aggregation process can be subjected to criticism on the numerous assumptions that were made in assigning the raw nightlight to the different groups. Particularly prone to be erroneous were the nightlight and also conflict data that was divided equally between groups in the same grid cell. Maybe are the nightlight data not even appropriate to study on ethnic group level, and should be left on grid cell level. These are procedures that could have been handled differently, and most definitely should be considered in future research.

In hindsight, making the map in Figure 3 at an earlier stage or studying the descriptive statistics more thoroughly would have led me to discover the serious disadvantage of using a nightlight per capita measure, and I would have operationalized it differently. At the time, however, the nightlight per capita measure seemed the best possible measure to assign the data to the various ethnic groups as well as making it comparable to the GGP per capita measure. In addition I could have operationalized conflict more narrowly and in accordance with previous research, to get more precise results. The failure of accounting for existing conflicts in the first year of the dataset can also have affected my results, and is among the limitations of this thesis.

On the basis of this, the results from my analysis are somewhat dubious, and contrast the finding of Weidmann & Schutte (2016), Elvidge et al. (2012), and Henderson et al. (2009) of nightlights being a highly accurate proxy for local wealth. The fact that Cederman et al. (2015) use a nightlight per capita measure and find no statistically significant effect of this

variable on its own strengthens my suspicion towards the use of nightlight per capita. I assume the discrepancy between my findings and former research to be caused mainly by this operationalization of nightlight as a proxy for wealth as well as the wide definition of conflict. Thus, I conclude that there might be use for nightlight data in such a context in the future, with further work with the raw data and a different operationalization.

Theoretically, although keeping in mind this analysis' data challenges discussed above, some implications for future research can nevertheless be made. On the one hand, the lacking support for the pure horizontal inequality theory, is likely to be on account of these problems, and in no way suggests that the theory of horizontal inequalities should be dismissed. On the other hand, the statistically significant results from combining opportunity and motivation based explanatory factors are very interesting, and although perhaps also influenced by the data quality or the construction of the different variables, indicate that this combination can be beneficial in explaining conflict onset risk. While existing quantitative research has focused on opportunity and motivation as separate and somewhat conflicting explanations of conflict the results of my analysis proposes that they are more meaningfully perceived as complementary explanatory factors. Both need to be present to a certain extent, for either one to lead to conflict, and it seems reasonable to assume that they are mutually strengthening. My research of this combined effect has been preliminary, and a more refined investigation is in order. Still, the combination of opportunity and motivation based explanatory factors for conflict is theoretically interesting and should decidedly be investigated further.

