ROMA TRE
UNIVERSITÀ DEGLI STUDI

DOTTORATO IN ECONOMIA E METODI QUANTITATIVI
XXIX CICLO

Tesi di Dottorato

Economic Shock and Civil Conflict: Evidence from Africa

Dottoranda: Giulia Rapicetta

Relatrice: Professoressa Margherita Scarlato

Co-Relatori: Dottor Giorgio d'Agostino,
Professor Paul Dunne

Comitato di tesi:
Professor Luca Pieroni,
Professor Roberto Ricciuti

Coordinatore: Prof. Luca Salvatici

DOTTORATO IN ECONOMIA
UNIVERSITÀ DEGLI STUDI ROMA TRE

Contents

Abstract

This PhD Thesis deals with the problem of civil war in Africa. It clearly arises from the economic literature that the most robust predictor of a country's probability of civil war is its level of GDP. Low GDP empirically dominates all other correlates, including the level of democracy, the degree of ethnic diversity or the dependence on natural resource exports. The main intuition behind this finding is related to the opportunity cost of the rebels who decide whether to devote effort to a productive endeavor or to violent predatory activities. When GDP growth is weak, there is a reduction in real wages that produces a gap in the returns from predatory and productive activities. In this situation of low opportunity costs, citizens are more likely to turn to predatory activities. After identifying main theoretical and applied works on determinants of civil war onset, we replicate one widely cited study of this field: Edward Miguel, Shanker Satyanath and Ernest Sergenti (2004). We extend this important study covering the African countries during 1981-2009. The probability of civil war is estimated by using an instrumental variable approach with rainfall variation as instrument for economic growth. Our results are in line with the original study, and we find a strong and negative relationship between economic growth and civil war. We test the robustness of the instrument with Stock and Yogo (2005) Test and we find out that the instrument is weak, therefore the estimates are biased. We show that the weakness of the instrument is not related to the coding rule of the dependent variable, namely civil war, a dichotomous variable assuming 1 when more than 25 battle-deaths per year are reached. Further, we adopt the Zero-inflated poisson approach to deal with the abundance of zero (peace) in the dependent variable. We find interesting and not biased results with this model. In the third chapter we deal with the critique of the coding rule of the civil war variable and we suggest a new indicator of civil war, based on violence escalation rather than battle-deaths threshold. Taking information from the Social Conflict in Analysis Database Version 3.1 (SCAD), from the Armed Conflict Location and Event Data Project 2015 (ACLED), and from the Uppsala Conflict Data Program (UCDP) we design a violence indicator ranging from 1 (peace) to 3 (civil war). We apply this new indicator by estimating Markov transition probabilities for countries, ethnic groups and non-ethnic groups violence status over time as function of observable characteristics. We propose 3 methods to estimate these Markov probabilities. The first method is a counting method, the second one predicts transition probabilities using ordered logit regression models and finally, we derive hazard rates from a non-parametric Kaplan-Meier estimator and a semi-parametric proportional hazard (Cox) model. We also test whether the Markov assumption holds. Our results are in line with the economic literature, but, beyond the economic growth effect, we find a strong relationship between civil war and diamond exports, soil fertility and population growth.

0.1 Introduction

Until the War World II, armed conflicts were mainly among States. After the Cold War it was expected to reach peace and stability around the world, on the contrary a new trend established: violent conflicts within internal organized groups have increased, leaving the space to several cruel civil wars (Fig. 3).

The consequences of civil wars are immediate and direct in terms of deaths and population growth, everyday life, injuries, destruction of property, and infrastructures. Moreover, there are indirect and long-term effects in terms of impacts on future generations, traumatic event-recovery, land and natural resources use. Everyday experiences, such as going to school, to work, or to market, become occasions for fear. People hesitate to build houses or invest in small businesses because these can be destroyed in a moment. In addition, the problems of conflictual States spread easily: they drag down neighbours with violence that overflows borders. Territories can become breeding grounds for far-reaching networks of violent radicals and organized crime.

Traditionally, military experts, historians, political scientists and international relations scholars have dealt with this topic. In parallel, economists and policy makers have long been interested in the causes and consequences of peace and conflict, but since the attacks of 9/11, there has been a significant surge of studies in the economics and political economy of conflict.

We present here an analysis of civil war: we introduce economic perspectives on civil conflict, briefly summarize the contents of theoretical and applied studies, bring together studies from a variety of disciplines to explore the different perspectives and explanations and, finally suggest future research directions. In particular, we try to contribute in this field in three ways: (i) first of all we critically explore current state of the art of economics of conflict with the aim to suggest small contributions to improve our understanding of civil wars (chapter 1); (ii) secondly, we focus on a particular widely cited study in this field and we test statistically its conclusions (chapter 2); (iii) we criticize current definition of civil war by suggesting a new indicator of civil war (chapter 3); (iv) to conclude, we suggest new approaches to deal with the analysis of civil wars (chapter 2 and 3).

Excepts for the first chapter, in which we summarize the economic literature of civil war in general, our efforts are addressed to the African continent. Africa, together with Asia, is the main theatre of civil wars since the decolonization (Fig.1 and 2). We have chosen to focus on Africa because of its numerous bloody civil wars and because of its clear difficulty of development. We cannot have development without peace and civil wars have increasingly been seen as a major obstacle to the economic development of many low and middle-income countries (Fearon, 2010), that is why it is crucial to study this topic from an economic perspective. We develop our reasoning looking at African historical facts and we test empirically our intuitions, by applying several different econometric methods.

The economic analysis of civil wars involves some of the basic foundations of micro and macro economics. Microeconomics of conflict models the reallocation of resources within and between groups. This reallocation is based on the military strength of the two actors: the group with superior military forces usually wins the war. Rebels start a war to steal nation's resources and, meanwhile, resources and infrastructures are destroyed, leading to war costs. Contrary to traditional economics, actors can engage in appropriation, grabbing the production of others or defending what they themselves have produced. Usually, economic models of conflict are based on game theory, involving strategic behaviours, contest between actors or bargaining tools. Therefore, most macroeconomic study of conflict is a microfounded empirical analysis. Macroeconomics of conflict estimate the probability of conflict onset and the duration of a civil war. Several determinants of civil war have been suggested in the economic literature, however scholars agree only on the negative impact of economic growth: a (positive or negative) economic shock and low GDP per capita increase the likelihood of civil war.

The causal relationship between economic growth per capita and civil war is endogenous since

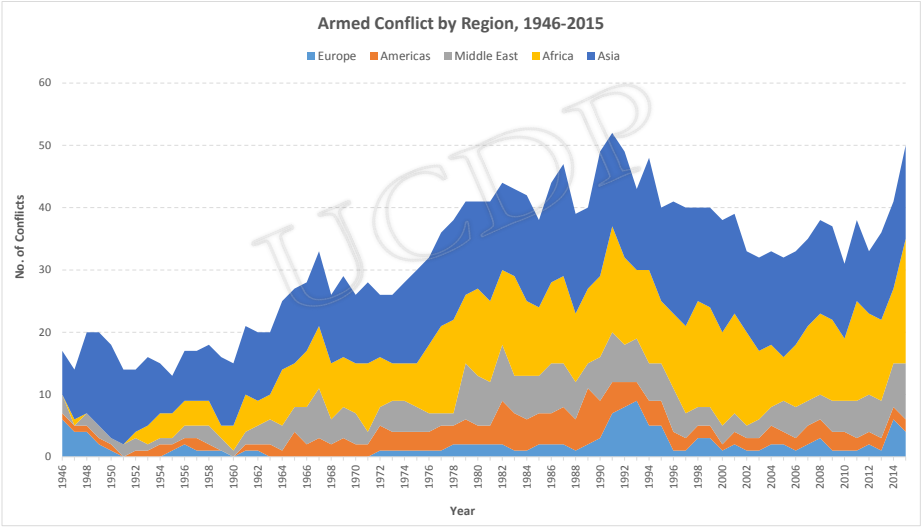


Fig. 1: *Conflict in the Regions of the World. Source: UCDP 2016*

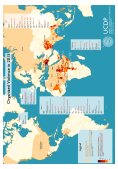


Fig. 2: *Map of the World's conflicts. Source: UCDP 2015*

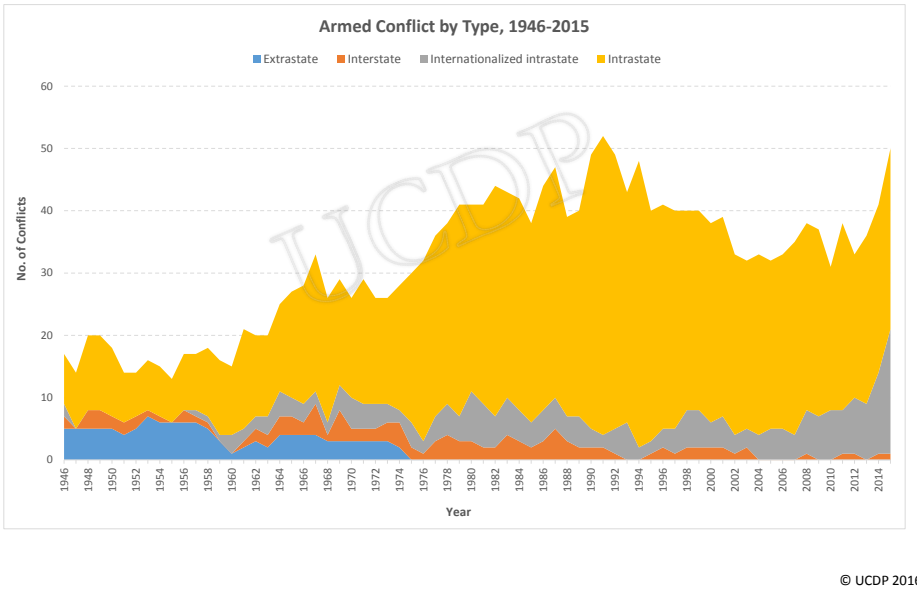


Fig. 3: *Typologies of Conflicts.*
Source: UCDP 2016

also civil war causes economic shock which is long-lasting and prevent countries from recovering. For this reason Edward Miguel, Shanker Satyanath and Ernest Sergenti (2004) (henceforth MSS) have addressed this reverse causality by suggesting a proxy of economic growth: rainfall variation. They have developed an instrumental variable approach to solve the endogeneity bias in the context of Africa. Their study covers the time period 1981-2009, so we update the analysis until 2009 to see the robustness of MSS's results.

Secondly, we raise doubts about current definition of civil war. The Department of Peace and Conflict Research defines a civil war as "a conflict between a government and a non-governmental party, with no interference from other countries where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths in one calendar year". This definition is converted into a dichotomous variable, assuming 1 when the threshold is reached (war). We develop some empirical models to test our hypothesis about this definition. In particular, we replicate MSS's analysis with new battle-deaths thresholds in order to see the robustness/weakness of this definition. Lastly, we hypothesise that estimates are biased because normal distribution approximation is not suitable in a context of a binary variable and rare event. In fact, civil war is considered as a rare event, since there are more peaceful country-years than conflictual country-years. We suggest that we should use non-linear least squares, in particular the Zero Inflated Poisson Model (ZIP), which is able to capture the overdispersion caused by an incidence of 0 (peace) greater than the 1 (war). This approach inflates the number of zeros by mixing point mass at 0 with a Poisson distribution. The ZIP is characterized by a dual-stage process: in the first stage we observe only zero values and in the second stage we analyse a Poisson distribution with both zero and non-zero values.

We will show that estimates are very sensible to the definition of civil war. Nevertheless, already some scholars (Sambanis, 2004; Fearon and Laitin, 2003) have debated about the definition of civil war, raising some concerns. Many researchers have designed their own definition

of civil war with a related list of civil wars (for a comprehensive list, see Eck, 2005) but most of them use the quantitative threshold of battle-deaths. In the last chapter of this thesis we suggest a new indicator of civil war which is not based on battle-death threshold and tries to be more dynamic, in order to capture the variability of civil conflicts. Our indicator is ordinal with three modalities: 1. peace, 2. armed conflict and 3. civil war. We apply this new indicator by estimating Markov transition probabilities for countries, ethnic groups and non-ethnic groups violence status over time as function of observable characteristics. We estimate Markov transition probabilities in three steps in order to see if our estimates are reliable when more accurate models are employed. The first method is a counting method, the second predicts transition probabilities using ordered logit regression models and finally, we derive hazard rates from a non-parametric Kaplan-Meier estimator and a semi-parametric proportional hazard (Cox) model. We also test whether the Markov assumption holds. We show that estimates are coherent along the three models and at country level results are in line with the economic literature. However, estimates change widely when we analyse at country level, ethnic and non-ethnic level.

Chapter 1

Literature Review on Civil War

Abstract

In this chapter we have summarized main theoretical and applied works on determinants of civil war onset. The majority of economic works rely on rational choice theory and game theory and prove that civil war is a function of per capita taxable base of the economy, of population expected costs and benefits of conflict. In applied economic studies, several determinants of civil war have been identified as potential determinants but only economic growth and GDP per capita affect significantly the probability of civil war in every study. Understanding causes and consequences of conflicts is critical for implementing policies aimed to prevent, intervene, recover and support social and economic systems after the conflicts. Drawbacks and limits of different strands of literature are highlighted and suggestions for future improvements are discussed. In particular, we propose a novel interpretation of the original Collier's Greed Theory, by suggesting that civil war may be motivated by contextual grievances which are, in turn, exploited by greedy actors.

keyword*Civil War; Game Theory; Greed and Grievance; Poverty*.

1.1 Introduction

Why do wars break out? Where and when are they most likely to occur? Understanding causes and consequences of conflicts is critical for implementing policies aimed at prevent, intervene, recover and support social and economic systems after the conflicts.

Since the end of the Cold War, there is a distinct rise in the number of civil conflicts, peaking in 1991, while armed conflicts in general have declined[1]. This means that in our Era there are more civil wars than international wars (Scott et al., 2016). Of course, a civil war does not break out just for one reason; usually, there are several reasons but only one is more visible and evident.

The majority of economic works rely on rational choice theory[2] and game theory. Theoretical and applied works have identified a set of factors as potential determinants of civil war onset and incidence[3]. In theoretical approach, reasons include incomplete information, miscalculations, over-optimism, biased negotiations due to military asymmetry, irrationality and a long-term planning strategy of gaining dominance over one's opponent.

In the applied literature there is an overall agreement that economic factors matter to conflict dynamics. On the contrary, there is little consensus as how the matter and how much, relative to other political and socio-cultural factors.

Usually, beside economic variables, other determinants are investigated in applied studies, such as: ethnic and religious fractionalization, natural resources, political instability, unemployment, geography and population. The economic literature of civil war shows contradictory results regarding non-economic factors. For example, among the main proponent of economic determinant of civil war, Collier and Hoeffler (1998) are cornerstones and have developed the Greed Theory, proving that only self-interest and slow economic growth determine civil war. Sambanis (2004), instead, has published several applied works in which underlines the importance of other contextual determinants, beyond economic reasons. At the extreme opposite side, economists as Keen (2012) can be seen as proponent of the "grievance" thesis, criticising the theoretical framework from which main applied works start and consequential results regarding the importance of economics.

This chapter draws different strands of literature together and investigates the link between civil war and several possible determinants, with a critical perspective and by making use of country specific examples and experiences (mainly from Africa). The main contribution of this chapter is to re-examine a vast economic literature by highlighting drawbacks and theoretical limits in order to suggest future research pathways, according to current world dynamics.

By starting from the Greed Theory developed by Collier and Hoeffler (1998) we follow Keen (2012) with the aim to propose a novel interpretation of the original Greed Theory, by suggesting that civil war may be motivated by contextual grievances which are, in turn, exploited by greedy actors. Consequently, policy makers and international organizations should supervise the needs of people, especially those who are poor, with redistributive and pro-poor policies.

The remainder of this first chapter is organised as follows. In Section 1.2, we present main theoretical approaches in the economics of civil war literature. In Section 1.3, we review main results in empirical works and in the final section, we conclude the chapter by summarising the main findings and highlighting the relevant policy implications.

[1] In 2014, the Uppsala Conflict Data Program recorded 40 armed conflicts, which is the highest number of conflicts reported since 1999. 11 out of these conflicts were defined as wars, that is, conflicts generating 1,000 or more battle-related deaths in one calendar year (Pettersson and Wallensteen, 2015). All conflicts but one were fought within states, but 13 of them were internationalized (which means that one or more states contributed troops to one or both sides).

[2] Applied to the economic theories of criminal behaviour.

[3] Economic studies also deals with the analysis of the duration of civil war: why some wars last much longer than others and whether the duration of conflict can be explained by the same determinants as the causes of conflict. However, this analysis requires that the start and the end of the conflict can be dated in a certain way. Often, this is not the case.

1.2 Theoretical Models

The first economist who model a framework for studying conflict in a general equilibrium setting is Haavelmo (1954) but actually the main baseline models are elaborated by Hirshleifer (1988, 1989, 1991, 1995), Skaperdas (2006), Garfinkel and Skaperdas (2007), and Collier (1998).

Hirshleifer's model is a simple model of contest based on the rational theory for thinking systematically about the elements of conflict (costly choices between production and appropriation). Later models from Skaperdas (2006) and Garfinkel and Skaperdas (2007) are more formal and complete than the first one.

The simplest model of Hirshleifer (1989) is based on the economic trade-offs that cause the outbreak of conflict by relating fighting efforts of the participants to their probability of success.

Based on the basic game theory[4] and bargaining (or rationalist) theory of war, Hirshleifer models two unitary players (a rebel group and a government) with egoistic preferences, complete information and initial endowment.

These two unitary players can both produce or predate. He assumes that each party has an initial amount of resources and plays a non-cooperative game by allocating its productive and non-productive endowment, that is weapons[5]. Hirshleifer was the first to call such endowment "technologies of struggle" from which he conceives the conflict success function (CSF) as the best combination of productive and fighting efforts: for any given combination of weapons, we can expect each player to have a certain probability of winning and a certain probability of losing[6]. Depending on the functional form of the technology function, we will have different implications for the probability.

Victory can be considered as a function of the ratio of the efforts committed, or as a difference between the two sides' efforts. Under ratio technology, a player with zero military goods will have zero success, even if the opposing player has only a negligible amount of military goods. In contrast, under the difference conflict technology, a player with zero military goods will still experience some degree of conflict success. In this latter case, the functional form will be a logistic family of curves, which is usually used when information is imperfect and there are imperfections of the "combat market". Here, greater efforts will yield battle success because there are increasing returns and the defeated side does not lose everything and zero effort still retain some positive gains. Using the ratio version, instead, zero effort implies zero success.

Following Hirshleifer (1989), the most commonly used formulation in theoretical applications is presented in equation 1, which is the Contest Success Function in the ratio of weapons form, where G_1 refers to 1's weapons, G_2 refers to 2's weapons, and m, which is always positive, captures the effectiveness of weaponry in determining the victory:

$$\mathrm{p}_1(G1, G2) = \frac{G2^m}{G1^m + G2^m} \tag{1.1}$$

[4]Game theory implies explicit or implicit game rules, order of play, available information, determination and a winner/looser. Preferences over outcomes determine players' payoffs or utilities. In a game-theoretic model we want to understand how the game will be played in order to provide the best strategy for winning. When we find the best strategy for each players, we will reach a Nash Equilibrium. The best strategy allows them to receive the highest payoff-pair.

[5]From an economic perspective, weapons can be thought of as inputs into conflict. These inputs of conflict are contributed by each party in an adversarial fashion against other parties. Instead of useful production, the output of conflict can reasonably be thought to be wins and losses.

[6]For example, rebels seldom have the option of aerial combat. The government has the airfields from which to mount such combat and its capacity to use them depends upon its financial resources.

Hirshleifer models a simple linear equation system with productive and fighting effort, and a productive technology function, which depends on productive effort. Our type of production is characterised by constant returns to scale and constant elasticity of substitution. Production function specifies the maximum amount of weapons that can be produced with any given combination of inputs under the current state of technology.

Using this framework, Hirshleifer formalizes the contest success function for both players, as a system where technology devoted to a conflict should increase with the relative effectiveness of the fighting technology.

Assuming interior solutions, Hirshleifer solves the system as:

$$\frac{F_1}{F_2} = \frac{m(E_1 + E_2)}{(F_1^m + F_2^m)} \tag{1.2}$$

where F and E corresponds to the fighting and productive function respectively, and the coefficient m is the key for choosing to fight or to buy weapons.

An increase in overall economic productivity yields an increase in the marginal profitability of producing and of fighting in the same proportion.

When we assume fixed value of the prize[7] in accordance with the conflict success function, players decide whether to attack depending on their investment. Relevant military technology does not provide advantages for attacking over defending and if both players have the same fighting function, $F_1 = F_2$, they choose peace and players will receive equally half the prize while paying for fighting costs.

Instead, if the first player chooses to improve its weapons endowment, then he will attack. Alternatively, if player 2 has improved its fighting effort, then player one will not attack and they reach a Nash equilibrium, i.e the best strategy for both players.

The equilibrium is destabilized in three cases: (i) if one player has malevolent preferences (i.e. if a player increases its fighting effort), or (ii) if there are disharmonious opportunities (the prize is not shared by the two players, but it goes only to one side) or (iii) if there are optimistic perceptions about the likelihood of winning. Hirschleifer underlines also that wrong optimistic perception might push players to fight and collapse because of unprofitably.

Following the model proposed by Hirschleifer (1995) net expected benefits from conflict influences the perception of the likelihood of a successful outcome in a conflict.

This baseline model is extended by Skaperdas (2006) by introducing some realistic war costs (such as material destruction, death, refugee camps etc) and an infinite horizon setting.

As in Hirschleifer (1995), there are two players endowed with weapons, $e_i (i = 1, 2)$, and a related probability of winning or loosing, $p_i(e_1, e_2$. This probability increases when own productive effort increases.

Fighting effort is a non-negative function and if the two players choose to fight, the expected pay-off will be:

$$V_i^W(E_1, E_2) = p_1(E_1, E_2)H_i(T_h, X_{1h}e_1, X_{2h}e_2) + (1 - P_i)H_j(T_l, X_{1l}e_1, X_{2l}e_2) \tag{1.3}$$

where W stands for war, $H_j(T, X_1, X_2)$ is a non-decreasing utility and production functions, and T_h and T_l stand for exogenous prize for the winner and loser, respectively.

According to Skaperdas's models, there is more rationale to peace than to war, because peace is always a Pareto superior solution to fighting. Only if we include a rule of division for prize of war[8] (which depends on the enforcement efforts chosen by the two groups) we can reach radically different Pareto or Nash equilibria.

[7] Hirshleifer leaves the nature of the prize unspecified.

[8] Under this rule the surplus from peaceful settlement is split evenly, while the remaining disputed resource is divided according to the players' military stocks and the conflict success function.

Skaperdas models a dynamic setting displaying a more complex and different scenario, where war can be more efficient than peace in Pareto terms.

In this new setting, he assumes that the two players are risk neutral. The expect pay-off of going to war is

$$V_i^{Wc} = p_i T + R_i - e_i - (1 - p_i)C_i \tag{1.4}$$

Players would accept any share of T that gives at least a pay-off as high as V_i^{Wc} or when marginal products β is $\beta_i >= p_i - (1 - p_i)\frac{C_i}{T}$

The higher the costs of war, the greater will be the Pareto range of division of the prize, superior to war.

On the contrary, if we assume risk aversion, players will have an expected utility function of war strictly concave and in this case, the two players will prefer to divide the prize according to winning probabilities, instead of engaging in war.

Similar output is reached when Skaperdas assumes diminishing returns of the production function (which stand for the contested resource): when we consider fighting as output, and contestable resource as an input in the production function (strictly concave), the better pay-off under civil war is the division of the prize.

Also when Skaperdas considers the reason of fighting as a function of endogenous input with decreasing returns to scale, there is a pay-off under war such that peace is better off of fighting because the output is Pareto superior to war.

When some norms are added, such as a rule of division of the contested good, they produce more equilibrium enforcement efforts and lower equilibrium pay-offs. The *ratio* comes from the fact that the two fighting groups (which are just military forces in the model) do not operate alone, but have to follow the institutional directions (namely, the government's intents). Hence, according to the norms involved, we will have radically different levels of arming.

Finally, Skaperdas considers a bargaining model in an infinite horizon setting in which, if the two groups choose to fight, there is only one winner. If, instead, they choose to bargaining, they share the war prize, but both have to maintain costs for armed peace.

In this infinite-horizon setting, if they choose war, the pay-off will be:

$$V_i^W(e^w, e^w) = \frac{\theta T}{4(1 - \delta)}, \theta \in (0, 1) \tag{1.5}$$

where θT is a share of the contested resource. This pay-off depends on the enforcement effort choice of each group, because the latter influences the probability of winning, without including costs for weapons. In each period, both players will choose the best combination of equilibrium efforts (e_1^w, e_2^w) in order to get better future resources, whose shares are β^p for player one and $1 - \beta^p$ for player two.

Hence, when future pay-offs are high, war becomes the equilibrium outcome despite its costs, especially because armed peace is much more expensive in terms of endowments[9].

A new and more complex dynamic model is formalized in Garfinkel and Skaperdas (2007), where they focus specifically on civil wars. By using a contest model with a general equilibrium framework, Garfinkel and Skaperdas (2007) show that, although peace is reasonably preferable, for a rational-egoistic individual, conflict is more suitable.

The authors consider N actors (always rational, identical and risk-neutral individuals) who participate in a 2 period game. They assume that (i) parties cannot enforce long-term contracts on arming, (ii) war changes future strategic choices (where future is *t=2*), (iii) war is destructive ($\theta < 1$) and (iv) they adopt Hirshleifer's contest success function.

[9]This is, somehow, proved by historical trends; for instance, Skaperdas (2006), gives the example of wars within Northern Italian city-states in late medieval times, that lasted for decades with tremendous costs to the participants but long-term advantage over opponents.

Since all actors are assumed to be rational, they will choose the best combination of weapons which allow them to win the war. The choice of the number of weapons increases with conflict effectiveness and the contested resources. Moreover, this choice depends on the rule of division and the destructiveness of war.

In the first period ($t=1$) each party uses its information for its own objective function and chooses its weapon endowment, while in the second period ($t = 2$) they choose whether to bargain or go to war, depending on the information they have. In the first case, they have to split the war prize, while in case of war the looser is eliminated and the winner takes the entire prize (discounted for war destruction).

In the baseline dynamic model, they assume that in the first period each side makes its weapon endowment choice and in the second period they decide whether go to war with an expected pay-off.

If in the first period there is war, then in the second period they will employ their weapons for war and no more budget is spent for endowment. Since only one winner is allowed in war, in the second period a player gains everything. If instead the two groups prefer to reach a compromise and there is a settlement, they can share the resource but they have to afford also other costs related to the armed peace and to the destruction costs.

In case of peace, both player will share the prize. For any combination of weapons F, both sides would be willing to settle only if in the long-term destruction is low and if the effectiveness of weapons is high.

From this baseline model about war in general, the authors focus on the specific case of civil war: here, actors join a group of people (representing an ethnic group or a group with shared interests) belonging to the same population and individuals do not compete each other for the prize. Actors within groups want to maximize their expected pay-off over time by maximizing the overall prize of the group. Only fighting effort of the group matters for the probability of winning, because individual's effort is not enough. Moreover, the bigger the group is, the greater will be the dilution of the prize.

In this model we can reach a Nash equilibrium in which each individual of the winning group enjoys an equal share of the prize and, by definition, has no incentive to change its strategy.

In the second period, the individual pay-off is decreasing in the size of the group. In any case, it is more advantageous to participate in war than not participate at all, because the pay-off always exceeds the zero pay-off of peace. Moreover, when one side wins the war, it no longer needs to spend budget on arms to deter future conflict, while if they settle they must spend for armed peace. Therefore, the likelihood of war is affected by parties' valuation of future gains.

The model proposed by Garfinkel and Skaperdas (2007) confirms previous theoretical solutions: in the long-run there are high interests on civil war if the short-run costs to fight are less than the long-term gains of weakening potential opponents so that they cannot pose threats in the future. In other words, in the long-run if gains are expected to be higher than costs, rebel group will choose to fight.

To sum up, when we formalize a static model, peace is the best choice. If, instead, we consider a dynamic theoretical model, war seems to be more profitable than peace, because the pay-off of war is always more pareto-efficient than peace, in which there are fixed costs to shoulder.

Other influential theoretical models have been suggested by Paul Collier. As we will notice in this review, Collier and Hoeffler are reference points in this domain, thanks to their multiple contributions, both theoretical and empirical. Moreover, studies sponsored by the World Bank on the economic aspects of civil war under the research directorship of Collier has had a profound influence on the subsequent international policy.

Collier's works (2000, 2002, 2004, 2007 and 2009) are based on the rational choice theory and economic theories of criminal behaviour.

Collier considers two groups and within each groups (rebels and government) there might be

some heterogeneity, which translates into more costs of coordination (called transaction costs in the model).

Generally speaking, Collier considers a rebel group who wants to take the power in a given State. At the same time, the State capacity is dependent upon the capacity of the government to defend itself which, in turns, is related to the potential revenue of the taxable resources needed to invest on military technologies.

According to Collier, the demand and supply of civil war depends on expected costs and benefits of conflict, including the opportunity cost of rebellion (which is a function of the probability of victory). The incentive for rebellion is an increasing function of per capita taxable base of the economy $p(T) * T$, namely natural resources, and of population (high income population has more to lose than a low income population). Collier argues also that the size of population is relevant in conflict onset, because more densely populated countries are more likely to be heterogeneous, which may generate conflicts. Hence, the gains of war are an increasing function of population as well. Since per capita taxable base of the economy (T) both reduces the probability of victory and increases the gain in the event of victory, its net effect on the risk of war is *a priori* ambiguous.

We will have revenues (R) and costs (C) during a civil war. Costs are considered as the opportunity costs of labour[10] and coordination costs. Revenue increases with fighting efforts at a diminishing rate, while costs increase at increasing rate with per capita income and the duration of conflict, excepts for the initial costs which are considered as fixed, such as those associated with the start up of the rebel organization. Hence, the probability of rebel victory, p, would be diminishing in T and the probability of war is diminishing in both the expected duration of conflict (D) and the per capita income of the population (Y).

Collier starts by modelling the probability that the conflict has a mortality rate that exceeds 1000 battle-deaths[11] and assumes that rebels receive a wage. Wages for rebels depend on ethnic fragmentation[12], on the value of natural resources exports and on income from natural resource exports.

At the same time, government defends itself. State gets its endowment from taxation and natural resource exports. In this model, taxation is an increasing function of GDP and a share of natural resource exports. Moreover, since rebels are seen as predators, it is assumed that the more a State is rich in terms of natural resources[13], the more the government needs to protect itself from predation of rebels.

Given this framework, rebels must face a government which has always more probability to win[14] .

In particular, a civil war will occur if we stochastically solve the equation:

$$a * p(T) * T + b * P - c * D - d * Y - e * C > \eta \tag{1.6}$$

where p is the probability of rebel victory, G is the gain of the war, T is the taxable capacity of the economy, P stands for population, D is the (expected) duration of the conflict, Y is per capita income, C is costs for rebellion and r the discount rate.

Equation 1.6 implies that when rebels estimate their gains from war, they will take into account duration and related costs. There will be a specific duration of war in which rebels find

[10] In the applied model Collier and Hoeffler (1998, 2000) use per capita income as proxy for costs.

[11] This threshold has been chosen because the conventional definition of civil war implies 1000 deaths (Correlates of War).

[12] They hypothesize that more diverse societies are less likely to experience civil war.

[13] In the empirical models, Collier uses as greed proxies also primary commodities, diasporas, low earnings, human capital, and dispersed populations, which all result to be positively correlated to the outbreak of civil conflict, suggesting support for the "greed" hypothesis.

[14] Because a government can always rely on taxation and legal revenues from natural resources exploitation. Rebels, on the contrary, needs to guarantee a minimum degree of financial viability which exceeds a critical value for survival, relative to government forces.

an acceptable price for victory. The observed duration of civil war will be an increasing function of $p(T) * T$ and P, and a decreasing function of Y and C. They show that the occurrence of war depends on the strength of the government (in terms of expenditure for defence) and on the ability of rebels to steal natural resources. The more rebels steal natural resources, the more they grow in size and increase their possibility to win. At the same time, government's strength depends on natural resources, so in Collier's model, big quantity of natural resources reduce the risk of civil war.

To sum up, in Collier's theory, rebel groups will start a war only if their fighting effort is equal or bigger than State's strenght, if the final prize is big enough to compensate war costs and if per capita income is low.

This approach will generate the Greed Theory, which will be discussed and criticised in the next section.

1.3 Determinants of Civil War

There is an extensive empirical literature on the causes of civil war. Both cross-sectional and panel data estimation have been proposed.

Conflict studies include variables from different datasets, because several social, geographical and institutional issues are taken into account. Many of these variables do not change over time and the dependent variable (conflict onset) is a dichotomous variable, that is why usually non-linear models are applied. Also ordinary least squares and panel model with fixed effects are sometimes used.

Depending on the dataset, on the definition and on the model, we obtain different estimates of effects on the likelihood of civil war. For this reason, we have structured main results in six macro-areas: in the first one we deal with the economic determinants; in the second section we discuss the effects on civil war of social exclusion processes. Here, we will discuss different causes of social exclusion, such as frustration related to working and social condition, inequality, ideology and psychology. These issues lead us to the successive section, regarding the role of institutions, especially if weak; in the fourth section we will cover the role of ethnicity and religious groups; then we summarize main studies on the relationship between civil war and natural resources; finally, in the last section we report some methodological and data issues advanced in literature.

The literature review regards only cross-country and panel data. We will underline drawbacks and limits of each macro-area, also by making use of examples from specific countries. Cross country and panel data studies try to find out a general rule of the world, on the contrary, we cannot make general statements from case studies, because of course they are related too much to country specific experiences. However, we can receive new intuitions from current world dynamics to improve theory and models. Therefore, we are aware that cross country and case studies are very different (both in terms of theory and in econometric models), but these examples will be used to clarify my critiques with the main goal of suggesting new efforts for future cross country research.

1.3.1 Greed versus Grievances

As showed in the previous section, theoretical models are based on game theory, where utility functions and profit maximization are included. From this framework, much emphasis is given to economic factors (i.e. high poverty and slow economic growth) as key determinant of civil war outbreak in economic literature. This finding has proved to be robust in several econometric methods and time periods (Berdal and Malone, 2000; Collier, 1999; Collier and Hoeffler, 2004; Kang and Meernik, 2005; Elbadawi, et al. 2008; Grossman, 1999; Blattman and Miguel, 2010; Fearon and Laitin, 2003; Hegre et al., 2001; Collier 2007) and when we move to an instrumental

variable approach, as showed by Miguel et al., 2004 who instrument economic growth with rainfall variation.

One of the main upholder of the economic motivation is Paul Collier. Collier has become very influential in this field thanks to his theory of greed, based on the game theory; as we have seen in the theoretical section, Collier (2006) argues that civil wars occur only if rebel organisations are financially viable, because rebellion is seen as a large-scale predation of productive economic activities[15]. According to his framework, grievances are not important, but only opportunities to raise revenues matter for the conflict onset. Moreover, volunteers who seek to join the movement with genuine and altruistic reasons, will increasingly be drawn from those with criminal and lucrative intents. Collier and co-authors have published several empirical studies in which they estimate the probability of conflict onset, given the theoretical framework explained before.

Collier and Hoeffler (2000) summarize their starting point by saying that "rebellion is a type of theft which attracts and involves entire communities". According to this view, this criminal behaviour leads to a conflict trap: a situation in which a country is locked into a syndrome of further conflicts, caused by different reasons that exacerbate hostilities. Strong evidence related to the conflict trap theory is given by Collier and Hoeffler (2004), Hegre et al. (2001), Bleaney and Dimico (2011) and Hegre and Ranveig (2011). The latter use simulation tools to assess how the outbreak of conflict tend to affect the risk of future conflict in the same countries, its neighbourhood and globally. Bleaney and Dimico (2011) show that the risk of conflict in a year is substantially higher if a country has had previous conflict. Fearon and Laitin (2013) extend this view showing that a territory who experiences either civil war or interstate war before 1945 is not more conflict prone afterwards, but having experienced more extra-State war (imperial or colonial war) before 1945 is fairly strongly related to having more armed conflict. Hence, according to the conflict trap-greed theory, not only greed justifies rebellion but can bring people into a dramatic cycle.

Although economic determinants of war are considered as crucial by almost every study, many scholars criticize the greed theory, by suggesting a less pessimistic point of view (Keen, 2012; Nathan, 2005; Ballentine and Nitzschk, 2003; Cramer, 2008; Bensted, 2011; Suhrke et al., 2005)[16]. In the following lines we will summarize these alternative viewpoints and we will explain the reasons why we criticize the Greed Theory.

First of all, we cannot study civil wars without taking into account the community involved and its relational network. Keen (2001) suggests that, instead of focusing on the distinction between greed and grievance, a more useful focus for research is to see how the greedy manipulate the grievances of others.

Following this line, we should distinguish determinants of civil wars from the interests emerging from the war itself. Therefore, during a civil war we have rebels and warlords[17]; warlords are everyone who is able to profit from a conflictual situation, by building international and local networks with politicians, companies, mafias and so on. Warlords are a mixture between politics and businessman in this global world[18](Duffield, 2004).

[15]Collier shares the argument of Grossman (1999) who states that in such insurrections the insurgents are indistinguishable from criminals.

[16]This debate might remind of the quarrel between Hobbes and Locke. Namely, Hobbes had a pessimistic anthropological view, where humans are rational and wicked by definition. Starting from a Cartesian approach -where emotions, customary behaviours and history are not included into the political analysis- according to Hobbes, life is a keen race toward the highest benefits (*homo homini lupus*). On the contrary, Locke looked at humanity as good animals able to live in peace through natural law, i.e. certain moral truths that can be discovered by reason alone and applied to all humanity.

[17]Duffield (1998) defines a warlord as a leader of an armed band who can hold territory locally and at the same time act financially and politically in the international system without interference from the State in which the warlord is based.

[18]Africa is the continent in which warlords have found the largest profits, in fact the most famous warlords are from Africa: Charles Taylor in Liberia, Joseph Cabila in Congo, Paul Kagame and Bosco Ntaganda in Rwanda, Jonas Savimbi in Angola, Foday Saybannah Sankoh in Sierra Leone, Joseph Kony and Wedi Amin in Uganda,

The greed theory does not explain the cause of civil war, rather greed is an instrument for some actors interested on profiting from instability. This is not to say that there are no economic activities run by rebelling groups during the civil war for personal gain or to feed their war machine[19]. Moreover, often rebel leaders who start the fight with genuine reasons are then bewitched by money and power. This leads to corruption and new wardlords. Hence, greedy people exist and do get rich during and after a civil war[20]. However, we cannot give a crucial importance to these greedy people, because civil war would probably break out without them, anyway. Following this view, a conflict trap may occur but because there exist wardlords who do not want the war to end.

To make clearer the concept, we give an example from a case study: in south Nigeria, where are concentrated many natural resources. Local communities do not support this industry because they rely on agriculture and fishing, which are deeply affected by the pollution of oil extraction. For this reason, since 1980 there is a civil war among rebels[21], the State and oil companies. From a side there is an asymmetric civil war between these three forces, at the same time there are several other hidden actors which profit from this situation, such as: (i) the private military firms (or the private military companies, or the private security companies) that provide military support and protection to the (western) workers and to the factories (Pagliani, 2004); (ii) the corrupted politicians who profit from briberies; (iii) and businessmen who illegally sell the oil in the black market (Gugliotta, 2008). Of course, rebel groups (and local communities who are forced to migrate to other territories) want the end of this conflict but all the other actors involved are interested in the continuation of the conflict, because they obtain private gains (Pepino, 2009; Baffoni, 1997; Deriu, 2005).

This example[22] makes clear a crucial issue: civil war breaks out because of real social reason(s) but it is perpetuated by others with economic interests[23].

Meanwhile, the everyday life in villages is completely threaten and jeopardised by civil war: agriculture and livestock cannot be arranged because it is very dangerous to work in countryside during a civil war and also there might be an assault forcing everyone to move, or worst to die; schools are destroyed or closed, so that children do not have any solution but to wait for a turn-point or join an armed milita; streets and infrastructures are vulnerable to weather and war because no public works is provided.

This is sharpened by the fact that the new conflicts are no longer managed by a State. Often the State does not provide enough financial resources to the army[24], but in parallel companies and government have launched a new generation of conflicts, where private or public-private

---

John Garang in Sudan, Aidid e Madhi in Somalia, General Butt Naked in Liberia, Sani Abacha in Nigeria, Musa Hilal in Sudan, and many others. All of them are a consequence of the colonial period and profit from an unstable situation created and sharpened by internal wars.

[19] Quoting Engels, "the economic situation is the basis, but the various elements of the superstructure also exercise their influence upon the course of the historical struggles, and in many cases preponderate in determining their form (Marx-Engels Correspondence, 1890).

[20] After all, quoting Clausewitz (1832) "war is not merely an act of policy but a true political instrument, a continuation of political intercourse carried on with other means".

[21] There are several different rebel movements, each one with its own strategy. Among them, the most involved are: Niger Delta Peoples Volunteer Force (NDPVF), Movement for the Emancipation of the Niger Delta (MEND) and Environmental Rights Action/Friends of the Earth (ERA).

[22] The example of Nigeria is not a *sui generis* case, because the origin of turmoil is sometimes positive and represents the willingness of local people who want to build their own institutions for self-defence and self-government.

[23] Another telling example is the case of the famous warlord of Liberia, Charles Taylor: he recruited his militia among the marginalised youth who were frustrated by their poor condition and by a failed State which was supposed to be the heaven of ex African slaves. Meanwhile, Taylor developed an international trade of diamonds and timber with western firms. In particular, in 1990, Taylor was France's third largest supplier of tropical hardwoods and, in return, he receives weapons and small arms to start his war (Duffield, 1998).

[24] So that soldiers are actually unable to face armed militias or attacks to villages. This is a long-lasting problem in developing countries in general and in Africa in particular. In fact, when the State does not support the army, it creates a risk for corruption, defection, mutiny and violence against civilians.

organizations work together. For example, in Africa there are 5939 private organizations involved in the provision of military support to the State or to private companies. Only the Gran Lake Trading 46, a South-African company, employs 1500 mercenary soldiers (Pagliani, 2004) aimed at protecting the trade from Africa to other continents. Hence, a civil war is local and global at the same time (Deriu, 2005).

The most striking example of global-local conflict is what we are facing over the last years: Daesh is the most terrifying and organized group able to recruit people from western countries. It could be argued that those terrorist groups are motivated by greed and lust of power but, actually, once again, there are several anthropologist who argue much more complicated profiles of them. At the same time, it is also true that Daesh is involved in business activities. They gain around 50 million dollars from selling oil and we do not know how much they gained from the selling of artefacts from Mesopotamia region (Fiori, 2016).

Generally speaking, there is considerable variation across conflicts in the ways that rebel groups operate in the economy. Most insurgent groups do not have war-fighting capital (troops and weapons); in many cases they are small groups and rebels need to finance their struggle, with little budget. Sometimes they act as economic producers, providing public goods (for example, in Uganda Yoweri Museveni[25]). Sometimes however, they act as extractors (example: Boko Haram and Daesh); some others receive local support (for instance the Mayi-Mayi in Congo[26]).

If we underline these aspects, the greed theory becomes less short-sighted and this leads one to think about public policies which can tackle both the real needs and problems of people, and the private interests of greedy people. We cannot consider warlords and poor people as the same. Of course they both exist. At the same time, we should be careful when we state that civil war breaks out because of greedy people. Civil wars break out because people feel some injustices and want to change their material conditions. The relationship between greed and civil war is reverse: entrepreneurs of violence take advantage from grievances to come in the business of warfare for gaining power and market opportunities.