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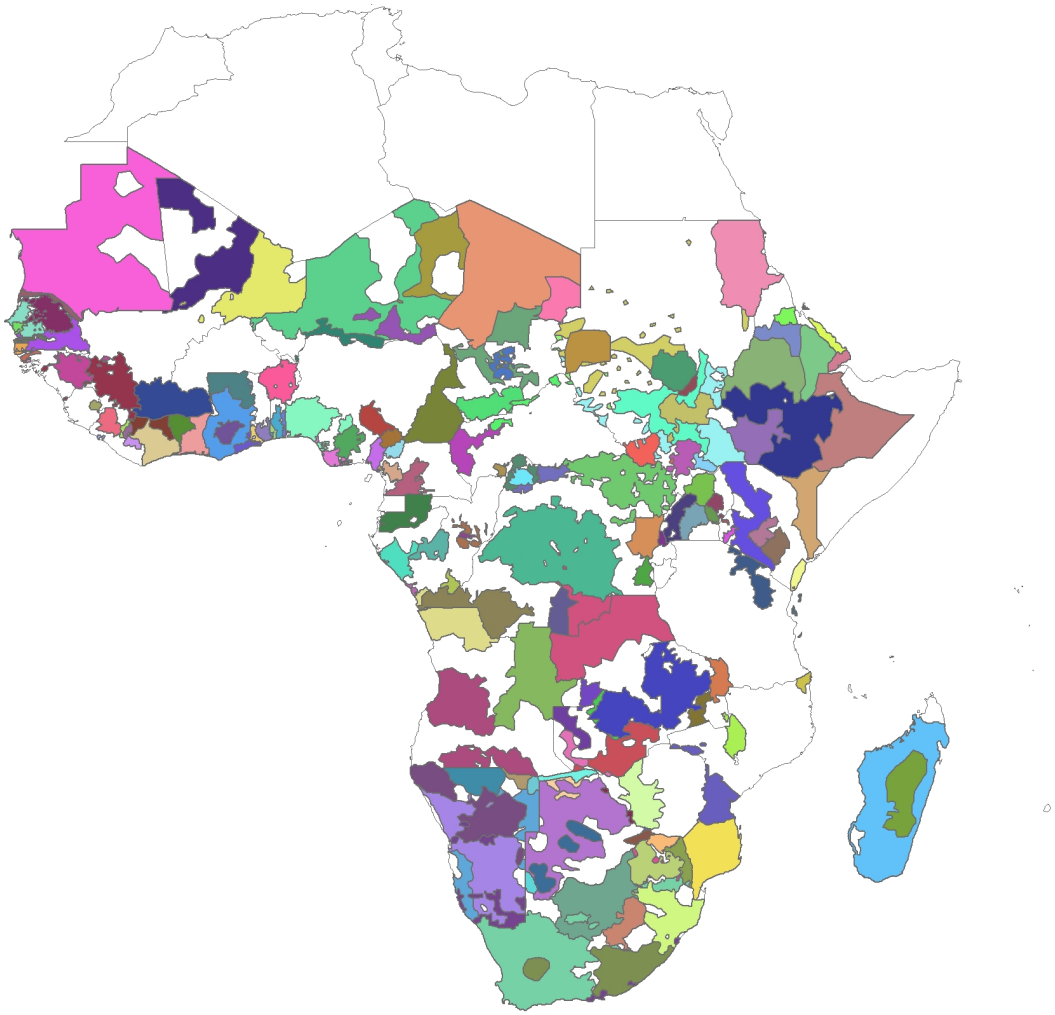
Appendix A

Figure A1: Map of geographical distribution of groups included in the analysis



Appendix B

A number of supplementary models will be presented here. Table B1 and B4 contribute to the robustness tests I have run, whereas Table B2 – B3 and B5 – B7 are part of the testing of the influence of conditional structural factors on the effect of poverty and inequality on conflict risk in the analysis.

Table B1: Mixed effects logistic regression of ethnic groups' conflict risk

VARIABLES	Model 1	Model 2	Model 3	Model 4
GGP per capita (log, *t*-1)	-0.339**			
	(0.165)			
Inequality GGP (*t*-1)		0.0959		
		(0.117)		
Low GGP (*t*-1)			0.0651	0.110
			(0.0597)	(0.0977)
High GGP (*t*-1)			-0.280	-0.269
			(0.267)	(0.268)
Low GGP*excluded				-0.0646
				(0.116)
Group population (log)	0.147**	0.156**	0.134*	0.138*
	(0.0730)	(0.0727)	(0.0726)	(0.0731)
Excluded (*t*-1)	0.755***	0.772***	0.760***	0.882***
	(0.199)	(0.198)	(0.198)	(0.296)
Downgraded (*t*-1)	1.587***	1.616***	1.619***	1.703***
	(0.470)	(0.469)	(0.470)	(0.492)
Country population (log)	0.0138	0.0221	0.0215	0.0221
	(0.102)	(0.102)	(0.102)	(0.102)
Country GDP per capita (log, *t*-1)	0.133	-0.181*	-0.207*	-0.197*
	(0.191)	(0.109)	(0.111)	(0.111)
Democracy	-0.311	-0.262	-0.274	-0.297
	(0.197)	(0.195)	(0.195)	(0.197)
Peace years (log)	4.793***	4.796***	4.824***	4.802***
	(0.662)	(0.663)	(0.668)	(0.665)
Peace years squared	-1.836***	-1.846***	-1.850***	-1.842***
	(0.248)	(0.248)	(0.250)	(0.249)
Groups in country exp. conflict (*t*-1)	0.781***	0.826***	0.806***	0.811***
	(0.215)	(0.211)	(0.213)	(0.215)
Constant	-6.408***	-6.779***	-6.047***	-6.265***
	(1.763)	(1.771)	(1.875)	(1.898)
Constant (country)	0	0	0	0
	(0)	(0)	(0)	(0)
Observations	2,279	2,279	2,279	2,273
Number of groups	35	35	35	34