1.3.2 Ethnicity and Religion

The economic literature has shown contradictory results regarding the role of ethnicity on conflict onset; for example, Fearon and Laitin (1996) argue that ethnicity in Africa has a key role in terms of resilience and community cooperation but does not affect conflicts, while Collier and Hoeffler (1998) argue that ethnically polarized countries face high risk of conflicts. The authors suggest also an inverted-U relationship between ethno-linguistic homogeneity and wars in Africa. This has been supported by Bates (1999) who studies specifically the case of civil wars in Africa and by Montalvo and Reynal-Querol (2002, 2005). Reynal-Querol has created empirical indicators of polarization to show that while ethnic fragmentation is an insignificant factor, ethnic polarization affects the onset of civil war. This argument follows along the line of work by Ellingsen (2000), Barrows (1976), Cederman and Girarding (2007) who find a consistent impact of ethnic fractionalization on wars in Africa. At the extreme opposite side, Schlichte (1994) proves that ethnicity is not a crucial factor in conflicts.

There are other concerns related to the ethnicity. For example, Francis (2006) underlines the relationship between civil war and the politicisation, exploitation and manipulation of ethnicism by the political elites and governing class. Before colonization period, many African groups were open-minded toward other cultures. Despite some differences, they succeeded to live together

[25]Yoweri Museveni's violent takeover of the Ugandan State organised citizen councils that became the basis for strong postwar administration; Other examples are, Islamic Courts in Somalia; IRA in Ireland; EPLF in Eritrea; Maoist in Nepal

[26]In the case of the Mayi-Mayi in the Democratic Republic of Congo they were a low-tech, low-cost but long-lasting rebel movement against the Rwandan invasion; or the Chechyan rebels; or the Viet Cong; the IRA; or the case of Kurds who are spread around Iraq, Afghanistan, Syria and Turkey but they all fight for the same reason as part-time militant.

in peace. The most evident case is Nigeria: nowadays, Nigeria is split in two competitive regions. Before colonization, current Nigeria was inhabited by several different ethnic groups. When a conflict occurred, it was solved through religion (from Middle Age, 90% of Nigerians were Muslim), or through mixed marriages. Another unifying ingredient was language: they were even able to reach the unity through a common language. In Nigeria, thus, there was not a conflict-attitude, rather people preferred to evolve toward new structured organization in which different cultures were mixed. When England colonised Nigeria, the British introduced Christianity which fragmented Nigeria's unity (Fortuna, 2016). As a consequence nowadays we cannot even imagine the Nigerians as inclusive people, since its longlasting and virulent conflict between Muslim in the North and Christian in the South[27]. The Global Terrorism Index ranked Nigeria as the world's third-most terrorized country, because of Boko Haram and the North-South armed conflicts. Similar case studies are the case of Rwanda genocide and the separatist movements in Somalia. In Rwanda Hutus and Tutsis speak the same language and share the same territory and cultural traditions. Similarly, Somalia is unique in terms of its ethnic homogeneity: people share the same ancestral origin, language, religion, culture and nomadic heritage. However, Rwanda lived one of the saddest period of human history and Somalia is a failed State with longlasting internal conflicts. These case studies are coherent with results from Reynal–Querrol (2002) who finds a relationship between ethnicity and religion; in particular, Reynal-Querrol proves that polarized religious cleavages are positively correlated with the prevalence of ethnic civil war.

Another aspect concerns the link between religion and conflict. Iannaccone and Berman (2006) explain that when governments are poor providers of social services, then strict religious groups can leverage their ability to produce collective goods for group members into the production of violence. A religious group able to produce club goods can use the same mechanism to enforce the discipline necessary to institutionalize violence. Berman (2009) cites evidence that religious groups are more successful in their terrorist acts than secular organisations and he attributes the finding to a religious organisation's effectiveness in limiting defection (as in Somalia with the Islamic Courts).

As mentioned before, nowadays we see terrorist movements like Daesh, Al Shabaab, Boko Haram, Al-Qaeda, who use the pretext of religion for spreading terror around the world. Of course, each of them has different purpose and strategy (namely, Al Shabaab is a result of the US war against terrorism[28]; Boko Haram represents the conflict between South and North in Nigeria; Al-Qaeda[29] was founded in 1988 when the Soviets withdrew from Afghanistan with the final aim to create a Sunni State and to include Islamist struggles in other parts of the world; Daesh, to conclude, born in Iraq after Hussein's overthrow and has a similar purpose: to create a caliphate, i.e. a federation of Islam). Atran (2015) claims that Daesh (but we can extend this analysis to other extremist Islamic groups) is simply the manifestation of the will of every religious group; they are the first ones who have been able to organize their fight strategically,

[27] This conflict which, has never exploded into a proper civil war, is, however, pretty bloody and the potential is there for radicals to exploit the conflict, but its roots are not primarily religious. Particularly, the Middle Belt is the Nigerian region which mostly suffers this conflict. The area was historically Christian but before Nigeria's independence in 1960, the British opened up tin mines and invited Muslim Fulani, the biggest tribe in the north (which is considered the largest nomadic ethnic group in the world) to work there. Because the herdsmen are largely Muslim and the farmers are mostly Christians, since 1999, bigger herds of cattle have been encroaching on greater parcels of farmland and often the Middle Belt lives bloody and terrifying armed conflicts (there have been even acts of cannibalism). An investigative committee set up by the Nigerian government found that between 2001 and 2004, as many as 53,787 individuals were killed as a result of this conflict and in 2014 alone, at least 1,229 people were killed by Fulani herdsmen, according to the latest Global Terrorism Index.

[28] Al-Shabaab is an offshoot of the Islamic Courts Union (ICU), which splintered into several smaller factions after its defeat in 2006 by Somalia's Transitional Federal Government (TFG) and the TFG's Ethiopian military allies. TFG has been created in agreement with the African Union and Western countries, after the collapse of Somali Republic. However, Al Shabaab has never recognised this government and foreign presence in Somalia. Since 2006 this extremist group has been spreading terror in Somalia.

[29] Allied with Al Shabaab in the Horn of Africa, since 2010.

in order to (try to) reach their purpose. Others (Albanese, 2016), instead, claim that their main aim is to change the Sykes-Picot world organization, and to answer to the western aggression against international Muslim community. According to the author, their focus (especially Al Qaeda and Daesh) is not only to create a clash between different cultures, but also to erase the colonial setting of the world.

These terrorist movements can profit from a generation of cultivated people who do not find job in western countries and are looking for a meaning of their lives (Atran, 2015). Once again, the terrorism is not the cause but the consequence of deep and long-lasting grievances which are not listened by governments.

Ethnicity and religion issues have been debated for long time by scholars but there is no agreement. Of course, if we take a look at the history, we can observe that the majority of multi-ethnic countries have not degenerated into civil war. Therefore, we might suppose that what may superficially appear as ethnic conflict is in reality a complex conflict, rooted in the political, socio-economic and historical context of the polity.

For example, the ethnicity issue is often strictly related to commodities management because a strong ethnic group can profit of its power to gain high revenues, legally or illegally. This concern has been studied by Esteban and Ray (1994, 1999) who find that resources polarization owned by single group brings more easily to conflict. These findings will be examined in the following section.

1.3.3 Natural Resources and Geo-Political links

Natural resources are considered as key indicator for conflict onset and duration (Berdal and Malone, 2000; Ross, 2006). Amongst many, oil is one of the most statistical significant and main problematic determinant[30]. Most of economic studies deal with this issue as an ultimate purpose of rebellion or as means to sustain the rebellion. However, natural resources create grievances because of a lack of redistribution of gains from natural resource-exploitation, or because of Dutch disease. In Africa it is very usual that the extraction of a commodity, such as for example gold, is not particularly remunerative for locals, because the resource takes on particular value when it is embroidered in other continents.

Collier and Hoeffler (1998, 2004) were the first to show that the dependence on natural resources and the risk of civil war are positively correlated when the level of dependence of a State on natural resources is low (or negatively correlated when the level of dependence is high). Collier and Hoeffler (2004) empirically find that natural resources endowment and primary commodity exports have a non linear effect (up to 32% of exports to GDP ratio, conflict is more likely; after 32%, a substantially lesser risk is observed) and production and exports of oil dependence brings high risk of conflict. This is more acute if pre-conflict political repression is severe. Ross (2003) confirms these results for war (over 1000 deaths) and resource dependence, but not when using other lower conflict thresholds. Moreover, Hegre (2004) shows that democracies with low primary commodity dependence have a lower probability of civil war than autocracies and inconsistent regimes with low primary commodity dependence.

Nevertheless, contradictory results have been found by Ross (2004), Humphreys (2005), Elbadawi and Sambanis (2002), Brunnschweiler and Bulte (2009), and Cotet and Tsui (2010). Ross (2004) replicates Collier and Hoeffler's study using a different dataset and finds different and mixed results. Also Sambanis (2004) argues that Collier and Hoeffler use a no proper proxy of resource dependence (the ratio of primary commodity exports -included agricultural commodities- to GDP). According to Sambanis, Collier's interpretation should be that a country should diversify its economy in order to reduce the risk of civil conflict.

[30] Of course also other natural resources affect the likelihood of civil war. Notwithstanding, oil concerns not only the injustice but also environmental damages which amplify grievances over the resource, because communities ask for redistribution of profits and remediation of natural disasters from oil extraction.

Following this critique, when we study the causal relationship between natural resources and conflict, we have to take into account that, usually, natural resources are located into specific zones. Thus, when we make a country-year analysis, we make strong assumption in relating the country-level conflict with natural resources. In fact it is easy to see that very few conflicts extend throughout the entire country. The whole country is affected by the conflict only when the rebelling group succeeds to gain the power, like the case of The Alliance of Democratic Forces for the Liberation of Congo-Zaire (AFDL), The National Union for the Total Independence of Angola (UNITA), The National Resistance Army (NRA), The National Patriotic Front of Liberia (NPFL), Revolutionary United Front (RUF) and Resistência Nacional Moçambicana (RENAMO) (Raleigh and Hegre, 2005).

For example, in the south of Nigeria, there is a civil war among local people, the State and multinational oil companies. This conflict does not affect at all the rest of the country which ignores what is going on Niger Delta and has other kind of internal conflicts (namely, Boko Haram and ethnic conflicts[31]). Recently, data banks have begun to provide GPS informations related to conflicts; this tool will help us to enhance our analysis by doing punctual studies (Harari and La Ferrara, 2013).

Moreover, when we deal with developing countries and natural resources we have also to keep in mind that the majority of natural resources are sold in developed country[32]. Often, even the management and extraction of natural resources is run by multinational companies, so that internal conflicts related to natural resources should be studied taking into account the role (and so the interests) of those actors[33].

Therefore, we can assert that natural resources seem to be related to the "revisited" greed theory: usually, armed groups are financed and politically supported by corrupted politicians[34], governmental forces and economic powers[35] (Sambanis, 2004). Often, economic resources and agendas create an environment for illegal business practices and commercial opportunities for a vast array of actors and entrepreneurs at local, national, regional and international levels[36].

Sometimes, small groups of poor locals are engaged in the research and/or extraction of a particular commodity. When price lowers or the resource becomes rare, these groups start to fight each other, trying to win the remaining market. This poor context, together with the widespread presence of weapons, leads to armed conflict which can implicate related villages

[31] In Nigeria the horrific Biafran Civil War, for example, was not related at all with the South of Nigeria, but rather was much more related to the English tactic of supporting ethnic groups in order to weaken and divide nationalist opposition to colonial rule.

[32] The most unknown and striking example is the illegal market of animals: it is estimated that only from Africa, there is an international business of about 20 thousand million dollars per year, while the legal market is around 160 thousand million dollars. These exotic- and very rich- products are sold to China and Singapore for traditional medicine, for high fashion, and jewellery (Fiori, 2016)

[33] For instance, it is well documented (Harden, 2001) that the bloody conflict in Congo has been financed by multinational companies interested on the coltan (which is the fundamental input for any technological object, from computer to phones).

[34] Africa presents 9 out of 15 long-lived president of the world (Ballarini and Zordan, 2016) and out of 28 governments, 18 are seen as completely failing to address corruption (Africa survey 2015 – Global Corruption Barometer).

[35] For instance, a striking case is Congo in which civil war is completely alimented by economic interests managed by international powers. Ethnicity is instrumental to those forces which have no reason to make the war end. In particular, the role of France, USA, China and Lebanon is fundamental in this war: France supports Hutus in order to maintain its power over the region of Big Lakes; USA supports Hutus to have a partner against Islamic terrorism and for the control of Big Lakes; China is the most important commercial partner of Congo for its natural resources; Lebanon is another commercial partner for natural resources, in particular uranium. (Touadi, 2016).

[36] Among many examples, Niger is an interesting case because it is considered by international community as a strategical partner against illegal trafficking of migrants. The high representative of the Union for Foreign Affairs Mogherini has claimed in 2015 that European Union will do its best for stopping the illegal market of migrants who come through Niger. Though, in Niger politicians, businessmen and soldiers have built an international network of illegal market of cocaine from South America, cigarettes made in China, weapons from Russia and oil from Nigeria (Raineri, 2016).

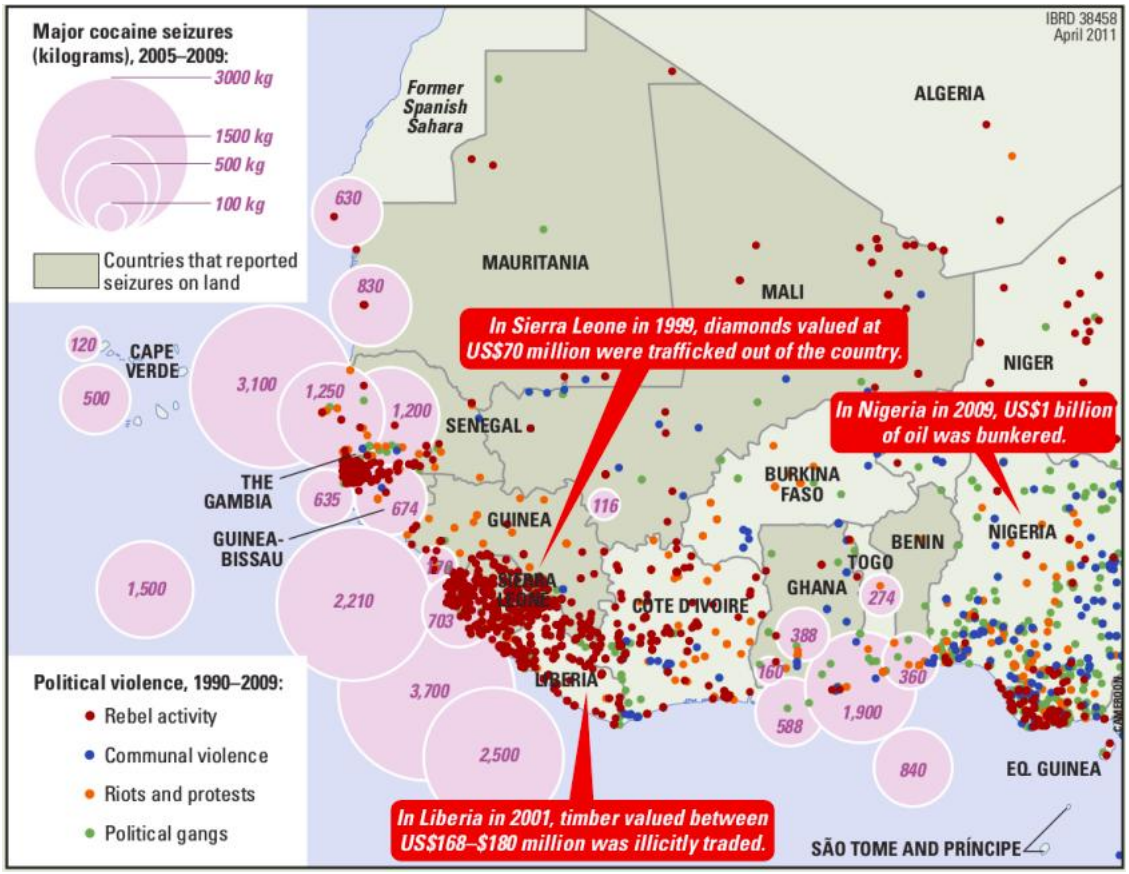


Fig. 1.1: *Trafficking and violence during conflicts in West Africa, 1990–2009*
Source: Conflict data are from Raleigh and others 2010 ACLED database (Armed Conflict Location and Event Database), seizure and trafficking data are from UNODC 2010a; WDR team calculations.

(Masto, 2011).

Hence, natural resources have a crucial role in the conflict onset and duration. Usually, economic analysis underestimates the importance of grievances related to natural resources; we have cited problems regarding soil pollution, working condition in mines, the killing of animals for luxury goods and so on. All these cases create longlasting and severe sources of disappointment and poverty in local communities which are usually not properly addressed by governments. As many scholars argue, natural resources are one of the main interest of armed groups both to finance their fight and to get richer, but we cannot ignore other important cases where people start to fight to protect their natural resources wealth.

1.3.4 Institutions and Weak States

In Africa, institutions are still related to ethnic roots which determine the behaviour of families and communities. In literature, the weakness of institutions is one of the most debated cause of conflict onset (Goldstone et al., 2010; Sawyer, 2004; Ngaruko and Nkurunziza, 2000; Azam, 2001; Addison, 2005; Ndikumana, 2005; Hirshleifer, 2001; Calipel, et al., 1996; Gates et al., 1997; Handerson and Singer, 2000; Collier and Rohner, 2008). In fact, as Blattman and Miguel (2010) claim, the institutional legacies of conflict are arguably the most important but least understood of all war impacts.

Both cross-country and case studies highlight the vulnerability of States with weak institutions to civil war. In particular, anocracy or non-perfect democracies (i.e. societies which

allows some rights while making deep social control) have emerged as countries with high risk of conflicts. This is due to the partial freedom to organize (violent) collective action (Gates et al., 1997; Hegre, 2001). Sambanis (2004) shows that in case of rebellion repressed by a strong State, terrorism can grow by worsening the conflictual situation. Gurr (2000) and Reynal–Querrol (2002) argue that political grievance is the primary motive for civil violence. In particular, it is shown that in non-democratic States, ethnopolitical groups are more likely to use rebellion than protest. Moreover, Reynal–Querrol (2002) shows how different types of political system can influence civil war risk.

Other researchers, like Fearon and Laitin (2003), find out that war is engendered by a mix of weak central governments and environmental conditions favouring insurgents. In particular, they estimate that conditions like rough terrain increase the likelihood of civil war, especially because (weak) governments cannot control inaccessible zones. According to them, rough terrain is, after income, the most important determinant of civil war onset[37]. In other words, the State does not have the capacity to enforce the law, to discourage the formation of rebels group or to build an army to impress the rebels. On the other hand, Collier and Hoeffler (2004) interpret the result as being due to a weak opportunity cost of fighting faced by potential rebels, which favours rebel group recruitment.

In the case of democratic regime, Hegre (2004) has found strong and robust correlation with peace, but only for middle and high-income countries with high levels of literacy and education. Conversely, Hegre (2004) finds that the risk of civil war decreases with economic development only in democratic countries.

In contrast, Henderson (2000) and Miguel et al. (2004) do not find any statistical significant role in regime type, whether democracy, anocracy or dictatorship.

At the same time, there could be a regional dependence; for instance, in the case of Africa the concept of State has always been hard to assimilate (Strangio, 2010, 2012; Calchi Novati and Valsecchi, 2005; North and Douglass, 1993; Henderson, 2000; Touadi, 2016). Therefore, to the Africans is a hard job to understand the role of a State and its governance over a country. This means that often in Africa there is no perception of democracy and democratic rights simply because government appears in countryside only before elections. This difficulty might influence also the eventual outbreak of civil wars. Notwithstanding, it is very difficult to estimate the relationship between the perception of State and the onset of civil wars.

Usually empirical works employ regime type but do not control for quality of the regime, which is crucial. Africa ranking about corruption performs very bad and, according to the Global Corruption Barometer, corruption is increasing over time. When a democratic regime with a corrupt government does not invest public spending in the well-being of its population, in turn this increases poverty and exclusion and so the likelihood of conflict increases as well.

1.3.5 Social Exclusion

Institution quality is strongly related to social exclusion. There exists several social exclusion typologies[38] that can trigger a conflict outbreak (unemployment, frustration, injustices, psychology, ideology and inequality).

The relationship between unemployment and civil war seems to be pretty simple: when a large share of active populations is unemployed, there is more enrolment in rebel movements

[37] Other results prove that countries at war have slightly lower forest coverage (29%) than peaceful countries (31%) (Collier and Hoeffler, 2004). However, countries in war have, on average, 25% mountainous territory compared to a 15% average in peaceful countries (ibidem). Coherently, Buhang and Gates (2002) also report inconclusive results when relating rough terrain to the scope of conflicts.

[38] Generally speaking, these include: social marginalisation, new poverty, democratic legal/political exclusion, non-material disadvantage, exclusion from the "minimal acceptable way of life", cultural exclusion (including race and gender), exclusion from family and the community, exclusion from the welfare State, long-term poverty, exclusion from mainstream political and economic life, poverty, State of deprivation, detachment from work relations, economic exclusion, and exclusion from the labour market (Peace, 1999

where they receive wages in order to improve the quality of their lives. So guns seem to be the easiest answer to the lack of job.

Collier and Hoeffler (2003) study the relationship between unemployment and risk of conflict. The authors explain this relationship in terms of opportunity cost (the less income opportunity young people have, the more they find opportunity costs to join the rebellion). This result is supported by Cincotta et al. (2003) who demonstrates that in countries with the 40% of young adults and absence of employment, opportunity or constructive activities, are more conflict prone because young congregate in gangs that may evolve into politically mobilised insurgencies[39].

However, the opportunity arguments may be an incomplete explanations for civil war (Fearon, 2011); as Kuran (1989) argues, there are a number of individuals who are sufficiently motivated by their common interests to get a rebellion started.

Probably, the truth lies somewhere in the middle: in fact, if we combine these econometric works with psychological and historical studies, we can discover that the recruitment of rebels is not always done by their own choice. Often, people are forced to join a guerilla and they receive a shock therapy which transforms them into cruel executioner who do not kill for any rational reason, but just because they belong to a group in which the more you are wicked the more you are accepted by the group[40] (Atran, 2015). Neuropsychiatric science has proven that human brain receives positive stimulus when you belong to a group in which what you do is approved, even if you are going to fight knowing that you will die. Nevertheless, already Darwin (1871) proved that those who belong to a group share a morality, brotherhood and fidelity that make them feel stronger and able to do everything. Similarly, in the Leviathan, Hobbes (1651) explains how a spiritual ideal can motivate someone to do the ugliest things in order to give a meaning to its life.

Other reasons (which is the case of nowadays recruitment of foreign fighters) are those related to the frustration and the feeling of impossibility to change our lives[41]; in this case, several people (especially the young ones) are inspired by the promised glory and esteem of jihad which is a thrilling motivation because it is egalitarian and equal-opportunity employer (Atran, 2015). According to Atran, often executioners are moved by a sort of sublime à la Burke; this means that they do not receive any brain washing or shock therapy. They are fascinated by what is perceived as horrific because it is felt as sublime and gives a meaning to their lives. Although terrifying, those foreign fighters are young people who suffer from distant States that do not address ordinary-people troubles and they find their "rebel" voice in these extremist groups (De Georgio, 2016).

In our perspective, we hypothesize that if a person takes up arms and risks his/her life, it is because he/she has proper reasons, probably resources and, of course, no alternatives to violence

[39] These results are confirmed also by some theoretical models, such as Weinstein's (2005) model of rebel recruitment which suggests that in absence of wages, where there are opportunities for large gains, the composition of the rebel group will gradually shift toward those with a motivation for private gain: the rebellion experiences adverse selection in motivation.

[40] As in the case of Talibans in Afghanistan - in 2012 United Nations Assistance Mission in Afghanistan (UNAMA) observed that, among other things, there was an increase of conflict-induced displacement from Western Afghanistan due to forced recruitment-, or the sadly and popular case of child soldiers (UNAMA, 2016). Namely in 2015, Afghanistan, Central African Republic, Democratic Republic of the Congo, Iraq, Israel and State of Palestine, Lebanon, Libya, Mali, Myanmar, Somalia, South Sudan, Sudan, Syrian Arab Republic, Yemen, Colombia, India, Nigeria, Pakistan, Philippines, Thailand still force children to join armed groups. The European Asylum Support Office (EASO) recognizes that children are especially vulnerable to recruitment.

[41] In 2016 Child Soldiers International interviewed more than 150 former Congolese girl soldiers who explained that they joined armed groups to be able to pay for schooling, and most said that being in school promotes their social acceptance and reintegration into the community once they come back (Child Soldiers International Report, 2016). Similarly, in France it has been run a survey in which it emerges that 1/4 of the people between 18 and 24 years-old, have a positive consideration of Daesh's values. After the Paris attack in 2015, this survey has been reproduced and they found that a large part of the young living in suburbs share the values of Daesh (Atran, 2015). I had the opportunity to meet two ex Daesh fighters from Tunisia who explained me that the majority of young Daesh militant are motivated by rage and economic possibilities.

(Ohlson, 2008; Atran, 2015). Following Dunne et al. (2006, 2013, 2015), Holsti (1996), Herbst (2000) and others, it is here argued that legitimacy is a critical variable when attempting to explain the relative weakness and strength of States. If people do not recognise anymore the State as representative actor, they will perceive to have the right to self-determine their will. Thus, the wider this gap becomes, the greater the risk for intra-State violence is[42]. How can we amaze about a social community that takes up arms to protect their lands, resources or history? Of course, in the best of all possible worlds, we would prefer other tools than weapons, but we have also to be intellectually honest and recognize that sometimes we have no other choice.

As highlighted by Sambanis (2004), ideology and psychology cannot be ignored as explanations of civil war. To support this idea the author gives the example of the civil war between Ireland and United Kingdom, where each Irish person was outraged with the State but only people who faced mostly the injustices turned to violence. The argument claimed by Sambanis underlines the fact that only those who most suffer injustices are really motivated to take up arms[43]. This topic is related also to the inequality issue, which is another concern for civil war onset.

Collier (2007) yields results against the importance of both vertical and horizontal inequality (inequality between groups with ethnic[44], religious or linguistic ties) which, to him, are statistically insignificant.

However, we should not ignore spatial variations in socioeconomic welfare (Hegre et al., 2003, 2009; Sambanis, 2005; and Stewart, 2002, 2004). For example, the idea that inclusive societies matter was the main conclusion of the 2011 World Development Report (WDR) on conflict, security and development. Inclusion is a concern both in remote areas and in cities. When we deal with Africa, we are mainly concerned with countryside and villages, where most of people are poor. On the contrary in towns we find entrepreneurs, politicians, administrators and other middle-class or rich people. However, the rich side of cities is always much smaller compared to the slums; there, we can see the real inequality, misery and poverty. Slums are particularly related to civil wars; refugees and migrants from conflictual countries escape toward cities where they have no job, no relationship, no money and no house. In slums, social exclusion is endemic and produces a vicious circle, where violence is usually present.

In literature, there are many researchers who underline that horizontal inequality is a particularly important driver of civil conflict (Sambanis, 2005), especially when economic, political and social exclusion has long-lasting story (Stewart, 2002; 2004; Call, 2012).

To conclude, we encounter again the quarrel of Hobbes against Locke. We have seen that in the economic literature we find opposing results regarding the social issues but these results depend, once again, on the theoretical model and on the chosen variables for the applied analysis. As we have already said before, sometimes econometric models underestimate the importance of quality of institutions and performance of governments, risking to obtain misleading results.

1.3.6 Empirical Problems and Data issues

Various statistical, methodological and data issues have emerged in literature so far. As already mentioned, the reliability of data is a concern, but also the causal relationship between GDP and conflict, the choice of the region of analysis and the choice of econometric models. In this paragraph we will cover these arguments.

There exists several sources of bias which might affect estimates. First of all, the choice

[42] One interesting data is that African States have experienced fewer than 2% of all interstate wars from 1946, while experiencing almost 30% of all civil wars from 1946 (Henderson, 2000)

[43] In political science, on the contrary, many researchers claim that those who take for first the guns against government, are not the poorest, because the poorest are too much concentrated to survive than organize a revolt.

[44] It is important to remind that we have more than one ethnic fractionalization indicator, but often governments hide or do not collect data on ethnicity or religion because they want to exclude some particular group. For example, in Nigeria since 1963 religious groups are not surveyed (Fortuna, 2016).

of variables. One of the greatest challenges in research on violence prevention and recovery is the lack of available quantitative and qualitative data, due to challenges of security and access, along with low statistical capacity. Without fully taking the validity and reliability of data of developing countries, many studies are introducing bias into their analyses (Treier and Jackman, 2008; Herrera and Kapur, 2007; Woods, 2006, 2014). Jerven (2013) points out that many of the statistics on Africa, including those published by the World Bank, are not actual measurements by the concerned countries but rather extrapolations and rough estimates made by the international organizations. Moreover, there has been a decline in donor interest in censuses and vital registration systems (UNICEF, 2008; Rao et al., 2004), and an increasing reliance on household surveys[45] (Carr-Hill, 2013). This implies a high frequency of omitted variables which may drive to misleading cross-country estimates.

We risk to have biased results also if it is not adequately addressed the endogeneity of economic variables to civil war. In fact, despite the extensive agreement about the economic motivations, only few authors (Miguel et al., 2004; Besley and Persson, 2008; Djankov and Reynal-Querol, 2010) have dealt with the causal relationship between conflict and economic growth. The main strategy to address this bias is by using as explanatory variables lagged values of per capita GDP growth or levels (see Collier and Hoeffler 2002; Fearon and Laitin 2003). However, this approach implicitly assumes that economic actors do not anticipate the incidence of civil war and adjust economic activity (such as resilient activities or investments) accordingly. Since this is a very strong assumption, simply lagging economic variables is not a convincing solution to the endogeneity problem (Caruso et Al., 2016).

Miguel et al. (2004) are the most important authors who face the endogeneity issue in order to overcome this drawback in conflict studies. In this largely-cited work they argue that there are likely to be permanent fixed differences between countries that are correlated with their income levels, economic growth rates and civil war. To overcome this issue, Miguel et al.(2004) use annual rainfall growth as an instrument for income growth and they find that the growth shocks predicted from rainfall shocks, powerfully affect the risk of civil war. In sub Saharan Africa (where most households rely on rain-fed agriculture) falling rainfall and drought cause large reductions in income.

This important study has been criticized by Ciccone (2011) who claims that Miguel et al.(2004)'s results are driven by a positive correlation between lagged rainfall levels and civil conflict. Ciccone (2011) uses the latest rainfall levels data (rather than rainfall growth, as in Miguel et al. (2004)) and finds that higher rainfall levels are associated with more civil conflict. However, Miguel and Satyanath (2011) justify their choice by claiming that behavioural economics (which explains why individuals are often sensitive to recent changes in the *status quo*) support the use of rainfall variations rather than rainfall levels. Moreover, they prove that results in Ciccone's paper are based on incorrect STATA code, outdated conflict data, a weak first stage regression and a questionable application of the GMM estimator. So far, rainfall variation remains the only instrument for GDP growth in Africa (Hendrix and Glaser, 2007; Jensen and Gleditsch, 2009).

Another limit is that mostly every macroeconomic work does not focus on a single region, but analyses the whole world, losing relevant information about country-specific political, economic and cultural factors. In particular, it is hard to find similarities among African countries but it is even harder to find similarities between African, Asian or Latin American countries. When we deal with conflicts we should handle with caution such differences. For example, in the African continent, colonization and decolonization have a deep weight which is still influencing their

[45]Clearly, "if the connection between what is actually measured and what is purported to have been measured is tenuous (or absent altogether, in some cases), then the inferential relationship between cause and effect makes little sense" (Herrera and Kapur, 2007, pg.367). Moreover, often statistics are taken from census and any problem with the census, if used as the sampling frame for a national survey, will lead to that sampling frame being biased

history[46]. We cannot say the same for Latin America[47]. We find some similarities between Africa, Middle East and Extreme East, but in the second case the "geopolitical games" and the Palestinian issue plays a crucial role in the outbreak of conflicts, while in the Extreme East we have a completely different kind of colonization and different types of conflicts (Caruso et Al., 2016). Thus, when we run a macro analysis at world level, we must be aware of the fact that we are trying to find general determinants of civil war by comparing very different continents whose history deeply affects the likelihood of civil war (Henderson, 2000, 2001; Ayoob, 1995; Holsti, 1996; Stedman, 1996). This does not mean that there are some continent which are more conflict prone or have more probabilities to live a civil war[48]. Our argument is only related to historical trend, which are *sui generis* for each continent. Of course as economist we should infer universal rules, however, maybe, we should first start by doing a continent-level analysis and then compare the results at global level.

Some researchers have dealt with the constraints related to macro analysis of conflicts; for example, Sambanis (2004), Kalyvas (2006), Kalyvas, et al. (2008), Verwimp, et al. (2009), Barcells and Justino (2014), and Wimmer and Min (2006) address the complexity of micro-macro theories by using a multi-level econometric approach, with a combination of case studies and large-N datasets in order to overcome both the limits of macro and micro-level analysis of conflicts (Kalyvas, 2006). In this perspective, they can infer causal pathways that link individual or group behaviour with the outbreak of civil war (Sambanis, 2004). Using a global dataset including fixed geographical territories from 1816 to 2001 independent of the political entity in control of the territory in a specific year, Wimmer and Min (2006) find that both interstate and civil war are intimately related to the rise of nation-states through political discrimination along ethnic lines and the subsequent demand of new ethnically homogeneous states.

Other researchers have addressed this issue by running an analysis at ethnic-country level (Montalvo, et al., 2004; Cederman, et al., 2010; Wucherpfennig et al., 2011; Cunningham et al., 2010; Morelli and Rohner, 2011, 2013). This opens another source of imprecision: when we deal with anthropological data we should consider carefully their reliability. As Fearon (2003), Bridgman (2008) and Reybrouck (2012) underline, ethnic, religious and linguistic data on African groups have been registered and compiled during or around the colonization period. For instance, in Congo between 1907 and 1914 it has been gathered data on ethnicity by Belgian ethnographers. Their intentions were genuine, but influenced by the time period. Hence, they produced an immense encyclopedia in which ethnic groups were steadily identified as unalterable entities[49]. On the contrary, at that time ethnic groups moved continually and they had mutual relationships with other ethnic groups so that many ethnic groups spoke more than one language (Reybrouck, 2012; Fearon, 2003). Still, data on language, religion and ethnicity depicts the African Continent as if it is divided into well-defined and immutable ethno-linguistic groups. For example, Narodov Mira atlas (1964) is the most used dataset on ethnicity; however, the Atlas has been published during the Sixties and it provides a list of population by ethnicity with no documentation of its methodology. In 2010 Narodov Mira atlas has been converted into a digital version, the GREG (Geo-referencing of ethnic groups) project. The latter has created a GIS (Geographic Information Systems) by disaggregating ethnicity spatially[50]. This exceptional effort is however based on a anachronistic view of the world. Since the sixties some parts of the globe are experiencing terrific changes, in which entire ethnic groups have to leave their lands

[46] After all, it is less than 50 years that Africa became free from a long period of colonization, where the impact of slave trade, of colonial regime and world war -during which only in the first world war about half a million African soldiers fought in Europe (Koller, 2016)

[47] Decolonization in America took place in the first quarter of the 19th century

[48] In 1987 Hansen arises the question "How then can we begin to particularize it by talking of an African perspective? How legitimate is it to talk of European peace or Asian peace?"

[49] This work has also produced a negative consequence: the Belgians profited from this study by creating "nationalist" ethnic groups characterized by particular features. Then, Congo population begun to give importance to the tribal identification which led to ethnic conflicts. (Reybrouck, 2012)

[50] GREG dataset has global coverage and consists of 929 groups represented with 8969 geo-referenced polygons

because of wars, occupation, disputes about the land, dictatorship, religious extremism and so on. When we deal with conflictual countries, we should take into account that the speed of change in post-conflict countries is particularly fast and has dramatic consequences on concerned countries. The dramatic images of migrants from Middle East and Africa are eloquent.

This conception of immutable ethnic groups raise also a statistical problem: these data do not display time variation. Since the bulk of this research uses country level data in the form of a panel, with repeated observations for every country, we risk to estimate biased results when we include time-invariant variables (Wooldridge, 2002). As a consequence, the results highlighted in most of this literature use either ordinary least squares, or some limited dependent variable model without fixed effects at the country level.

Some scholars have attempted to distinguish between ethnic, linguistic and religious groups with other indicators. For example Alesina et al. (2003) have drawn up a fractionalization (ELF) index in a sample of 190 countries. Most studies rely on the ELF index; among many, Collier and Hoeffler (2002, 2004), Fearon and Laitin (2003), and Sambanis (2001). Nevertheless, also in this case Alesina and co-authors derived this index from the Soviet Atlas Narodov Mira. Posner (2004) argues that the ELF is inherently problematic and unable to capture (or even misrepresenting) the subtle channels through which ethnicity results in civil wars.

Of course ethnicity is a huge topic and it is a hard job to follow nowadays changes, but at least we would need an updated version of the Naradov Mira Atlas. Despite that, the problem of reliability is not really debated (Schedler and Mudde, 2010).

The last source of bias is related to the definition of civil war and the related civil war onset variable used in economic studies. This topic will be extensively discussed along the thesis. Here we simply explains that the civil war onset variable is a dichotomous variable which assumes zero when there is no war, and one if a civil war breaks out. For this reason, almost all works use probit models. However, conflict variable assumes more often the value zero (i.e. peace), so that we have many zeros in the dependent variable. As proved by Bagozzi et al. (2014) and by Dunne and Tian (2015) probit or logit models with many zeros produce biased estimates. Dunne and Tian (ibidem) suggest that we should use a zero-inflated Poisson model in order to improve our estimates. In their paper, they have showed that estimates from Elbadawi and Sambanis (2002) were biased. By controlling for the excess of zeros and for observable and latent country-characteristics, they obtain estimates with lower standard errors and substantial differences in the significance of the grievance terms which prove to be significantly related to conflict onset.

In the second chapter of this thesis, after exploring and criticising the conflict onset variable, we replicate this study by applying a Zero-Inflated Poisson model on our dataset in order to compare the results with a IV2SLS and a probit model.

1.4 Conclusion

There can be no human well-being and development without peace. This is as logical as unachievable. Compared to inter-wars (war among States), civil wars have a more severe destructive power for current and future generations. This implies that there are not only material damages (as in war) but also relational damages, because people lose faith in their neighbours. Civil wars can have crucial repercussions also for other countries and they may influence the stability of entire regions. Such important externalities call not only for attention from scholars and policy makers, but also call for more critical and interdisciplinary reasoning about civil war.

Since long time, many of the world's great philosophers and pubic social intellectuals have been reflecting on peace and wars. Nowadays, scholars should devote themselves to this field for helping policy makers to design policies such as anti-terrorist, conflict prevention, social protection, conflict recovery, political stabilisation and economic development. In today's Era of international terrorism, these policies are fundamental both for the well-being of critical countries

and for the security of western countries.

For this reason, a large body of literature has examined the effect of some elements which are supposed to affect civil war onset. In this chapter we have focused on the civil war determinants by reviewing the economic literature. The positions taken by each researcher varies considerably, by creating a variegated literature of economics of conflict.

Since the end of the Cold War, violent political conflict has increasingly been seen as a major obstacle to the economic development of many low and middle-income countries (Fearon, 2010). Thus, it is clear the reason why there is a growing economic literature about civil wars.

This literature reviews the theory under which empirical studies rely on. We have showed that main civil war theories are based on game-theory models where rebels are assumed to be actors who want to maximize their gains. Few theoretical models have been developed so far and all of them come from the baseline game theory of bargaining of Hirshleifer (1989).

Most papers present the finding that civil wars are not caused by political grievances, but only by the opportunity cost for the organization of rebellion or insurgency. Therefore, economic growth is the ultimate remedy to conflict.

However, in literature other determinants have proven to affect the likelihood of civil war. For example, many researchers agree in the geographical condition of a country favouring conflicts. The geographical condition includes both the the share of mountains in a country and its natural resources endowment; unemployment, which is related to the economic condition, intensify the frustration and the willing to take the arms. Institutions (especially weak States) are considered as crucial determinants of conflict but scholars find difficulties on understanding its impacts on civil war. As we have seen, this is due to the fact that we have data-reliability problems: although several databases provide us indicators of social, cultural and institutional conditions, both the methodology to collect those data and the reliability of data is a concern. Since data are often missed or biased, we need to combine our analysis with qualitative information, such as historical, anthropological and political science resources.

In this chapter we have suggested that economic determinants are related to social and political conditions so that marginalised and frustrated people are pushed to start a rebellion or to join a civil war. At the same time, other actors, engaged in international relations, can profit from this unstable situation to gain profits and fuel the conflict until they obtain the highest power or gains. Hence, civil war might break out with real social reason(s) while others with economic interests take advantage. Greedy people exist and establish conditions to get richer but probably they are not the main determinant of civil wars. They are parallel actors which profit from poor people reclaiming their dignity. In light of this, when we study civil wars, we should take into account also historical, anthropological, political and psychological elements which might steer people behaviours. With these ingredients, maybe we can reach a durable and lasting peace which will ensure that the broad mass of the people achieve a measure of material and psychic well-being and control over the political processes which guide and order their lives (Hansen, 1987).

In addition, we have underlined the change of ongoing civil war, where actors, determinants and instruments are internationally interrelated with a mixture of public-private organizations. Hence, civil wars cannot be seen no more as a matter of poor countries. We are all at risk, both from external threats and from inside.

Several economic, political and historical ingredients influence civil wars, especially in the African Continent. We, as researchers, must develop models and tools able to predict and prevent those turbulent events. In order to succeed in this aim, we need more and new efforts that can allow us to really understand actors and determinants of civil wars. New statistical instruments are continually provided by the scientific community and we still have a long way in front of us.

Chapter 2

Economic Shock and Civil War in Africa: Reassessing the Nexus

Abstract

This chapter revisits the relationship between economic shocks and civil conflict. We establish that the empirical literature identifies two different patterns. First, poor countries have a higher propensity to live a civil war. Second, civil war occurs when countries suffer negative income shocks. We replicated a very important study of Edward Miguel, Shanker Satyanath and Ernest Sergenti (2004) covering the African continent during 1981 to 2009. The probability of civil war is estimated by using an instrumental variable two stage leasts squares approach: rainfall variation as instrument for economic growth. Our results confirm Miguel et al.' results and show a strong and negative relationship between economic growth and civil war. We tested the robustness of the instrument with Stock and Yogo (2005) Test and we find out that the instrument is weak, therefore estimates are biased. We showed that the estimates are biased also because of the coding rule of the dependent variable, namely civil war, a dichotomous variable assuming 1 when 25 battle-deaths per year are reached. Further, we adopted the Zero-inflated approach to deal with the abundance of zero (peaceful countries) in the dependent variable. Our findings tell that economic growth increases the likelihood of civil war but, at the same time, also oil exports, population growth, mountainous countries, and bad institutions increase the likelihood of civil war.

keyword*Civil War; Africa; Endogeneity; Instrumental Variables; Coding Rule*.

2.1 Introduction

The concept of civil war, the obstacles to peace, what civil war actually is and how peace can be realized are issues on which there is no agreement. The economic literature of civil wars agrees only on few things: (i) conflict variable must be based on the number of deaths over a year in a given country; (ii) we need a robust instrument for income per capita and GDP growth; (iii) civil wars are mainly caused by economic motivations. In this chapter we contribute to the debate on these issues by proposing different strategies.