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

Table B2: Extension of Table 3, explaining group level conflict onset (nightlight and structural conditions)

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Nightlight per capita (log, *t*-1)	-0.0276	-0.446				
	(0.106)	(0.292)				
Nightlight per capita*democracy	0.0719					
	(0.135)					
Inequality nightlight (*t*-1)			0.0151	-0.125	-0.0431	0.0661
			(0.0384)	(0.190)	(0.0511)	(0.0729)
Inequality*autocracy			-0.359*			
			(0.188)			
Inequality*GDP dummy					0.0961	
					(0.0682)	
Group population (log)	0.166	-0.301	0.172*	-0.128	0.180**	0.172
	(0.114)	(0.210)	(0.0954)	(0.137)	(0.0872)	(0.139)
Excluded (*t*-1)	0.778***	1.601**	0.872***	1.329**	0.840***	1.126***
	(0.239)	(0.628)	(0.225)	(0.653)	(0.253)	(0.311)
Downgraded (*t*-1)	1.637***	Omitted	1.653***	Omitted	1.727***	1.764***
	(0.495)		(0.461)		(0.469)	(0.650)
Country population (log)	0.0158	-0.160	-0.0316	-0.0623	0.0175	0.0130
	(0.0902)	(0.272)	(0.0898)	(0.183)	(0.0943)	(0.0967)
Country GDP per capita (log, *t*-1)	-0.191*	3.981***	-0.203**	3.419**		
	(0.106)	(1.211)	(0.0999)	(1.414)		
Democracy	-0.708				-0.293	-0.188
	(0.918)				(0.225)	(0.274)
Autocracy			0.103			
			(0.403)			
GDP per capita dummy (*t*-1)					-0.0947	
					(0.217)	
Peace years (log)	4.804***	5.273**	4.913***	4.553**	4.807***	4.470***
	(0.503)	(2.135)	(0.531)	(1.843)	(0.530)	(0.650)
Peace years squared	-1.835***	-1.554*	-1.883***	-1.381*	-1.859***	-1.693***
	(0.208)	(0.940)	(0.208)	(0.824)	(0.214)	(0.280)
Group in country exp. conflict (*t*-1)	0.832***	1.449**	0.924***	1.525**	0.831***	0.989***
	(0.286)	(0.640)	(0.260)	(0.670)	(0.275)	(0.278)
Constant	-6.558***	-28.15**	-6.212***	-29.89***	-8.293***	-8.333***
	(1.726)	(13.50)	(1.149)	(10.80)	(1.344)	(2.226)
Observations	2,297	230	2,364	230	2,291	1,112

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Logistic regression of ethnic groups' conflict risk. Model 2 & 4: subsample of autocratic states, Model 6: subsample of groups in countries with low GDP per capita.

Table B3: Extension of Table 3, explaining group level conflict onset (nightlight and structural conditions)