In the first part of the chapter, we replicate the work of Edward Miguel, Shanker Satyanath and Ernest Sergenti (2004), henceforth MSS, who found a robust instrument for economic variables in developing countries: rainfall variation. They prove that lower rainfall levels and negative rainfall shocks increase conflict risk in the time-span 1981-1999 in sub-Saharan Africa, where most countries rely on rain-fed agriculture and do not have automatic irrigation. The authors find a negative correlation between current conflict and previous rainfall growths, conversely, droughts can influence the likelihood of a civil war. Of course, this identification cannot be valid for other regions of the world, such as industrialised countries, since weather is not sufficiently closely linked to income growth (Miguel et al., 2004).

Since the majority of economic studies have found that economic determinants are the most significant and relevant reasons for civil war onset, MSS's findings have been a fundamental step forward in this literature. According to google-scholar, this article has been cited 1559 times from 2004 up to 2016. In the first chapter we have seen that Collier and Fearon are cornerstones of this domain. In parallel, in 2016 MSS is the seventh most cited on civil war topic in social sciences, according to the ISI Web of Science (http://apps.webofknowledge.com).

In recent years, Bazzi and Clemens (2013) have demonstrated that several instruments are invalid and weak. For example, rainfall variation has been adopted as instrument for economic growth but, as far as we know, any scientific article has tested its robustness with advanced statistical tests. A weak and/or invalid instrument can produce biased estimators, thus it is important to be sure that our instrument is robust in order to conduct meaningful analysis about the causes of civil war.

In this chapter we extend MSS's dataset, covering the African continent from 1978 to 2009 and apply Stock and Yogo test (2005). This test is run by using the same linear regression and variables used in MSS. Our findings are in line with those of MSS, and display an even more dramatic picture of the relationship between economic growth and civil war. The rainfall instrument may be strong enough to deal with reverse causality endogeneity, but it could be weak to solve a measurement error bias. We will show that our results rejects this instrument, meaning that rainfall variation is a weak and invalid instrument of GDP growth.

We continue the study by exploring the reasons why this instrument is weak. In the second part of the chapter, we discuss the current definition of civil war as a possible cause of invalid and weak instrument. The most important database in this field is the Uppsala Conflict Data Program (UCDP) which defines a conflict as "a contested incompatibility which concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths".

However, the choice of 25 battle-deaths is pretty arbitrary. For example, Sambanis (2004) has proven empirically that changes on the coding rule for conflict variable affects estimates. This means that our conclusions and policy suggestions depend on the threshold we use. As a consequence, the weakness of the rainfall variation instrument could depend on the measurement bias related to the used conflict data.

In this chapter we will criticize the "threshold" approach and we will underline some limits and problems related to this definition. Following Sambanis (2004), we will show that estimates are sensitive to battle-deaths threshold by showing that small changes in the coding rule of civil war variable imply big changes on the estimated effects.

Finally, in the last section we will deal with the problem of endogeneity and weak instruments from another perspective. We argue that biased estimates are actually caused by wrong models; MSS (2004), Sambanis (2004), and Fearon and Laitin (2003) use respectively IV2SLS, probit and logit models on panel or cross section countries. Recently, Dunne and Tiann (2015) have proven that both linear, probit or logit models do not perform well in estimating the effect of variables on civil war. The reason relies on the nature of conflict variable in which there is an excess of zeros (peaceful countries). If we do not account for this excess of zeros, we yield biased or inconsistent estimators when we use probit or logit specification or, even worst, with linear models.

In recent years, count data that allow for excess zeros are receiving considerable interest, particularly in the econometric literature with diverse applications (Caruso et Al., 2016). The Zero-inflated count model (ZIP) provides a method that models the data as a mixture of two distribution: 1) the Poisson distribution that generates both zero and non-zero counts and 2) a constant distribution that generates only zero counts. Hence, zero value has a zero-inflated probability that the observation came from the always-zero distribution. Following Dunne and Tiann (2015) we apply the ZIP to our dataset.

2.2 Endogeneity and Brief Description of MSS

In this section we briefly describe the problem of causal relationship between economic growth per capita and civil war and we summarize the work of MSS.

Statistically, when an explanatory variable x is correlated with the error term e for any reason, then x is said to be an endogenous explanatory variable. This implies that two or more variables are jointly determined in a model.

One simple and immediate way to solve this problem is to add quadratic terms of any significant variables to a model and to perform a joint test of significance. If the additional quadratics are significant, they can be added to the model. Sometimes, instead of quadric terms, we can use a logarithm transformation of a variable. In both cases, we complicate the interpretation of the model but we can detect many important nonlinear relationships in economics (Wooldridge, 2002).

When we have panel data or cross country data containing unobserved heterogeneity and omitted time-varying variables, control function methods can be used to account for both problems. Namely, we can include time period dummy variables to allow for aggregate time effects. These dummy variables are exogenous — because the passage of time is exogenous — and so they act as proxy variable or instruments.

Econometricians (Wright, 1928; Reiersol, 1941) have provided an alternative estimation method: instrumental variables (IV) that can be used to eliminate the endogeneity bias of one or more explanatory variables. The logic of IV is that it should capture only the effects on the dependent variable of shifts in x induced by the instrument. Therefore, the IV are not correlated with the dependent variable and the error term ($Cov(Z, \varepsilon) = 0; Cov(Z, X) \neq 0$), but is correlated with the causal variable of interest x[1]. If the instrument is valid, then it can capture movements in X that are exogenous and, in turn, can estimate consistent coefficint β. In other words, IV help to see clearly the causal direction of our "arrow": is economic shock causing civil war or does civil war cause economic shocks? IV solve this doubt.

Therefore, β can be found as:

$$\beta = \frac{Cov(y, z)}{Cov(x, z)} = \frac{Cov(y, z)/V(z)}{Cov(x, z)/V(z)}$$

where the second equation is in terms of coefficient than in terms of covariance (Angrist and Pischke, 2008).

[1] This is called "exclusion restriction", since the instrument is excluded from the causal model of interest.

The instrument needs to be numerically equal to the number of endogenous regressors, must be exogenous (or a subset of exogenous variables), so should have no partial effect on the dependent variable and not be correlated with other factors that affect the dependent variable; must be related, either positively or negatively, to the endogenous explanatory variable x having a clear effect on x. In parallel, the IV must have no effect on outcomes other than through the first stage channel. In the IV framework, the first stage (2.1) represents the regression of the causal variable of interest on covariates and on the instrument:

$$X = \pi_0 + \pi_1 Z + \nu \tag{2.1}$$

where π_0 is the intercept and π_1 the slope, which are unknown. In this first stage we estimate the reduced form, by decomposing X into two parts: $\pi_0 + \pi_1 Z$ is the part of X that can be predicted by Z and is uncorrelated with ν because Z is exogenous. The other component of X is ν which is correlated with ε. Therefore, we estimate

$\widehat{x} = X\widehat{\pi_1} + \widehat{\pi_2}Z$

where $\widehat{\pi 1}$ and $\widehat{\pi 2}$ capture respectively the first-stage effect of Z on X and of Z on Y and are OLS estimates of $X = X\pi_1 + \pi_2 + \xi$. The coefficient of $\widehat{x}$ is the two-stage least square estimator of β, therefore we use fitted values of the first stage to estimate 2.2

$$Y = +\beta\widehat{x} + [\eta + \beta(X - \widehat{x})] \tag{2.2}$$

2.2 is the two-stage least square (2SLS): we first estimate consistent $\widehat{x}$ and then we treat an independent variable as endogenous by replacing it with the fitted values in the second stage of a 2SLS procedure, where Y is regressed on $\widehat{x}$ using OLS.

In economics of conflict, as we have already showed in the first chapter, it has been proven that civil wars affect negatively the economic growth and the general well-being of people, both living in the country-in-war and in neighbour countries. Clearly, also in our field there is a contemporaneous effect between economic growth per capita and civil war: economic shocks create the conditions for conflict onset but, civil war destroy countries, by sharpening economic conditions. Therefore, the endogeneity is inevitable.

MSS use an instrument already applied in the economic literature, which is perfect for Africa: exogenous variation in rainfall. Rainfall as instrument for transitory income has been adopted by Paxson (1992) for the first time. Paxson used this instrument in a context of farmers in Thailand and his purpose was to examine marginal propensities to save out of transitory income for Thai farm households.

A further strength of MSS's approach is that they address the problem of measurement error in African national income figures. An instrumental variable approach deals with issue and, rainfall variation, in particular, allows us to attenuate the bias that may result from mismeasured explanatory variables. In doing so, we avoid biased coefficient estimates.

MSS find that GDP growth is significantly and negatively related to the incidence of civil conflict in sub-Saharan Africa across a range of regression specifications, including with country fixed effects. In their work, the relationship between GDP growth and the incidence of civil wars is extremely strong: a five-percentage-point drop in annual economic growth increases the likelihood of a civil conflict (at least 25 deaths per year) in the following year by over 12 percentage points. This strong relationship is the same also in richer or more democratic African countries, suggesting that economic conditions are the most critical determinants triggering civil conflict in Africa. Indeed, low GDP per capita empirically dominates all other correlates, including the level of democracy, the degree of ethnic diversity or the dependence on natural resource exports. MSS not only solve the problem of endogeneity but confirm the economic literature, especially the Greed Theory (where grievances do not matter in civil war onset).

Clearly, their conclusions have become a cornerstone of the literature on the economics of civil wars. However, Ciccone (2010) has raised some critiques to MSS's approach. Ciccone's critique

starts from the reasoning about the negative correlation between civil conflict and year-on-year rainfall variation between $t-1$ and $t-2$ found by MSS and driven by a positive correlation between civil conflict and rainfall variation. According to Ciccone, MSS's explanations are counterintutive. As we have seen, MSS claim that civil conflict is less likely following positive rainfall growth. Ciccone, instead, argues that the negative relationship found in MSS may not be true because "if civil conflict was triggered by lower rainfall levels or negative rainfall shocks, the negative correlation found by MSS should have been due to a negative correlation between civil conflict in t and rainfall levels in $t-1$". This is due to the fact that rainfall levels are mean reverting by definition. According to Ciccone, MSS should have used levels of rainfall rather than year-to-year changes in their regression specifications because when we link rainfall shock with conflict, the effect of year-on-year rainfall growth may lead to misleading results.

MSS reply to this critiques (Miguel and Satyanath, 2010) by proving that their main findings hold using rainfall levels variables as instruments for economic growth and that other critiques made by Ciccone are not persuasive because the author does not provide enough theoretical and statistical argumentations.

Recently, Hsiang et al.(2013) have conducted a meta-analysis of all empirical studies of weather and intergroup conflict whose empirical analysis can be specified as fixed-effect panel regressions. While not all estimates are statistically significant, sixteen of eighteen studies reviewed predict that anomalous precipitation events increase conflict. This result conceptually contradicts the use of rainfall as instrument for economic growth and we are not able to definitively pin down a unique causal mechanism: rainfall shocks may provoke conflict because people are affected by climate change and have less opportunity cost of fighting, or because crop failure reduces government revenues and state capacity, or both. In this chapter we do not address this issue and we analyse the rainfall instrument from a statistical point of view. However, we underline that many analysts turned their attention to how climate change affects violent unrest, but the academic research has not yet fully matured to the point of establishing well-accepted findings (Salehyan, 2014). There is little systematic evidence to date that short-term climate variability, such as prolonged droughts or unusually warm weather, has any significant effect on the likelihood of civil war (Salehyan, 2014; Dell et al., 2014). This depends on the no commonly-accepted units of observation, temporal scales, correlation and definitions (both conflict and weather shocks can be parameterized in many different ways). Finally, we raise a question concerning the extent to which weather events create conflicts that would not otherwise occur, as opposed to impacting the timing at which latent conflicts surface[2]. Nevertheless, this ambiguity underlines the importance of further examination, which are not covered in this thesis.

2.3 Dataset: Sources and Descriptive Statistics

The dataset we use is an updated version of MSS's dataset covering the African Continent in the time period 1981-2009. Table 2.1 provides a descriptive statistics of our dataset.

As dependent variable MSS use a civil conflict indicator variable, taken from UCDP, where country i in year t denoting conflict *it*. MSS use the Uppsala Conflict Data Program (UCDP) which provides armed conflict information for macro-level research for the period 1946 to the present (see Appendix A for more details about this Databank and conflict variable). The data provided by UCDP is one of the most accurate and well-used data-sources on global armed conflicts and its definition of armed conflict is the most used in literature: they label an event as a conflictual event when it causes more than 25 fatalities. According to this database, we can have a low-intensity conflict when we have from 25 to 1000 battle-deaths in a year, or a civil

[2]In addition, we notice that weather shocks do not lead to civil conflicts in stable countries, and in the world as a whole. On the contrary, social-institutional reasons are conflict drivers even in wealthy countries (Dell et al., 2012).

Table 2.1: Summary statistics

Variable	Mean	Std. Dev.	N
GDP Per Capita Growth	0.011	0.089	1533
Rainfall Variation	0.02	0.22	1095
Economic Growth, 1978	1.967	2.869	1418
Quality Policy	-2.151	7.953	1580
Ethnic Fractionalization	0.65	0.238	1214
Religious Fractionalization	0.478	0.192	1214
Oil Export	0.173	0.379	1199
Population Growth	15.867	1.277	1634
Mountainous Terrain	1.591	1.404	1214
Trade	0.021	0.221	840

war if there are more than 1000 deaths over a year. In MSS all country-year observations with a civil conflict in progress with at least 25 battle deaths per year are coded as ones, and other observations are coded as zeros. They cover the time period ranging from 1981 to 1999, during which there was civil conflict in fully 27 percent of all country-year observations according to the UCDP definition of 25 annual battle deaths and 17 percent according to the UCDP 1,000-death definition.

Economic growth and income per capita are drawn from the Penn World Table and from the World Bank. In addition, MSS use the economic trend, by taking into account the starting period; therefore, MSS use as baseline GDP in 1978, which is a time-invariant, taken from the Penn World Table.

The instrument for economic growth is the rainfall variation. MSS use the Global Precipitation Climatology Project (GPCP) database of monthly rainfall estimates, which stretches back to 1979. The GPCP rainfall measure at latitude-longitude degree node point p in country i during month m of year t is denoted R_{ipmt}.

$$\frac{R_{it} - R_{i,t-1}}{R_{i,t-1}}, \text{ denoted as } \Delta_{it}.$$

MSS estimate rainfall shock as the proportional change in rainfall from the previous year.

In particular, they estimate monthly rainfalls as a source of exogenous weather variation.

Other data are drawn mainly from World Bank databases and from Fearon and Laitin (2003). Since MSS supply a very detailed manual for their variables, we do not describe these variables in detail here. Rather, we refer to the excellent data description in MSS and in Fearon and Laitin's article.

Other time-invariant variables are those describing social and geography characteristics: ethnic, religious and ethnolinguistic fractionalization, percent of muslims in the society and terrain. Religious, ethnic and ethnolinguistic fractionalization have different sources: the most used is the Soviet ethnographic index Atlas Marodov Mira, but also the Ethno-Linguistic Fractionalization (ELF), Reynal-Querol index and the CIA Factbook. The percentage of Muslims within a society has been estimated by Fearon and Laitin (2003).

Fearon and Laitin (2003) were the first to include in their regression a variable which estimates the percentage of mountains in a country. This information has been collected by the geographer A. J. Gerard in a study for the World Bank's "Economics of Civil War, Crime, and Violence" project. Moreover, Fearon and Laitin measure non-contiguous countries and new States. MSS introduce these variables into their study.

Other natural resources data are related to fuel exports as a percentage of merchandise exports (World Bank Indicators). Fearon and Laitin create a dummy variable marking country

years that have greater than 33% fuel exports. Therefore, this variable is a dummy binomial variable.

Institutional measures include democracy, anocracy, political instability and total country population. Strictly institutional information can be taken from the Polity IV data set, the Database of Political Institutions (Beck, et al., 2001) and the Minorities at Risk (Gurr, 1999). Information on population is supplied both by the World Bank and from the Penn World Tables.

2.4 Empirical Framework and Results

Given that rainfall variation is a valid instrument for economic growth from a theoretical and logical point of view, MSS have proven that it is also statistically robust: in the first stage of the IV2SLS, the relationship between current and lagged rainfall growth and economic growth is very strong. MSS have also proven that rainfall variation is a valid instrument, able to help us to identify causes of conflict, without risking that the instruments affect conflict through other unobserved channels.

Their estimation framework is an instrumental variable two stages least squares (IV2SLS) approach. They estimate the probability of incidence and onset of civil war by using current and lagged rainfall growth and country characteristics. In some specifications they include country fixed effects and time trend, in order to capture time-invariant country characteristics that may affect civil war.

Their model is based on:

$$growth_{it} = a_{1i} + X'_{it}b_1 + c_{1,0}\Delta R_{it} + \Delta R_{i,t-1} + d_{1i}year_t + e_{it*} \tag{2.3}$$

Following Achen (1986), the second-stage equation estimates the impact of income growth on the incidence of violence:

$$conflict_{it} = \alpha_{2i} + X'_{it}\beta_2 + \gamma_{2,0}growth_{i,t-1} + \delta_{2i}year_t + \epsilon_{2,it*} \tag{2.4}$$

Where ΔR_{it} and $\Delta R_{i,t-1}$ are current and lagged rainfall variation respectively and are used to instrument for GDP per capita growth ($growth_{it}$) in the first stage with other country characteristics (X_{it}). e is the disturbance term which is allowed to be correlated across years for the same country in all regressions. They include also country fixed effects (a_{1i}) and country-specific time trends ($d_{1i}year_t$) to capture time-invariant country characteristics that may be related to civil conflict.

2.4.1 Tests

Econometricians have developed some tests to verify the endogeneity, the correct equation specification and the robustness of IV. Each of them imply severe bias which yield to wrong policy conclusions. Hence, it is crucial to be aware of these potential problems.

Generally speaking, when the explanatory variables are exogenous, the 2SLS estimator is less efficient and have larger standard error than OLS. For this reason we should use IV2SLS only when we are sure about the endogeneity of an explanatory variable. One simple way for testing whether an IV is necessary or not, is by means of the Hausman Test (Hausman, 1978). This test compares the OLS and 2SLS estimates for determining whether the differences are statistically significant. Usually, this test is made with reduced form of the regression. This is so, because we simply compare estimates of the variables of interest. If there are significant differences, then one model is better than the other. The usefulness of the Hausman test is that, if we fail to reject the null, then we can have some confidence level in the overall set of instruments used. If we reject the null hypothesis, then our logic for choosing the IVs must be reexamined.

Another usual and simple test is the Sargan overidentification test. This test is usually interpreted as a test of orthogonality between the regressors and the instruments, by allowing also for heteroskedasticity and time series dependence. A parameter is said to be identified if different values of the parameter would produce different distribution of the data. In IV regression, the identification depends on the relation between the number of instruments and the number of endogenous regressors. Intuitively, when we have more instruments than endogenous regressors we have overidentification. If, instead, we have enough instruments to estimate, our parameter is exactly identified. In the Sargan test our null hypothesis is that each instrument is valid, that is they have to be not correlated with the error term.

Once we are sure about the need of IV2SLS method, we should verify the specification of our model. A functional form misspecification generally means that the model does not account for some important nonlinearities. A very powerful and simple tool for detecting misspecified functional form is the F-test for joint exclusion restrictions. F statistic is at the base of another important test to detect general functional form misspecification: Ramsey's (1969) regression specification error test, which is a very simple and general test. The latter works by adding polynomials in the OLS fitted values to equation. In Ramsey's Test we should not reject the null hypothesis to be sure that the model is correctly specified. Thus, a significant F statistic suggests some sort of functional form problem, so at least some of the IVs are not exogenous. However, Ramsey's Test does not provide any solution when the null is rejected.

The overidentification test can be used whenever we have more instruments than we need. If the model is identified the R-squared will be identically zero. Generally, when we have more than one endogenous explanatory variable in a regression model, identification can fail in several complicated ways. But we can easily use a necessary condition for identification, which is called the order condition. Since there are not linear dependencies among the exogenous variables, there is perfect collinearity (i.e. full rank). Along with the exogeneity condition, the assumption of rank condition are used for identification test by computing a *t test* after OLS estimation. The sufficient condition for identification is called the rank condition: IV is sufficiently linearly related to x so that rank has full column rank. Necessary for the rank condition is the order condition, that is we must have at least as many instruments as we have explanatory variables. If we do not have as many instruments as right-hand-side variables, then β is not identified. Often this kind of tests are somewhat complicated, that is why usually it is used the reduced form for testing the rank condition (Wooldridge, 2002).

When we do inference, it is also important the instrument relevance. Often in widely-cited studies, cross-country instruments may be weak, invalid, or both (Bazzi and Clemens, 2013). If the instrument is only marginally relevant, or weak, then they can be a poor guide to the inference.

As stressed by Stock and Yogo (2005) "the strength of the instruments matters because the natural measure of this strength – the so-called concentration parameter – plays a role formally akin to the sample size in IV regression statistics". The sample size, in fact, enters the distribution of TSLS (two stages least squares) only through the concentration parameter (if not, a standard normal variable does not depend on the sample size).

Rothenberg (1984) proves that the square of the concentration parameter can be considered as an effective sample size and when it is small, the quality of this approximation can be poor. This means that inference based on some IV estimators and their conventional standard errors are potentially unreliable, and so the instruments are said to be weak.

Stock and Yogo (2005) provide a statistical tool based on Cragg–Donald (1993) statistic to measure how small the square of the concentration parameter must be for instruments to be weak. They provide this measure by formulating the bias as a relative bias measure, that is by normalizing the squared bias measure by the bias of the OLS estimator. In doing so, they separate the problem of endogeneity (OLS bias) and weak instrument (IV bias).

In particular, Stock and Yogo (2005) define a sort of weak instrument set, constituted of three

different tests: Kleibergen and Paap Lagrange-Multiplier (LM) Test for underidentification, Cragg–Donald Wald Test, and Kleibergen and Paap Wald Test for weak instruments. In order to have a strong instrument, it is necessary to pass each test. Only one test-verification is not sufficient for strong identification.

Each test is based on null hypothesis that a given group of instruments is weak and not identified against the alternative that it is strong and identified. Each test is independent, so instruments are weak, even though the parameters might be identified or the inverse.

According to the weak instrument set, the first test is about the underidentification of structural equations: a rejection of the null indicates that the smallest canonical correlation between the endogenous variables and the instruments is nonzero. This test is based on p-values and on a Lagrange-Multiplier (LM) test using the rank-based rk statistic (Kleibergen and Paap, 2006).

After testing for identification, we can continue with the other two tests. In the Cragg–Donald Wald Test we are able to estimate the bias and so an instrument is considered as weak if the bias of the IV estimator, relative to the bias of ordinary least squares (OLS), exceeds a threshold of 10% and 30%. The Cragg–Donald statistic is simply the "first-stage F-statistic," the F-statistic for testing the hypothesis that the instruments do not enter the first stage regression of TSLS. Stock and Yogo (2005) provide tables of critical values that depend on the estimator being used, "whether the researcher is concerned about bias or size distortion and the numbers of instruments and endogenous regressors". These critical values are obtained using weak instrument asymptotic distributions (Staiger and Stock 1997) with a small concentration parameter (Stock and Yogo, 2005).

Then, they provide a tool to estimate the maximum size of bias, based on the Wald Test of each coefficient. They consider an instrument as strong from the perspective of the Wald test if the size of the test is close to its level for all possible configurations of the IV regression model. As before, instruments are weak if the Wald test based on IV statistics has an actual size that could exceed a threshold of 10% and 25%, compared to OLS.

Following Bazzi and Clemens (2013) we will test the instrument by applying Stock and Yogo (2005) test. We estimate k separate regressions

$$conflict = \alpha_{2i} + x'_{it}\beta_2 + \gamma_{2,0} growth_{i,t-1} + \epsilon_{2,it*}, i = 1, ..., k$$

The test verifies the validity of the instrument, so unless for every country i it is the case that $\beta_l = 0 \; \forall \; l \neq i$, we have $Cov(\Delta R_{it}, e_{it}) = \sum_{l \neq i} \beta_l Cov(\Delta R_{it}, X_{it}) \neq 0 \; \forall i$ and the instrument is invalid in every regression.

2.4.2 Results

We first replicate MSS with our extended dataset. As a start, we want to see whether estimates remain stable over time and we repeat MSS's regressions by removing one country per time, in order to see if a country affects heavily estimates. Secondly, we apply Stock and Yogo (2005) test.

Following MSS, Table 2.2 performs both linear least squares and non-linear models. Here, our dependent variable is civil war. As we have seen in literature, we expect that GDP growth is the most important determinant of civil war onset. In particular, we expect that when in t there is a negative economic shock, in $t+1$ there are more probabilities of conflict. Therefore, lagged economic growth rates are supposed to be significantly related to civil war onset.

We run two different specifications of probit model (first and last column) and three OLS specifications. Country fixed effects are included in the second (OLS), fourth (OLS) and last specification (Probit). Time trend is used in all specifications but the first (probit) and the second (OLS).

First of all we have to underline that our results are quite different than those of MSS. We have different signs of economic growth rates only in two models, but our findings show a more

Table 2.2: Probit and OLS: Economic Growth and Civil War

	Probit I		OLS I		OLS II		OLS III		Probit II	
GDP Growth, t	-1.779	**	-0.666	***	-0.446	**	-0.456	***	-2.323	***
	(0.802)		(0.207)		(0.175)		(0.137)		(0.724)	
GDP Growth, t-1	0.263		-0.124		-0.121		0.011		0.199	
	(0.786)		(0.212)		(0.165)		(0.187)		(0.828)	
GDP, 1979	-0.185	*	-0.011		0.017					
	(0.106)		(0.007)		(0.021)					
Quality Policy	-0.012		0.001		0.005	**				
	(0.026)		(0.002)		(0.001)					
Ethnic Fractionalization	1.004		0.384		22.927					
	(0.774)		(0.148)		(0.229)					
Religious Fractionalization	-1.056		0.048		23.506					
	(0.688)				(0.319)					
Oil export	0.218		0.047		-0.149					
	(0.474)		(0.042)		(0.109)					
(Log)Population	0.122		-0.026		0.060					
	(0.124)		(0.022)		(0.022)					
(Log)Terrain	0.315	**	0.013	***	0.076	*				
	(0.124)		(0.002)		(0.044)					
Country Fixed Effects	No		Yes		No		Yes		Yes	
Time Trend	No		No		Yes		Yes		Yes	
N	813		1017		1017		1177		974	
R square adj			0.455		0.460		0.502			

Notes: Huber robust standard errors are in parentheses. Regression disturbance terms are clustered at the country level. A country-specific year time trend is included in all specifications (coefficient estimates not reported).
** Significantly different from zero at 90 percent confidence level.*
*** Significantly different from zero at 95 percent confidence level.*
**** Significantly different from zero at 99 percent confidence level.*

severe picture of the relationship between economic growth rate and civil war. In fact, current economic growth is always significant, ranging from -2.32 (probit) to -0.45, meaning that an increase in the economic growth rate reduces the predicted probability of civil war. We have bigger values in probit specifications (pseudo r-square is 0.1183 and 0.4983 in probit with and without control variables respectively). When we use country control variables, we see that also mountainous terrain and the quality of policy affect positively the onset of civil war. Other explanatory variables do not show any significant effect. Hence, from this first analysis we are in line with the theory of greed, because only economic growth rate influences the likelihood of civil war. However, geographical and political variables display an unexpected effect which contradicts the insignificant effect of other variables.

We study what happens when we change the time period and we see that, in general, probit models are more stable than linear specifications; in fact the effect of GDP growth on civil war changes slightly when we drop some years (namely, we drop one year per time starting from 2008 up to 2005 and from 1985 un to 1982) in probit specification, and, if anything, becomes stronger (the highest value is -0.525, significant at 1% level). Something interesting is that each control variables become highly significant (excepts for oil) when we drop years year 1982 and 1983. In particular, polity indicator and population growth become more significant, meaning that changes in these two indicators affect the likelihood of civil war. In fact, for instance Nigeria, Mozambique and Ghana are among the most popoulous countries and during 1980 and 1981 had a civil war. In addition, Namibia and Zimbabwe were fighting against the aparthaid and because of unstable governance (caused also by the interference of South Africa).

We remove years one by one also in the OLS case (OLS III) and we see that estimates remain stable (the highest value is reached when we cover the period 1985 to 2009 and current economic growth rate becomes -0.470).

Results prove to be stable even when we remove from the model some countries (one by one). Only few countries seem to be crucial for the estimated impact of GDP growth on civil war. From the first stage, it seems that mostly every country is significantly related to civil war[3], but when we regress using within effects, only Zambia, Zimbabwe, Tanzania and the Democratic Republic of Congo reduce the impact. In fact, by removing these countries (one by one), the coefficient of contemporaneous GDP growth rates becomes larger (the highest is -2.481 when we drop Tanzania). By removing Sierra Leone from our model, we reach the lowest estimate of GDP growth (-0.351, significant at 1% level).

On the contrary, if we regress the simplest model (i.e. without time and country fixed effects), Angola, Uganda and Sierra Leone do change results[4]. In particular, when we drop Uganda, the estimated impact of GDP growth rates on civil war becomes much higher (-2.218, significant at 1% level), while without Sierra Leone it becomes smaller (-1.381 and significant at 10%).

Table 2.3: Rainfall and Economic Growth: First-Stage Dependent Variable: Economic Growth Rate, t

	I		II		III		IV		V	
Growth in rainfall, t	0.037	***	0.041	***	0.037	***	0.036	***	0.042	***
	(0.011)		(0.013)		(0.011)		(0.011)		(0.012)	
Growth in rainfall, t-1	0.017	*	0.019	**	0.017	*	0.016	*	0.024	**
	(0.009)		(0.009)		(0.009)		(0.009)		(0.010)	
GDP, 1979			-0.024							
			(0.182)							
Quality Policy			-0.000							
			(0.000)							
Ethnic Fractionalization			-5.379	*						
			(2.849)							
Religious Fractionalization			2.317							
			(3.242)							
Oil export			0.020	*						
			(0.012)							
(Log)Population			0.009							
			(0.007)							
(Log)Terrain			-0.917	*						
			(0.477)							
Trade									0.008	
									(0.022)	
Growth in rainfall, t+1							0.000	***		
							(0.000)			
Country Fixed Effects	Yes		No		Yes		Yes		Yes	
Time Trend	Yes		Yes		Yes		Yes		Yes	
N	1072		960		1072		1072		1072	
R square adj	0.052		0.046		0.052		0.077		0.012	

Notes: Huber robust standard errors are in parentheses. Regression disturbance terms are clustered at the country level. A country-specific year time trend is included in all specifications (coefficient estimates not reported).
** Significantly different from zero at 90 percent confidence level.*
*** Significantly different from zero at 95 percent confidence level.*
**** Significantly different from zero at 99 percent confidence level.*

[3]Which is something that does not amaze us, since about every African country has suffered at least once a civil war.

[4]Also Sudan, Guinea-Bissau, Liberia, Ghana, Burundi, Mozambique, Lesotho, Botswana, Madagascar and Egypt change estimates, but in a smaller size.

Following the exercise of MSS, we present table 2.3 where it is shown the relationship between rainfall variation and economic growth. The first and fourth specification are the simplest models (the first with country fixed effects and the fourth does not use any fixed effect) and in the second specification we include country control variables and country specific time trend. Third specification is equal to the second one but we add future rainfall variation (which should be orthogonal to current economic growth, conditional on country-specific time trends), and the last one adds a control variable representing growth in terms of trade.

From this first stage, we can see that the instrument are highly significant in almost each specifications. Even if rainfall variation shows a lower effect, compared to MSS, current rainfall variations are strongly and positively related to income growth.

Regarding the covariates, polity, ethnic fractionalization and mountainous terrain change the sign (respect to MSS) but remain non significant.

In this first stage we do not use dummies for time period but, we are aware that some years might be particularly important for conflict onset: over the African history, there have been years during which some exogenous events have changed the conditions of some countries. We have replicated the same model with different time periods in order to establish weather small changes to the model influence the robustness of the empirical results. Then we drop in every regression each country one by one to see if a specific country affects estimates.

In general, we see that the first-stage relationship between rainfall and income growth is strongly positive and stable. Both current and lagged rainfall growth are positively and significantly related to income growth at over 95% confidence level, and this relationship is robust to the change of time period and also to the inclusion of country controls and time trends.

Hence, so far we can confirm MSS'results: higher rainfall variation are associated with positive economic growth.

Table 2.4 reports estimates of the reduced form. We clearly see that any coefficient is significant and the effects of rainfall variation on the likelihood of civil war is quite small. In MSS, instead, higher levels of rainfall are associated with significantly less conflict, and in the case of major conflicts (i.e. those involving more than 1000 deaths per year), coefficient estimates on both current and lagged rainfall growth are statistically significant at 95 percent confidence level. However, our R-square is larger than MSS's.

Finally, Table 2.5 reports the IV-2SLS. Country fixed effects are included in the first and last specification. Country specific time trend, instead, are used in all specification but the fourth, which is the simplest.

If we plot a local polynomial regression[5], we can clearly see that the majority of conflicts take part in countries with a degree of economic growth between -2 and +2. Higher-order polynomial rainfall growth terms are statistically significantly related to economic growth. In the following Tables we will report estimates with clusters based on country (as in MSS). In the Appendix, instead, we report estimates with clusters at GDP level.

[5]This is a powerful and useful smoothing method for fitting curves and surfaces to data. Some significant references are, for example, Lejeune (1992), Fan and Gijbels (1992, 1996), and Fan et al. (1997). The fit at x is the value of a parametric function fitted only to those observations in a neighborhood of x via weighted least squares and it presents advantages compared with other kernel nonparametric regression estimators. In practice this method models the data, making certain assumptions about the distribution of y. Usually, a distributional assumption is that the y has a constant variance. Moreover, it is supposed that the function can be well approximated locally by polynomials of a certain degree (parametric localization). Fan (1993) showed that the local linear model using the Epanechnikov kernel optimizes the linear minimax risk. Minimax risk is a criterion used to benchmark the efficiency of an estimator in terms of the sample size necessary to obtain a certain quality of results. In local polynomial regression is crucial the choice of bandwidth. Smaller values for bandwidth will result in less smoothing while larger values produce a curve with fewer sharp changes. Additionally, larger values for bandwidth will reduce the variance and increase the bias, since more points will be included in the estimate. According to Fan and Gijbels (1996), a natural way to choose a bandwidth and balance the aforementioned tradeoff is by minimizing the mean squared error (MSE). In our case we have calculated that .39 was the best choice.

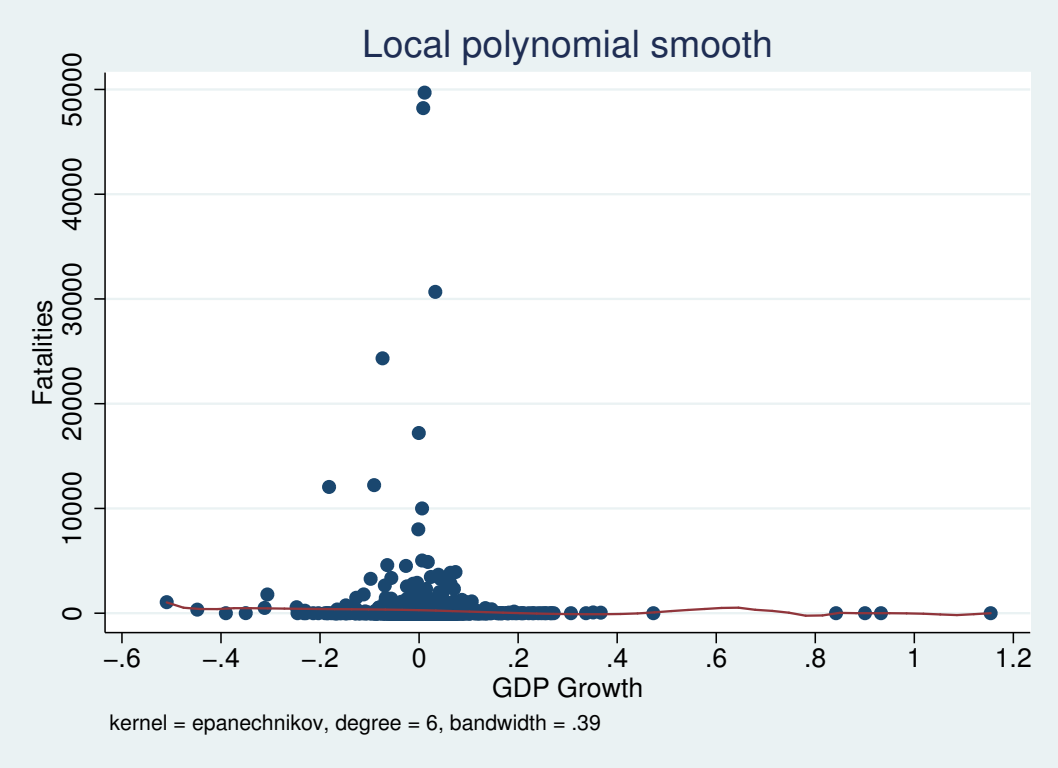


Fig. 2.1: *Local Polynomial Regression*

Calinski – Harabasz pseudo-F test[6], suggests us that the best number of cluster is 8. Therefore, we have aggregated our 49 countries in 8 clusters, according to their mean real GDP per capita (Penn World Tables Data). Results are the same if we use clusters based on countries (as in MSS) or on GDP. Estimates differ only in terms of significance.

In particular, we see that current economic growth rate is significant only when we consider major conflicts (with more than 1000 battle-deaths). Lagged GDP per capita growth is significantly different from zero at 90% only in the second specification, where we use time trend and control variables. In the latter, also oil exports results to be significant. When we run a simple regression (without country fixed and time trend effects) also the quality of policy and mountainous terrain are significant. These results are very different, compared to those of MSS. First of all, MSS find lagged economic growth rate to be highly significant. Secondly, the size of the (estimated) effect of current economic growth rate on civil war is much more bigger in our estimates. For example, in the second specification we see that one-percentage point decline in GDP increases the likelihood of civil conflict by over two percentage points. On the contrary, lagged economic growth has a smaller effect, compared to MSS. For example, in the second specification a negative economic shock increases by 1.72 point estimates the likelihood of civil war in the following year (in MSS it is by 2.2 point estimates).

In any case, IV-2SLS estimate is much more negative than the analogous OLS estimates, which suggests that bias due to measurement error in the per capita income growth measures is likely to be larger in magnitude than the endogeneity bias, which is presumably negative. In

[6]The pseudo F statistic describes the ratio of between cluster variance to within cluster variance (Calinski and Harabasz, 1974):

$$PseudoF = \frac{(GSS)/(K-1)}{(WSS)/(N-K)}$$

where N is the number of observations, K is the number of clusters at any step in the hierarchical clustering -i.e. when each variable is considered as a separate cluster-, GSS is the between-group sum of squares, and WSS is the within group sum of squares. Large values of Pseudo F indicate close-knit and separated clusters. In particular, peaks in the pseudo F statistic are indicators of greater cluster separation.

parallel, other political, social, and geographic variables have, at best, a tenuous impact.

These estimates have to be taken with caution because when we run overidentification and robustness test[7], we see that, although the structural equations are identified, our instrument is weak. In fact, in almost every specification, p-values for Kleibergen-Paap LM test tells us that the structural equation is not overidentified, but F statistic is much lower than the 25% of the OLS bias. Moreover, every Cragg-Donald Wald and Kleibergen-Paap Wald rk F statistic have a very low value, meaning that the null hypothesis cannot be rejected (hence, instruments are weak). We see a significant p-value only in the simplest regression (third model), where the bias generated with the instrument does not exceed the 30% of OLS bias.

IV2SLS estimates are stable when remove countries one by one. Only few countries affect estimates, namely: Uganda, Angola, Niger and Congo. Of course, all these countries are crucial in the study of civil wars; in fact, they have critical conditions which often explode into armed conflict. For example, Niger has become a crucial country in geopolitical term. In Niger we have several different and dangerous sources of conflict. First of all, Niger is in the middle of a hot region, because it borders on conflictual countries, such as Nigeria, Chad, Lybia, Algeria, Burkina Faso and Mali. This is a crucial issue because Niger is influenced by refugees coming from those countries, but it is also a hub for illegal trafficking of products[8] and, of course, it is on the way to Europe. Moreover, Niger has its own internal problems, such as the desertification process which forces people (19 million) to move to the south, or natural resources conflict. In fact, Niger owns uranium mines which have created high turbulences in the country[9] . These illegal networks have created the condition for the growth of corruption among politicians and mafias. An interesting data is that in 2011 Niger has bought 13$ million of armaments from French and Russia (SIPRI Data, 2015). In 2015 new elections have led a new President who has attacked these illegal networks, however the country is still affected by those problems and Niger keeps on being very poor (Raineri, 2015).

Moreover, Niger shares its boundaries with Chad Lake. This lake is another concern in Africa. Because of climate change, the lake is shrinking and the four countries around it (Chad, Niger, Cameroon and Nigeria[10] are not able to find a compromise on lake's property and management. Hence, ethnic groups move following the changes of the lake and sometimes clash with one against the other to protect their needs.

However, Niger affects a lot estimates in the IV2SLS. Namely, in Table we report estimates without Niger because they are really different compared to findings with all African Countries. As we can see, both current and lagged economic growth become significant and with a huge

[7]For each specification, we test for underidentification and for weak instruments. Following the diagnostic approach developed in Stock and Yogo (2005) and implemented in Yogo (2004), we report p-values for a test of the null hypothesis that the structural equation is underidentified based on a Lagrange-Multiplier (LM) test using the rank-based rk statistic due to Kleibergen and Paap (2006). A rejection of the null hypothesis indicates that the smallest canonical correlation between the endogenous variables and the instruments is nonzero. However, nonzero correlations are not sufficient for strong identification. we therefore also report F-statistics—Wald statistics based on Cragg and Donald (1993) and the Kleibergen and Paap (2006) generalization to non-independently and identically distributed errors and associated p-values for weak instruments hypothesis tests. Namely, we report p-values for the null hypotheses that the bias in the point estimates on the endogenous variables is greater than 10 percent or 30 percent of the OLS bias, or that the the actual size of the t-test that the point estimates on the endogenous variables equal zero at the 5 percent significance level is greater than 10 or 25 percent.

[8]ONU has reported that in 2008 around 50 tons of cocaine passed through Niger to go to Europe (Pichon, 2008).

[9]In 2010, five French people have been kidnapped at Arlit, in a uranium mine (Salehyan, 2015).

[10]Although Niger is a crucial hub of resources feeding current and future conflicts, Nigeria remains the most complex and dramatic country. Nigeria is divided into two countries. In the North we have a majority of Muslims running the formal and informal power and working together with the terrorist movement Boko Haram (which has born, actually, in Niger during the 90's (Raineri, 2015)). In the South we have mostly Christians who have always suffered from the power of Muslims. Moreover, the South is rich of oil which is not equally redistributed among local people. This latter issue has created a long-lasting armed conflict with international repercussions. According to SIPRI Dataset, although Nigeria's budgeted military expenditure fell in 2014 by 9.3% to $2.3 billion, the total is still 79% higher than in 2005.

negative impact on the likelihood of civil war. This means that Niger underestimates our results, because when we cancel out this country we find a more dramatic relationship between economic growth and civil war. However, as we have explained we cannot ignore this country.