VARIABLES	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Low nightlight (*t*-1)	0.142*	0.0675			0.238***	0.0575
	(0.0804)	(0.181)			(0.0559)	(0.133)
High nightlight (*t*-1)	-0.00501	0.00975			-0.00573	-0.00635
	(0.00733)	(0.0118)			(0.00763)	(0.00757)
Low nightlight*GDP dummy	-0.235					
	(0.155)					
Nightlight per capita (log, *t*-1)			-0.00737	-0.0237		
			(0.115)	(0.117)		
Nightlight pc*no country conf. 10			0.568			
			(0.433)			
Low nightlight*country conflict 10					-0.365**	
					(0.174)	
Group population (log)	0.167*	0.128	0.149	0.143	0.157	0.124
	(0.0921)	(0.142)	(0.104)	(0.103)	(0.100)	(0.0988)
Excluded (*t*-1)	0.831***	1.152***	0.782***	0.814***	0.783***	0.809***
	(0.260)	(0.328)	(0.239)	(0.242)	(0.237)	(0.238)
Downgraded (*t*-1)	1.781***	1.775***	1.613***	1.639***	1.655***	1.626***
	(0.447)	(0.649)	(0.496)	(0.497)	(0.472)	(0.499)
Country population (log)	0.0332	0.00183	0.0300	0.0143	0.0177	0.0433
	(0.102)	(0.106)	(0.0926)	(0.0922)	(0.102)	(0.107)
GDP per capita dummy (*t*-1)	0.322					
	(0.370)					
Democracy	-0.292	-0.157	-0.238	-0.210	-0.243	-0.214
	(0.218)	(0.258)	(0.214)	(0.221)	(0.226)	(0.229)
Country GDP per capita (log, *t*-1)			-0.209**	-0.174	-0.190*	-0.182*
			(0.104)	(0.111)	(0.101)	(0.0998)
No country conflict last 10 years			-3.528			
			(3.143)			
Country conflict last 10 years					-0.0257	
					(0.834)	
Peace years (log)	4.987***	4.427***	4.812***	4.826***	5.192***	4.825***
	(0.533)	(0.601)	(0.514)	(0.516)	(0.542)	(0.511)
Peace years squared	-1.914***	-1.684***	-1.851***	-1.858***	-1.971***	-1.860***
	(0.214)	(0.257)	(0.210)	(0.211)	(0.216)	(0.208)
Group in country exp. conflict (*t*-1)	0.849***	0.998***	0.834***	0.855***	0.880***	0.844***
	(0.275)	(0.282)	(0.291)	(0.294)	(0.289)	(0.298)
Constant	-8.732***	-7.627***	-6.551***	-6.403***	-6.709***	-6.758***
	(1.317)	(2.237)	(1.768)	(1.734)	(1.377)	(1.152)
Observations	2,279	1,146	2,297	2,216	2,285	2,204

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Logistic regression of ethnic groups' conflict risk. Model 8: subsample of groups in countries with low GDP per capita, Model 10 & 12: subsample of countries with conflict within last ten years.

Table B4: Logistic regression of ethnic groups' conflict risk. Models without controlling for spatial autocorrelation and no timelags.

VARIABLES	Model 1	Model 2	Model 3
Nightlight per capita (log)	-0.257***		
	(0.0513)		
Inequality nightlight		0.0566*	
		(0.0405)	
Low nightlight			0.0633**
			(0.0278)
High nightlight			-0.00520
			(0.0061)
Group population (log)	0.0192	0.171**	0.111
	(0.0816)	(0.0714)	(0.0838)
Excluded	0.659***	0.586***	0.554**
	(0.252)	(0.215)	(0.222)
Downgraded (*t*-1)	1.281***	1.200***	1.245***
	(0.427)	(0.422)	(0.417)
Country population (log)	0.0415	0.0365	0.0789
	(0.101)	(0.882)	(0.099)
Country GDP per capita (log)	-0.265**	-0.364***	-0.373***
	(0.117)	(0.090)	(0.090)
Democracy	-0.666***	-0.779***	-0.724***
	(0.231)	(0.204)	(0.200)
Peace years (log)	0.197	0.0617	0.104
	(0.148)	(0.139)	(0.144)
Constant	-0.017	-2.654*	-2.557
	(1.407)	(1.600)	(1.583)
Observations	2,442	2,442	2,427

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table B5: Explaining group level conflict onset (GGP per capita and structural conditions)