Similarly, Uganda affects estimates downward, because when we remove Uganda, estimates become higher although not significant (excepts for the last specification, using the threshold of 1000 battle-deaths). This surprises us, since we expected that estimates would decrease without Uganda, because Uganda is a very conflictual country. In fact, from 1987 to 2008 (remember that our dataset covers from 1981 to 2009) Uganda had been fighting a civil war between the Lord's Resistance Army (LRA) and the Ugandan army. This conflict is sadly known around the world because Joseph Kony, the chief of LRA, kidnapped thousands of children to force them to become child-soldiers or sex slaves (Limes, 3/2010). Moreover, Uganda is surrendered by Rwanda, Kenya, Burundi and South Sudan, which are very problematic and conflictual countries. In particular, Uganda is particularly linked to Sudan which offered its help during the Ugandan civil war and where Uganda sent hundreds of soldiers in 2013 during its political crisis with the South Sudanese secessionists. Nowadays, Uganda has not a real civil war, however ex LRA fighters, refugees and marginalised ethnic groups are still waiting for a land assignment from the government, after the peace agreement (Limes, 12/2015; Kapuscinsky, 2009). In particular, the ethnic group of Acholi has been forced to leave their lands during the war to go to refugees camps. These camps were supposedly created for the safety of the people, but the camps were rife with disease and violence. At the height of the conflict, 1.7 million people lived in these camps across the region and since 2008 they have been trying to come back to their ancestral territories which, meanwhile, have been occupied by other ethnic groups (Lucima, 2002). In parallel, the LRA is not dissolved and nowadays it is composed of several bands of fighters that are spread across an area of central Africa that's roughly the size of Sweden (Limes, 12/2015). Some of these groups are nearly autonomous, and have limited contact with one another, but ultimately answer to Joseph Kony, who could escape from Uganda to avoid the arrest. Several crashes are recorded in the North of Uganda, where Acholi were used to live. Moreover, in the West, there are still some ethnic groups dreaming of a secession. For instance, on 27 and 28th November, 2016 around 80 people are dead during a clash between the government and an ethnic group aiming at obtaining the secession of the Rwenzururu (West Uganda) (Internazionale, 1177).

In the case of Angola, Sierra Leone and Mozambique, instead, estimates regarding GDP per capita growth become smaller. One interesting case is Angola: when we remove it from our IV2SLS, every model yields smaller values for economic growth, excepts for the last model (with 1000 battle-deaths) where the coefficient increases to -1.557 (significant at 5%).

Angola is another complex country. Right now, in Angola there is peace and a (slow) economic growth. However, Angola obtained its independence from Portugal only in 1975 and Portuguese administration was a complete default in terms of governance and social equilibrium. Therefore, since the dawn of independence, several ethnic groups wanted to come back to their ancestral land and reigns, starting a long and bloody civil war. From 1975 to 2002 Angola fought a civil war between the government and some ethnic groups. In parallel, there were (and there are) international countries[11] and organizations interested in the conflict and in the country because of its great natural resources, such as oil, steel and diamonds, and for its strategic location. When we study civil wars, the Angola case is always cited because of its long-

[11] Among many, the largest and most important groups, were the Movimento Popular de Libertação de Angola (MPLA) and the União Nacional para Independência Total de Angola (UNITA). The MPLA was supported by the Soviet Union and Cuba and UNITA received aid from apartheid-era South Africa and the United States, after the Cold War, support was provided by the UN Security Council. It is not a coincidence that in the 1990s UNITA was able to capture and control key diamond production areas, such as famous diamond fields in the Cuango Valley and eastern Lundas, and widely dispersed alluvial deposits (which are much less capital-intensive than kimberlite deposits). At the same time, MPLA took control over oil reserves and the exploitation of Angola's considerable oil wealth provided the main source of economic security and personal enrichment for the MPLA elite. Therefore, both sides have little interest in peace. (Berdal, 2003)

Table 2.4: Rainfall and Civil Conflict with Country Fixed Effects and Time Trend (Reduced-Form)

	I	II	III
Growth in rainfall, t	-0.039	-0.051	-0.004
	(0.047)	(0.031)	(0.050)
Growth in rainfall, t-1	-0.066	-0.028	-0.060
	(0.052)	(0.030)	(0.047)
N	1072	1072	1072
R-square adj	0.511	0.458	0.448

lasting hostilities and, aboveall, because the clear relationship between natural resources and civil war (Collier and Hoeffler, 1998; Collier, 1999; Ross, 2004, 2006; Fearon, 2005; Berdal, 2003). Nowadays, Angola, together with Nigeria, is the biggest oil provider in Africa and, according to the Archivio per il Disarmo (IRIAD), between 2009 and 2013 Angola has increased exponentially its military expenditure.

Angola's war economy throughout the 1990s is not the only one to be based on the exploitation of natural resources. It has been suggested, most explicitly in a report by a UN-appointed panel of experts in April 2002, that the war that has raged with fluctuating intensity since 1996 in the Democratic Republic of Congo (DRC), has come to be driven largely by economic agendas and interests. The geographical characteristics are, once again, very important: Congo is big as much as western Europe. In its enormous territory we find 33% of world's cobalt stock, 10% of world's copper and diamond stock (Raineri, 2015). Congo owns also uranium, zinc and coltan resources. The UN Report (2002) highlights the opportunistic behavior of private companies and influential individuals, focusing on the role played by Burundi, Rwanda, and Uganda. And, significantly, it seeks to establish a firm link between economic exploitation of resources and the continuation of war[12]. Since 1960, Congo is living a civil war with peak and low armed period. For example, in 2015 Congo's budget military expenditure has increase by 88%, compared to 2013 (SIPRI Data, 2015). Weapons are widespread and mainly used by ethnic groups and government to control natural resources and gain the profits. Although in 2016 there were democratic elections in Congo, right now this country is a failed State and there is no positive forecast. Moreover, Congo is surrounded by other conflictual countries, such as South Sudan, Rwanda, Central African Republic and Uganda (Raineri, 2015).

Similar processes driven by warlords who are, in turn, supported by international networks, can be found in the interrelated wars that, for much of the 1990s, have engulfed Sierra Leone. A struggle among warlords for control of the state has carried with it substantial and direct economic benefits for some; economic opportunities for others who were previously excluded from established and corrupted patronage networks; an expansion of the informal and criminalized sectors of the economy; and new alliances between warlords and external actors (including neighbouring states, traders, and businesses based in and outside West Africa) (Berdal, 2003).

These estimates prove to be pretty stable when we control for time periods. We test estimate variations in case of the first and second specification. In the first case, the highest value for current GDP growth rate (-1.723025) is reached when we run regression from 1985 to 2009, though is not significant. In the second case, instead, when we regress from 1985 to 2009 current and lagged GDP per capita growth become huge (although not significant, it is -2.82605 and -2.185284 respectively). When we regress from 1981 to 2004, instead, the effect of lagged economic growth rate becomes very small (-.4438052). Since the reduction of observations is not

[12]William Reno's suggestion that conditions of modern warfare might in some cases be better understood as "an instrument of enterprise and violence as a mode of accumulation" was made, not surprisingly in light of the above, with the conflict in Central Africa in mind.

Table 2.5: IV2SLS: Economic Growth and Civil Conflict

	I	II	III	1000battle deaths
GDP Growth, t	-1.517	-1.804	-1.508	-1.435 *
	(1.655)	(1.797)	(1.276)	(0.810)
GDP Growth, t-1	-1.545	-1.243 *	-0.983	-0.138
	(1.046)	(1.010)	(0.929)	(0.840)
GDP at 1978		0.017	-0.021 *	
		(0.023)	(0.012)	
Quality Policy		0.004	-0.005 *	
		(0.002)	(0.003)	
Ethnic Fractionalization		0.357	0.204	
		(0.236)	(0.248)	
Religious Fractionalization		0.111	-0.245	
		(0.291)	(0.214)	
Oil export		-0.125 *	0.061	
		(0.130)	(0.167)	
(Log)Population		0.044	0.037	
		(0.029)	(0.037)	
(Log)Terrain		0.063	0.081 **	
		(0.045)	(0.037)	
N	1071	959	959	1071
R-square adj	0.442	0.356	0.043	0.399
Country Fixed Effects	Yes	No	No	Yes
Time Trend	Yes	Yes	No	Yes
Cragg-Donald F stat	4.595	4.311	5.902	4.595
Kleibergen-Paap F stat	4.286	4.026	5.495	4.286
Kleibergen-Paap LM test p-value	0.00262	0.00291	0.00106	0.00262
$H_0 : t - testsize > 10\%(p - value)\|KP$	0.963	0.970	0.918	0.963
$H_0 : t - testsize > 25\%(p - value)\|KP$	0.231	0.261	0.128	0.231
$H_0 : t - testsize > 10\%(p - value)\|CD$	0.953	0.962	0.897	0.953
$H_0 : t - testsize > 25\%(p - value)\|CD$	0.200	0.228	0.104	0.200
$H_0 : t - testrel - bias > 10\%(p - value)\|KP$	0.660	0.693	0.505	0.660
$H_0 : t - testrel - bias > 30\%(p - value)\|KP$	0.181	0.207	0.0946	0.181
$H_0 : t - testrel - bias > 10\%(p - value)\|CD$	0.620	0.656	0.456	0.620
$H_0 : t - testrel - bias > 30\%(p - value)\|CD$	0.154	0.179	0.0752	0.154

Notes: Huber robust standard errors are in parentheses. Regression disturbance terms are clustered at the country level. A country-specific year time trend is included in all specifications (coefficient estimates not reported).
** Significantly different from zero at 90 percent confidence level.*
*** Significantly different from zero at 95 percent confidence level.*
**** Significantly different from zero at 99 percent confidence level.*

Fig. 2.2: *GDP growth rate, t in IV2SLS with Country Fixed Effects and Time Trend*

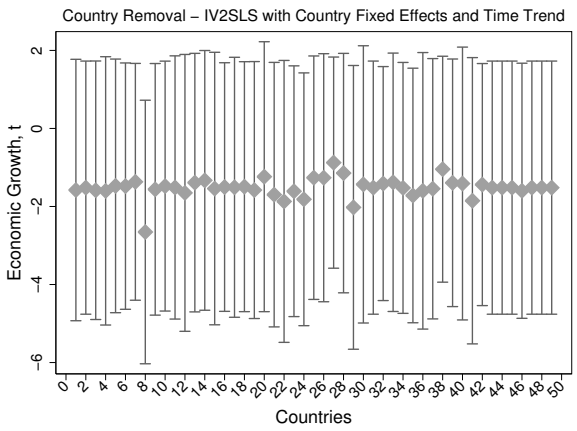


Fig. 2.3: *GDP growth rate, t-1 in IV2SLS with Country Fixed Effects and Time Trend*

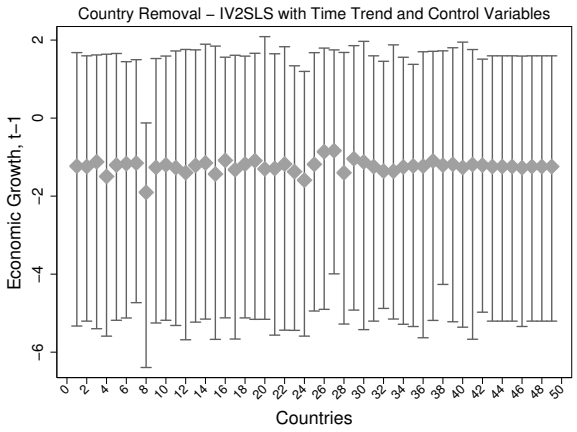


Fig. 2.4: *GDP growth rate, t in IV2SLS with Time Trend and Control Variables*

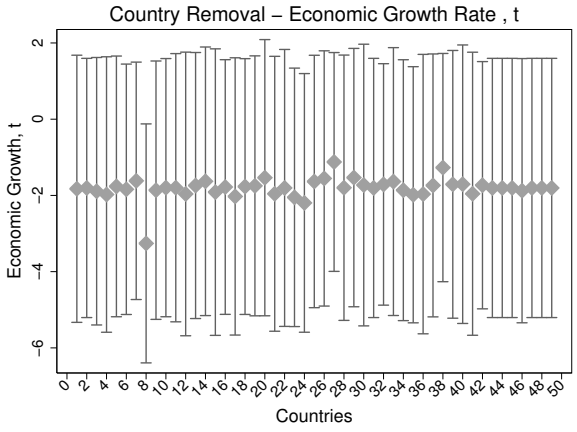


Fig. 2.5: *GDP growth rate, t-1 in IV2SLS with Time Trend and Control Variables*

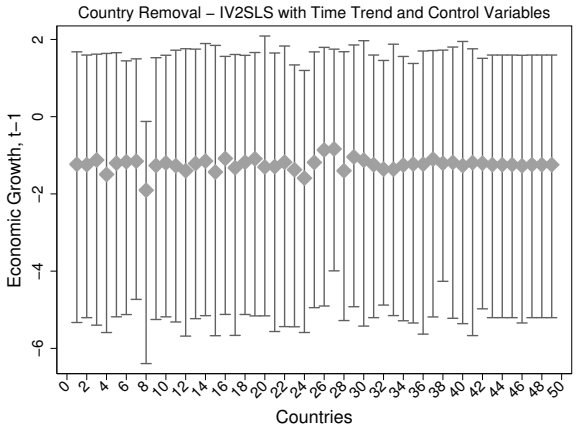


Table 2.6: IV2SLS without Niger

	I		II		III		IV	
$gdp_{gp}enn$	-2.654		-3.259	**	-2.512	**	-1.630	*
	(1.723)		(1.599)		(1.072)		(0.900)	
$gdp_{glp}enn$	-2.225	**	-1.904	*	-1.434		-0.041	
	(0.932)		(1.049)		(0.919)		(1.036)	
y_0g2			0.013		-0.022	*		
			(0.023)		(0.012)			
polity2l			0.004		-0.005	*		
			(0.003)		(0.003)			
ethfrac			0.340		0.194			
			(0.252)		(0.259)			
relfrac			0.049		-0.286			
			(0.290)		(0.228)			
oilwdi2m			-0.121		0.066			
			(0.146)		(0.171)			
lnpopwdil			0.025		0.041			
			(0.041)		(0.038)			
lmtnest			0.057		0.081	**		
			(0.048)		(0.037)			
N	1044		932		932		1044	
$r2_a$	0.322		0.183		-0.063		0.377	
Cragg-Donald F stat	4.595		3.974		5.495		4.286	
Kleibergen-Paap F stat	4.286		4.026		5.495		4.286	
Kleibergen-Paap LM test p-value	0.00262		0.00363		0.00106		0.00262	
$H_0 : t - testsize > 10\%(p - value)\|KP$	0.963		0.971		0.918		0.963	
$H_0 : t - testsize > 25\%(p - value)\|KP$	0.231		0.267		0.128		0.231	
$H_0 : t - testsize > 10\%(p - value)\|CD$	0.953		0.970		0.897		0.953	
$H_0 : t - testsize > 25\%(p - value)\|CD$	0.200		0.260		0.104		0.200	
$H_0 : t - testrel - bias > 10\%(p - value)\|KP$	0.660		0.700		0.505		0.660	
$H_0 : t - testrel - bias > 30\%(p - value)\|KP$	0.181		0.213		0.0946		0.181	
$H_0 : t - testrel - bias > 10\%(p - value)\|CD$	0.620		0.692		0.456		0.620	
$H_0 : t - testrel - bias > 30\%(p - value)\|CD$	0.154		0.207		0.0752		0.154	

Notes: Huber robust standard errors are in parentheses. Regression disturbance terms are clustered at the country level. A country-specific year time trend is included in all specifications (coefficient estimates not reported).
** Significantly different from zero at 90 percent confidence level.*
*** Significantly different from zero at 95 percent confidence level.*
**** Significantly different from zero at 99 percent confidence level.*

big, these differences are not caused by a reduction of the number of observations.

We test our instrument in every new regression we run and each specification shows the same situation. Therefore, the Kleibergen-Paap LM test cannot reject the null hypothesis, meaning that the models are overidentified and have weak instruments.

Estimates confirm MSS'results and, in general, economic literature. We have found a dramatic impact of economic variables on civil war incidence. At the same time, mountainous countries seem to have an inclination to civil war, while polity reduced this probability. Both results are logical and in line with literature. Other country specific characteristics do not seem to be relevant to civil war in this model. However, instruments found by MSS seem to be weak (especially lagged GDP growth rates) in our models.

2.5 Defining Civil War

So far, we have discovered that GDP per capita growth is endogenous to civil war and that rainfall variation is the only instrument for economic growth. However, this instrument has not succeeded to pass a robustness and validity test. Even if we change time period or the sample,

instrument fails almost each test. This is a surprising result, since rainfall variation seems to be a valid instrument in the African case from a logical and a theoretical point of view. Starting from this reasoning we may wonder that the problem is not related to the instrument rather to the definition of conflict. This means shifting the focus from our x to the y of our models. In order to investigate this hypothesis we must first analyse the definition of civil war and, then, we replicate same study of previous paragraph by applying different threshold of fatalities.

The first definition of civil war was designed in 1972 by Singer and Small in the book "The Wages of War". They classify civil war as:

Intrastate war: a sustained combat between the armed forces of the government and forces of another entity for central control or for local issues.

In their book, a variant of civil war is the Extra-state war, that is a sustained armed combat between a state member of the international system and a political entity (not a system member) outside of its territorial boundaries, that meets the violence threshold. Colonial and imperial wars belongs to this category. The violence threshold is a fundamental ingredient of their definition, in fact a sustained combat implies 1000 battle fatalities among all of the system members involved. They do not impose a fixed time in which these deaths must occur and only military battle-deaths are included.

Their pioneering definition[13] has become a conflict database (Correlates of War -COW) which is the reference point in conflict research for hundreds of scholars.

Although COW remains the predominant conflict dataset[14] the Uppsala Conflict Data Program (UCDP) (Gleditsch et al, 2002[15]) has developed the conventional definition of civil conflict:

Internal conflict occurs between the government of a state and one or more internal opposition group(s)[16] without intervention from other states;

Internationalised internal armed conflict occurs between the government of a state and one or more internal opposition group(s) with intervention from other states (secondary parties) on one or both sides.

These definitions inherited from COW the concept of fatalities threshold but UCDP divides civil war into three level of violence:

1. Minor Armed Conflict: at least 25 battle-related deaths per year and fewer than 1000 battle-related deaths during the course of the conflict.

2. Intermediate Armed Conflict: At least 25 battle-related deaths per year and an accumulated total of at least 1000 deaths, but fewer than 1000 in any given year

3. War: At least 1000 battle-related deaths per year.

The main contributor of UCDP is the Center for the Study of Civil War (CSCW) at the Peace Research Institute in Oslo (PRIO) which includes in the definition also the type of incompatibility involved: either government (type of political system, the replacement of the central government or the change of its composition) or territory (a change from one state to another in the control of territory in an interstate conflict or demands for secession or autonomy in an internal conflict).

[13] In reality the very first effort about civil war was published in 1942 by Quincy Wright. Wright tried to develop a basic theory of war by collecting systematic information on the history of war

[14] For example, Fearon and Laitin (2003) and Sambanis (2002) raise a number of concerns with the COW criteria, application and list.

[15] The definition of war as used by Gleditsch et al (2002) has two dimensions. First, they distinguish four types of violent conflicts according to the participants and location: (1) extra-systemic conflicts (essentially colonial or imperialist wars), (2) interstate wars, (3) intrastate wars and (4) internationalized intrastate wars. The second dimension defines the level of violence.

[16] UCDP defines an "opposition organisation" as any (formal) non-governmental group of people using armed force to influence the outcome of the stated incompatibility. UCDP deals only with armed conflict involving consciously conducted and planned political campaigns rather than spontaneous violence.

Thanks to these two databases, researchers can analyse and discuss several issues related to internal conflicts. Nevertheless, only few researchers have reviewed the coding rules or the definition itself. In fact, a plethora of work about civil war have been released by top journals, but usually everybody accepts the definition based on the battle-related threshold[17].

On the contrary, we find that the choice of the battle-related death threshold is a questionable starting point. As properly addressed by Sambanis (2004), it is true that a war distinguishes itself from other forms of violence because it causes large-scale destruction. But, at the same time, it does not exist any logical reason for choosing 1000, 25 or 50 fatalities. First of all, battle deaths supposes an idea of war which is still lied to the old-style (and western) idea of war (i.e. two armies crushing and fighting). Maybe over the past years it was sufficient to know how many soldiers belonged to a State to count easily battle-deaths. Now, we have much more disaggregated entities fighting each other and it is much more difficult to count properly the number of fatalities.

Moreover, there are technical difficulties related to the fact that in developing countries, statistical offices are not reliable[18], so that sometimes they do not even know the existence of a village, and hence its inhabitants[19].

During a civil war, many villages are completely destroyed. It is not unusual in developing countries that everyone in a village is killed and the State discovers that tragedy only after some times. Those killed people will not be counted as battle-death because nobody knows who are the killers and when the event has took place. This is an example of serious bias. In continent like Africa there are more informal armed groups than formal army. So, how can we count battle-death realistically? And, more important, how can we define a concept using data that can not be recorded with high certainty? This is proven by the fact that three dataset of conflict (UCDP, ACLED, SCAD) record fatalities in armed conflict and they provide different numbers (Tab. 2.4).

Moreover, measurement errors in the dependent variable results in a larger error variance than when no error occurs; this, of course, results in larger variances of the OLS estimators. This is to be expected, and there is nothing we can do about it (except collect better data).

Other than that, conflicts are complex events that have direct consequences (i.e. deaths; destruction of infrastructures, services and houses; and so on) and indirect consequences (i.e. refugees and migration, starvation, rapes, etc)[20]. Of course, battle-death is an important indicator, but maybe it is not the most important.

Already Sambanis (2004) has demonstrated that there are substantial differences across civil war lists with respect to the coding of the onset and termination of civil war. Exploring those differences analytically reveals some conceptual confusion but, above all, Sambanis shows that the estimated coefficients of most variables vary widely as a result of changes in the coded onset of civil war. Of course, this has important implications in the understanding of the conflict and in the policies adopted for preventing and solving conflictual situations.

If we use a battle-death threshold, we may misrepresent the nature of internal conflict (Raleigh, et al., 2010) where people claim their rights over some particular issue (such as natural

[17] Only Sambanis (2004) questioned COW coding rule criteria, suggesting a new definition of conflict. He conducted a meticulous review taking a close look at the coding rules and at the different versions of COW database. However, he still assumes numerical threshold of deaths as coding rule for conflict onset.