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
GGP per capita (log, *t*-1)	-0.361*	-0.166				
	(0.202)	(0.546)				
GGP per capita*democracy	0.0375					
	(0.196)					
Inequality GGP (*t*-1)			0.0384	-0.143		
			(0.124)	(0.307)		
Inequality*autocracy			0.0764			
			(0.163)			
Low GGP (*t*-1)					-0.000191	-0.0844
					(0.0778)	(0.179)
High GGP (*t*-1)					-0.309	Omitted
					(0.197)	
Low GGP*autocracy					0.0801	
					(0.0773)	
Group population (log)	0.148*	-0.111	0.165**	-0.125	0.138*	-0.124
	(0.0858)	(0.122)	(0.0811)	(0.125)	(0.0833)	(0.126)
Excluded (*t*-1)	0.753***	1.233**	0.835***	1.241*	0.812***	1.174*
	(0.250)	(0.628)	(0.239)	(0.636)	(0.242)	(0.642)
Downgraded (*t*-1)	1.581***	Omitted	1.607***	Omitted	1.615***	Omitted
	(0.483)		(0.483)		(0.487)	
Country population (log)	0.0136	0.00162	0.00581	0.0134	0.0125	0.0276
	(0.0877)	(0.153)	(0.0922)	(0.180)	(0.0865)	(0.177)
Country GDP per capita (log, *t*-1)	0.128	3.647**	-0.179*	3.435**	-0.201**	3.347**
	(0.208)	(1.427)	(0.101)	(1.492)	(0.100)	(1.530)
Democracy	-0.568					
	(1.360)					
Autocracy			-0.207		-0.287	
			(0.404)		(0.410)	
Peace years (log)	4.796***	4.711**	4.838***	4.565**	4.880***	4.514**
	(0.530)	(1.952)	(0.535)	(1.874)	(0.548)	(1.861)
Peace years squared	-1.837***	-1.467*	-1.877***	-1.406*	-1.882***	-1.394*
	(0.218)	(0.866)	(0.215)	(0.838)	(0.221)	(0.836)
Group in country exp. conflict(*t*-1)	0.778***	1.455**	0.909***	1.411**	0.861***	1.407**
	(0.280)	(0.641)	(0.273)	(0.635)	(0.273)	(0.658)
Constant	-6.229***	-31.79**	-6.819***	-31.16**	-6.078***	-30.55**
	(1.515)	(13.16)	(1.140)	(13.12)	(1.189)	(13.32)
Observations	2,279	224	2,273	224	2,273	209

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Mixed effects logistic regression of ethnic groups' conflict risk. Models 2, 4 & 6: subsample of groups in autocracies.

Table B6: Explaining group level conflict onset (GGP per capita and structural conditions)

VARIABLES	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
GGP per capita (log, *t*-1)	2.052*	-0.220				
	(1.114)	(0.181)				
GGP per capita*GDP per capita	-0.318**					
	(0.158)					
Inequality GGP (*t*-1)			0.177	0.0487		
			(0.137)	(0.145)		
Inequality GGP*GDP dummy			-0.138			
			(0.178)			
Low GGP (*t*-1)					0.0714	0.0613
					(0.0553)	(0.0936)
High GGP (*t*-1)					-0.258	-0.199
					(0.215)	(0.129)
Low GGP*GDP dummy					-0.0333	
					(0.0976)	
Group population (log)	0.118	0.109	0.177**	0.116	0.159**	0.0910
	(0.0830)	(0.135)	(0.0780)	(0.130)	(0.0810)	(0.139)
Excluded (*t*-1)	0.822***	1.046***	0.809***	1.099***	0.803***	1.092***
	(0.257)	(0.325)	(0.262)	(0.330)	(0.265)	(0.337)
Downgraded (*t*-1)	1.658***	1.667***	1.736***	1.760***	1.739***	1.768***
	(0.457)	(0.628)	(0.473)	(0.645)	(0.472)	(0.637)
Country population (log)	0.0491	0.0253	0.0188	0.0306	0.0228	0.0330
	(0.0917)	(0.101)	(0.0902)	(0.108)	(0.0869)	(0.109)
Country GDP per capita (log, *t*-1)	2.409**					
	(1.205)					
Democracy	-0.121	-0.277	-0.280	-0.162	-0.285	-0.192
	(0.248)	(0.315)	(0.244)	(0.303)	(0.245)	(0.303)
GDP per capita dummy (*t*-1)			0.168		0.186	
			(0.264)		(0.329)	
Peace years (log)	4.846***	4.370***	4.875***	4.398***	4.870***	4.394***
	(0.550)	(0.663)	(0.579)	(0.667)	(0.573)	(0.667)
Peace years squared	-1.857***	-1.632***	-1.887***	-1.662***	-1.882***	-1.655***
	(0.221)	(0.294)	(0.230)	(0.288)	(0.229)	(0.290)
Group in country conflict (*t*-1)	0.777***	0.901***	0.843***	0.984***	0.822***	0.951***
	(0.285)	(0.290)	(0.290)	(0.292)	(0.281)	(0.281)
Constant	-23.52***	-6.028***	-8.490***	-7.755***	-8.073***	-7.275***
	(8.239)	(2.197)	(1.207)	(1.958)	(1.233)	(2.178)
Observations	2,273	1,100	2,273	1,096	2,273	1,096

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Logistic regression of ethnic groups' conflict risk. Models 8, 10 & 12: subsample of groups in countries with low GDP per capita.

Table B7: Explaining group level conflict onset (GGP per capita and structural conditions)

VARIABLES	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
GGP per capita (log, *t*-1)	-0.337*	-0.310*				
	(0.179)	(0.182)				
GGP per cap*no country conf. 10	-0.239					
	(0.489)					
Inequality GGP (*t*-1)			1.592**	0.0897		
			(0.710)	(0.0978)		
Inequality GGP*country conf. 10			-1.468**			
			(0.685)			
Low GGP (*t*-1)					1.327**	0.0611
					(0.551)	(0.0481)
High GGP (*t*-1)					-0.285	-0.264
					(0.186)	(0.179)
Low GGP*country conflict 10					-1.220**	
					(0.529)	
Group population (log)	0.145*	0.149*	0.171**	0.157**	0.146*	0.136
	(0.0834)	(0.0834)	(0.0802)	(0.0785)	(0.0842)	(0.0831)
Excluded (*t*-1)	0.764***	0.783***	0.799***	0.800***	0.778***	0.788***
	(0.253)	(0.251)	(0.240)	(0.241)	(0.247)	(0.247)
Downgraded (*t*-1)	1.608***	1.606***	1.670***	1.633***	1.671***	1.637***
	(0.496)	(0.496)	(0.485)	(0.493)	(0.486)	(0.495)
Country population (log)	0.0137	0.0127	0.0202	0.0212	0.00940	0.0200
	(0.0865)	(0.0889)	(0.0941)	(0.0927)	(0.0903)	(0.0889)
Country GDP per capita (log, *t*-1)	0.145	0.110	-0.194**	-0.178*	-0.245**	-0.202**
	(0.204)	(0.206)	(0.0985)	(0.0996)	(0.100)	(0.0987)
Democracy	-0.312	-0.258	-0.229	-0.212	-0.243	-0.224
	(0.235)	(0.240)	(0.237)	(0.241)	(0.228)	(0.232)
No country conflict last 10 years	2.266					
	(3.543)					
Country conflict last 10 years			0.172		2.014	
			(1.097)		(1.903)	
Peace years (log)	4.818***	4.823***	4.853***	4.828***	4.889***	4.852***
	(0.534)	(0.536)	(0.534)	(0.537)	(0.536)	(0.543)
Peace years squared	-1.858***	-1.861***	-1.880***	-1.871***	-1.882***	-1.874***
	(0.220)	(0.221)	(0.216)	(0.220)	(0.217)	(0.222)
Group in country exp. conflict(*t*-1)	0.804***	0.820***	0.837***	0.862***	0.816***	0.842***
	(0.287)	(0.290)	(0.302)	(0.302)	(0.290)	(0.293)
Constant	-6.500***	-6.507***	-7.072***	-6.864***	-7.832***	-6.168***
	(1.199)	(1.188)	(1.500)	(1.123)	(2.017)	(1.268)
Observations	2,279	2,198	2,273	2,198	2,273	2,198

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Logistic regression of ethnic groups' conflict risk. Models 14, 16 & 18: subsample of groups in countries that have experienced conflict in the last 10 years.

Appendix C

Table C1: Descriptive statistics nightlight and population, all grid cells per country Sub-Saharan Africa 1992 – 2012.

		Nightlight calibrated				**Population**			
Country	N	Mean	Std.dev	Min	Max	Mean	Std.dev	Min	Max
Angola	9135	0.0367	0.0249	0	0.3366	32951	72596	14	1218012
Benin	840	0.0371	0.0184	0	0.1125	170109	241478	21345	1289229
Botswana	4305	0.0355	0.0170	0	0.1405	7806	18021	10	192653
Cameroon	3276	0.0364	0.0190	0	0.1659	100807	154507	7707	1202502
C.A.R.	4242	0.0342	0.0158	0	0.0690	15562	15495	217	88155
Chad	8211	0.0343	0.0159	0	0.0804	21827	34363	317	243054
Congo	2352	0.0415	0.0455	0	0.5557	71744	486235	141	6649402
Cote d'Ivoire	2373	0.0415	0.0224	0	0.1584	148499	221753	112	2093473
Djibouti	189	0.0380	0.0185	0	0.0949	55937	57580	3163	171159
DR Congo	16023	0.0345	0.0159	0	0.0933	68201	107976	3957	1727997
Eritrea	1040	0.0368	0.0145	0.0143	0.0833	83354	145286	439	1290315
Ethiopia	7864	0.0347	0.0165	0	0.1198	177546	235364	425	2619841
Gabon	1974	0.0423	0.0312	0	0.2660	14016	39744	83	364144
Gambia	63	0.0439	0.0220	0	0.0987	332183	273374	110050	954912
Ghana	1785	0.0436	0.0318	0	0.2901	236972	398719	2228	3873204
Guinea	1785	0.0352	0.0165	0	0.0919	95446	108319	86	1060310
Guinea-Bissau	273	0.0348	0.0158	0	0.0730	97497	94395	9527	453565
Kenya	4032	0.0367	0.0210	0	0.2465	165784	387960	6	4691041
Liberia	777	0.0348	0.0163	0	0.0804	93468	91490	518	480455
Madagascar	5355	0.0345	0.0159	0	0.0871	66772	120483	0	1859773
Malawi	819	0.0389	0.0185	0	0.0989	289912	272768	37001	1699054
Mali	8946	0.0345	0.0161	0	0.1058	28912	69401	349	1363213
Mauritania	7728	0.0344	0.0159	0	0.0958	7579	28003	2	587952
Mozambique	6342	0.0351	0.0168	0	0.1484	64816	94159	47	1311758
Namibia	6447	0.0351	0.0163	0	0.1109	5353	18269	0	242393
Niger	8442	0.0344	0.0159	0	0.0882	29441	70819	40	754204
Nigeria	6552	0.0585	0.0755	0	0.6923	385757	516758	7883	7651373
Senegal	1575	0.0377	0.0205	0	0.1620	138061	348106	3689	3617136
Sierra Leone	630	0.0349	0.0160	0	0.0699	173757	159606	791	1218391
South Africa	10143	0.0564	0.0615	0	0.8064	89559	264985	0	4311614
Sudan	17640	0.0354	0.0179	0	0.2363	39071	81736	504	1944843
Tanzania	6636	0.0353	0.0174	0	0.1757	113440	159551	0	3065564
Togo	399	0.0400	0.0224	0	0.1180	259755	275163	72476	1691037
Uganda	1680	0.0359	0.0185	0	0.1476	307733	363343	0	3091142
Zambia	5250	0.0360	0.0188	0	0.1965	43105	87236	1389	1472942
Zimbabwe	2835	0.0391	0.0233	0	0.2190	97276	175902	12607	2315789