[18] After the Twin Towers attack on September 11, 2001, in New York it was very hard to count the number of dead (Sambanis, 2004). How can we demand to measure attentively civil war deaths in developing countries?

[19] For example, in Uganda in 2009 there was a cruel massacre in the remote location of Makombo. This tragic event was discovered only months later (Human Rights Watch, 2010).

[20] Battle death estimates do not include victims of state-violence against unarmed civilians (such as the Rwandan genocide in which 800,000 people perished) and communal violence between non-state groups (such as the 1994-1995 ethnic violence of northern Ghana that saw 15,000 fatalities) (Jonsson, 2007). It also excludes rape, deliberate mutilation, forced conscription of children, the use of land mines and the depredations of militias on unarmed people. For example, between 1998 and 2004 in the Democratic Republic of Congo, around 3.9 million people died from all conflict-related causes of mortality (Coghlan et al, 2006).

Table 2.7: Number of Fatalities in Different Databases

COUNTRY	ACLED	SCAD	UCDP
Algeria	14593	0	17497
Angola	159134	0	29831
Benin	9826	0	0
Botswana	77	4	0
Burkina Faso	186	35	0
Burundi	21724	2203	8676
Cameroon	529	519	70
Central African	2356	559	520
Chad	6036	968	6567
Congo	5733	816	14173
Democratic Repub	62210	20165	18225
Djibouti	21663	7964	413
Egypt	58	454	630
Equatorial Guine	0	0	0
Eritrea	881	1155	19129
Ethiopia	41016	1176	166464
Gabon	2457	35	0
Gambia	8592	495	0
Ghana	455	475	0
Guinea	3066	848	647
Guinea-Bissau	3107	177	706
Ivory Coast	4386	877	834
Kenya	7253	5735	29
Lesotho	514	190	68
Liberia	2225	1683	3048
Lybia	172	558	0
Madagascar	881	896	0
Malawi	107	142	0
Mali	582	446	610
Mauritania	169	705	12
Mauritius	0	13	0
Morocco	702	215	226
Mozambique	196	168	4374
Namibia	556	81	63
Niger	1186	213	376
Nigeria	16599	17005	535
Rwanda	9856	9202	6523
Senegal	16726	108	1422
Sierra Leone	1247	354	10574
Somalia	5803	5456	18479
South Africa	6928	10982	0
Sudan	48029	5553	43254
Swaziland	68	1362	0
Tanzania	22256	1781	0
Togo	170	399	0
Tunisia	524	153	0
Uganda	15995	267	9968
Zambia	616	65	0
Zimbabwe	9183	322	0

resources, rights, equality, religion and so on). If anything, we can use battle-death threshold to see the magnitude or the intensity of internal conflicts and civil wars (d'Agostino, et al., 2013). But, in this case, we have to take in mind that countries with high density of population can cause high levels of deaths, compared with small countries or less populated countries. Hence, if we want to use a battle-death threshold, we should at least weigh it with population density

(Sambanis, 2004).

2.5.1 Replication with Different Thresholds

In the previous paragraph we have explained our reasoning about current definition of civil war and related coding rule. Namely, we have argued that the conflict variable developed by the UCDP (and invented by COW) is not a proper variable because estimates are too sensitive to the coding rule of conflict variable (Sambanis, 2004). To address the issue mentioned in the previous paragraph, in this section we report our findings showing that battle-death threshold is A very fragile indicator: small changes of the threshold cause big changes in the estimates.

In the underlying figure (Fig. 2.3), we see how estimates depend on the battle-death threshold[21]: we have run for 3000 times the same IV-2SLS by changing each time the threshold. Therefore, in the first regression the dependent variable (civil war) assumes value equals to 1 with one death over a year; in the second regression conflict variable corresponds to value 1 when there are two dead; and last regression, instead, assumes value 1 when we reach 3000 deaths.

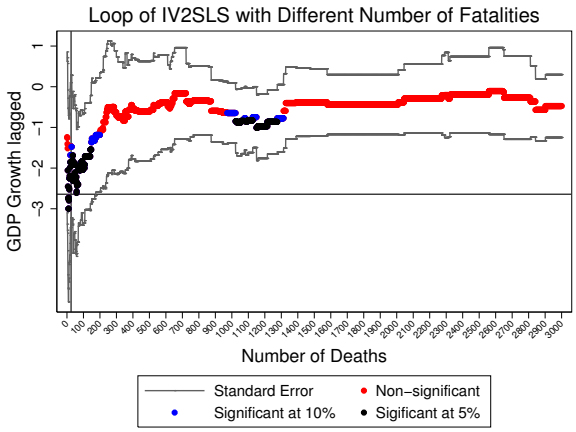


Fig. 2.6: *Loop of IV2SLS: From 1 death to 3000 deaths*

The graph shows that red points stand for non-significant lagged GDP growth estimates. Black and blue points, instead, indicate a 5% and 10% significance level respectively. Therefore, each dot shows the significance of the lagged GDP per capita growth coefficient corresponding to a particular regression. For example, the first dot shows that lagged GDP per capita growth is non significant if the y assumes value equal to 1 when we have 1 dead over a year.

Estimates of (instrumented) lagged GDP growth are significant in a cyclical way: we have significant coefficient in the interval ranging from 5 deaths to 200 and from 1000 to 1400 fatalities. These changes might be due to endogeneity related to countries. In order to address this issue, we run regressions of the same model by removing countries with the highest fatalities. Then, we replicate same model with different thresholds and we test MSS's instruments to see if estimates are simply biased by weak instruments.

Table 2.7 shows that even the main important Database of conflicts (i.e. UCDP) have some recording problem. In fact, as we can see, in the third column Ethiopia and Sudan[22] have the highest number of deaths. We remind that Niger was a problematic country in previous regressions. Here, we discover that this country has not many fatalities.

[21] Informations about the number of deaths are taken from the UCDP Database.

[22] In Sudan there is a cruel dictatorship of Al Bashir who came to power in a coup in 1989 and in 2009 has been condemned for genocide by the International Criminal Court for the crisis in Darfur province. Moreover, Sudan is affected by regional instabilities, displacements and terrors with Al Qaeda allegedly fleeing their Pakistan cells to Sudan and Somalia.

At the same time, we have also several zero values (1421 zero observations). First of all, these zeros can create estimation bias. Then, if we take a closer look at these zeros, we can easily say that, at least for some countries, they are missing values (i.e. they are not peaceful countries but countries with missing values). In fact, for example, it is quite unlikely that Lybia, Tanzania and Madagascar have no killings over the time span 1981-2009[23]. Similarly, in South Africa, the apartheid was removed in 1990. Hence, it is very likely that South Africa's zero fatalities during the period 1981-2009 is a measurement bias.

Table 2.8: IV2SLS without Sudan

	I	Ia	II	III
GDP Growth	-0.988	-1.597	-2.797	-2.797
	(2.288)	(1.668)	(1.843)	(1.843)
GDP Growth, t-1	-2.463	-1.530	-1.737 *	-1.737 *
	(1.562)	(1.051)	(1.029)	(1.029)
GDP, 1979			3.052	3.052
			(2.668)	(2.668)
Quality Policy			-0.001	-0.001
			(0.002)	(0.002)
Ethnic Fractionalization			19.707	19.707
			(23.837)	(23.837)
Religious Fractionalization			37.338	37.338
			(27.553)	(27.553)
Oil export			0.108	0.108
			(0.095)	(0.095)
(Log)Population			0.014	0.014
			(0.029)	(0.029)
(Log)Terrain			-2.803	-2.803
			(4.438)	(4.438)
N	1044	1044	933	933
R square adj	0.275	0.406	0.259	0.259

Notes: Huber robust standard errors are in parentheses. Regression disturbance terms are clustered at the country level. A country-specific year time trend is included in all specifications (coefficient estimates not reported).
** Significantly different from zero at 90 percent confidence level.*
*** Significantly different from zero at 95 percent confidence level.*
**** Significantly different from zero at 99 percent confidence level.*

Table 2.8 shows estimates when we remove Sudan and similar results are obtained if we drop Ethiopia (instead of Sudan).

We see that Ethiopia and Sudan affect estimates[24]. The reason is clear: in Ethiopia we have a dictatorship[25] and in Sudan we have a civil war. For this reason, we cannot remove those countries when we analyse civil war. However, we have to take into account that the number of

[23]Until 2011 in Lybia there was a dictatorship, then a revolution put down and killed the dictator Gheddafi. Although Gheddafi was able to maintain peace and gave decent life to its population, he was a cruel dictator inflicting dozens of deaths. In particular, SCAD Dataset records conflictual events since 1991. Similarly, Madagascar is a very unstable island with recurrent coup d'etat. According to World Bank Indicators, political stability in Madagascar has always been low but it is decreasing since 2006. In 2009 Madagascar had a deep political crisis and still now this big island has not recovered. Although Tanzania is rated as the most peaceful country in the region, it is still struggling with its internal economic dynamics. In Tanzania, from 1992 ethnic groups have started to kill each other with the aim to take the power. Tensions are high also for environmental issues (oil and land-grabbing for biomass) (Environmental Justice Atlas). There is not a proper civil war, but tension is still high among them.

[24]We have run also the overidentification and weak instrument test, following the same procedure as before. Once again, instruments prove to be weak, although equations are not overidentified.

[25]In 1991 the Ethiopian People's Revolutionary Democratic Front (EPRDF) assumed democratically power after overthrowing President Mengistu. EPRDF has been ruling the country since 1991 and currently controls all but one seat in parliament. Human Rights Watch reports in 2015 that thousands of Ethiopians are jailed, killed and tortured by the State. "Ethiopia is one of the most restrictive environments for independent investi-

fatalities influence estimates. Hence, if it is true, the bias from the missing values of conflictual countries is much bigger than we expect.

Of course, if we rely on the number of fatalities to build our conflict variable, we need to have reliable statistics.

In the following lines we will prove that estimates are very sensible to small changes of the threshold.

For example, let's see what happens if we run the usual IV2SLS specifications by using 30 battle-deaths as threshold for the conflict variable.

Table 2.9: IV2SLS with 30 Battle-deaths Threshold

	I		Ia		III	
GDP Growth	-1.859		-2.217		-2.310	
	(1.545)		(1.604)		(1.448)	
GDP Growth, t-1	-1.552	*	-1.539	*	-1.682	**
	(0.939)		(0.832)		(0.774)	
GDP, 1979			0.009		-0.026	***
			(0.007)		(0.008)	
Quality Policy			-0.002		-0.007	***
			(0.001)		(0.002)	
Ethnic Fractionalization			-0.206		0.052	
			(0.130)		(0.189)	
Religious Fractionalization			0.054		-0.175	
			(0.160)		(0.169)	
Oil export			-0.052		0.093	
			(0.072)		(0.103)	
(Log)Population			-0.002		0.004	
			(0.021)		(0.026)	
(Log)Terrain			-0.024		0.046	**
			(0.022)		(0.023)	
N	1071		959		959	
R square adj	0.326		0.288		-0.123	
Cragg-Donald F stat	4.595		4.033		5.902	
Kleibergen-Paap F stat	4.286		3.974		5.495	
Kleibergen-Paap LM test p-value	0.00262		0.00363		0.00106	
$H_0 : t - testsize > 10\%(p - value)\|KP$	0.963		0.971		0.918	
$H_0 : t - testsize > 25\%(p - value)\|KP$	0.231		0.267		0.128	
$H_0 : t - testsize > 10\%(p - value)\|CD$	0.953		0.970		0.897	
$H_0 : t - testsize > 25\%(p - value)\|CD$	0.200		0.260		0.104	
$H_0 : t - testrel - bias > 10\%(p - value)\|KP$	0.660		0.700		0.505	
$H_0 : t - testrel - bias > 30\%(p - value)\|KP$	0.181		0.213		0.0946	
$H_0 : t - testrel - bias > 10\%(p - value)\|CD$	0.620		0.692		0.456	
$H_0 : t - testrel - bias > 30\%(p - value)\|CD$	0.154		0.207		0.0752	

Notes: Huber robust standard errors are in parentheses. Regression disturbance terms are clustered at the country level. A country-specific year time trend is included in all specifications (coefficient estimates not reported).
** Significantly different from zero at 90 percent confidence level.*
*** Significantly different from zero at 95 percent confidence level.*
**** Significantly different from zero at 99 percent confidence level.*

From Table 2.9, it is clear how estimates change drastically by adding only 5 fatalities to the conventional coding rule for conflict variable.

As before we run weak instrument test and overidentification test for this regression. Once

gation, reporting, and access to information, earning the country a top-10 spot in the global ranking of jailers of journalists. For the past decade, the government has limited access to information by regularly threatening, imprisoning, and prosecuting individual activists, bloggers, and journalists and sending a clear public message that the media must self-censor and that dissent or criticism of government policy will not be tolerated." (Human Rights Watch Report, 2015).

again, the instrument is weak but the structural equation is identified. Therefore, we have not solved the problem yet, because instrument is always weak.

2.6 Non-linear Model for the Study of Conflict Onset

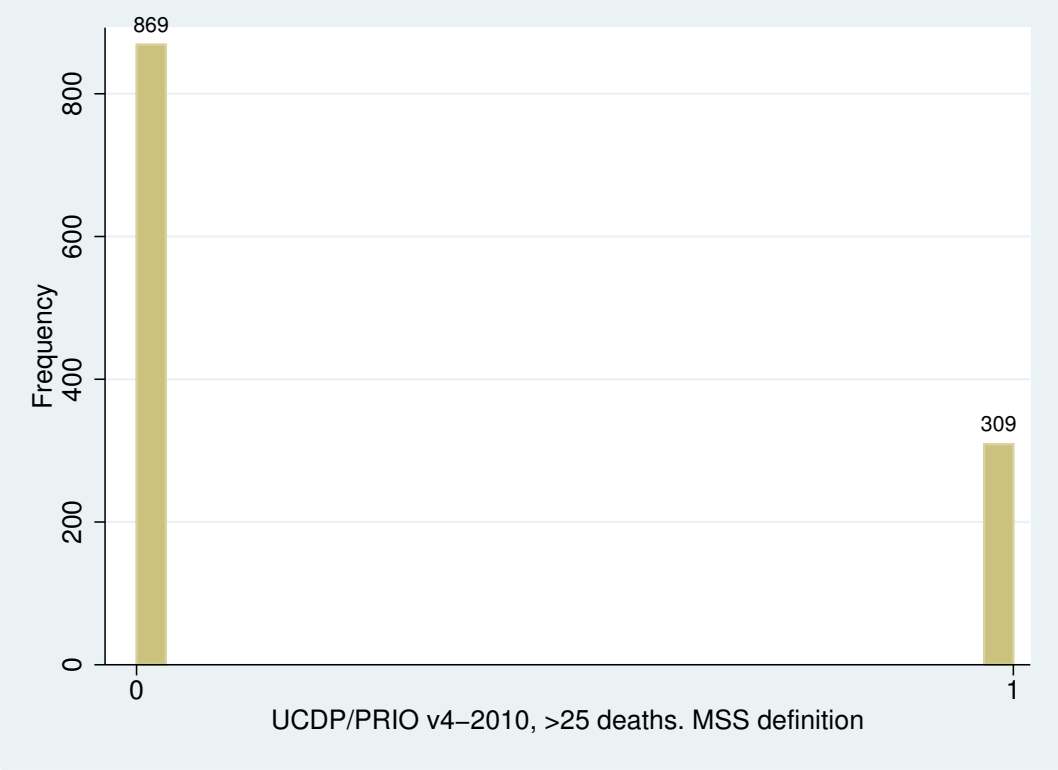
So far we have seen that MSS's instrument is always weak and often not valid. Then, we have showed that current definition of civil war is very sensible to the coding rule and we have criticised the choice of battle-death threshold as main indicator of a civil war. Moreover, we have seen that the dependent variable has important missing values. Therefore, we are aware that estimates are biased and we should improve our models.

In this section we criticize current definition of civil war from another perspective. In particular, we will debate the possibility to use a non-conventional model to answer to our question with reliable results.

As already said, battle-death threshold takes the form of a binary variable, which assumes zero when we are in peace and 1 when there is war. We have explained that economic literature records an event as a minor war if we reach 25 fatalities, or as a civil war if we have more than 1000 battle-deaths in a given year.

This conflict variable is characterised by two features: first of all, it has more zero than one values (Figure 2.7). Secondly, it is a random variable which assumes only positive values $0, 1, 2, ...$

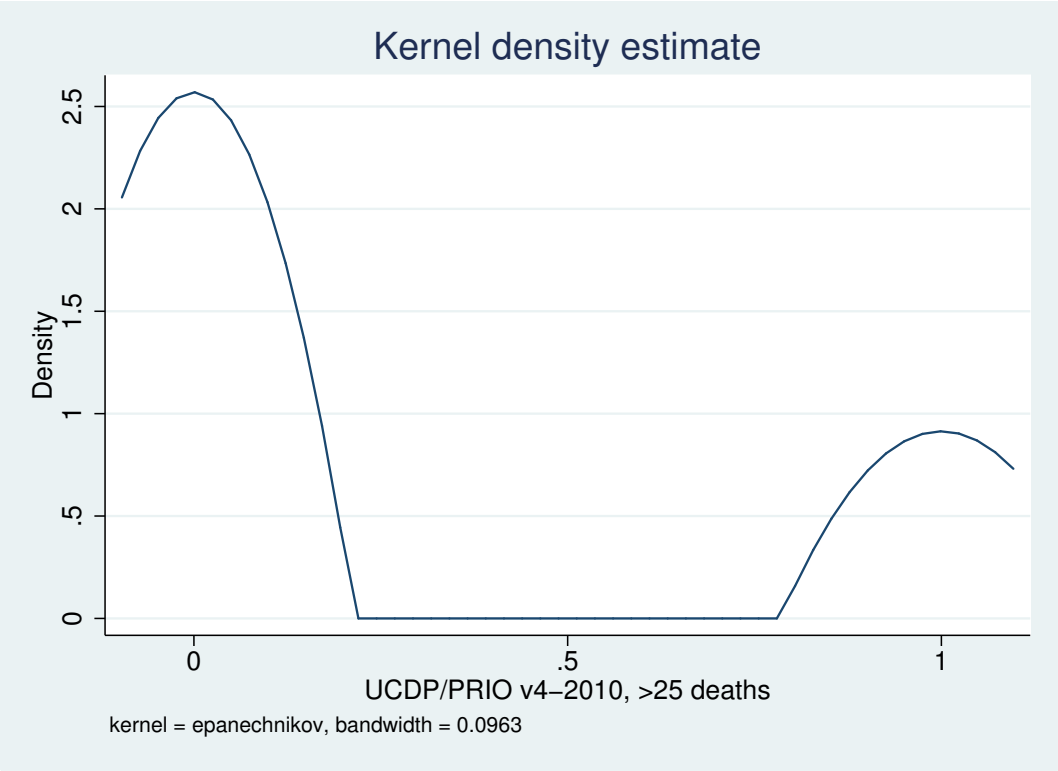
Fig. 2.7: *Frequency of Zeros and Ones*



Hence, we might think that this variable does not fit well in a normal distribution and so we should use non-linear least squares.

In this section we will show that the Zero-Inflated Poisson regression is preferred when the dependent variable is built with the number of deaths in battlefields.

Fig. 2.8: *Density of Civil War Variable*



Theory

We know that when a random variable can take on non-negative integer values, we cannot do the logarithm. Because y is non-negative, we need to choose a functional form that produces non-negative conditional expectations: an exponential function[26] (Wooldrige, 2002).

$E[y|x] = exp(x'\beta)$

Among the exponential distributions, we find the Poisson distribution which is an approximation to the Binomial distribution[27]. The Poisson distribution allows us to find probabilities for any values of the explanatory variables.

A random variable taking on one of the values $(0, 1, 2, \ldots)$, is said to be a Poisson random variable with a rate λ, if for some $\lambda > 0$,

$$p(i) = Px = 1 = e^{-\lambda}\frac{\lambda^i}{i!} i = 0, 1, 2, ... \tag{2.5}$$

If the rate is small, the probability to be verified an event is close to zero. As the rate becomes higher, the centre of the curve moves toward right. Therefore, the Poisson distribution is not symmetrical and goes to infinity.

The assumptions made on the Poisson distribution are that (i) the probability of observing an event is constant over a small interval and proportional to the size of that interval; (ii) the probability of two events occurring in the same narrow interval is negligible; (iii) the probability of an event in one interval is independent of the probability of an event in any other non-overlapping interval.

When we take into account a stochastic process for modelling the times at which an event occurs, we are dealing with a Poisson Process, or counting process: given $N(t), t \geq 0 N(t)$

[26] Because the exponential function is always positive, ensures that predicted values for y will also be positive.

[27] Poisson is a binomial distribution of rare events: the limit to infinity of the binomial distribution with a small probability of success leads to Poisson.

represents the total number of events that occur by time t. This process is non-negative, integer-valued and non-decreasing in t. The counting process $N(t)$ is a Poisson process with intensity $\lambda if N(0) = 0$ and with independent identically distributed exponential (λ) intervals between events. Hence, a Poisson process possesses independent and stationary increments because each event is independent from the other and with the same distribution.

Both Poisson distribution and process assume that the variance is equal to the mean; this assumption is quite strong and often in empirical applications we observe that it is violated. On the contrary, often we have that the variance is greater than the mean for all x; this is called over-dispersion, representing a convex relationship (Wooldrige, 2002). Overdispersion implies that there is more variability around the model's fitted values than is consistent with a Poisson formulation, even if the model is correct. The reasons are diverse, ranging from high heterogeneity, lack of predictors or excess of zero (Wooldrige, 2002).

Being a nonlinear function, we cannot use linear regression methods. We must rely on the maximum likelihood estimation but, since often we have to deal with overdispersion, we can adopt the quasi-maximum likelihood estimation to produce robust estimates. This latter method, in fact, allows for relaxing the assumption that our data respect entirely the Poisson distribution (Wooldrige, 2002). However, we need to adjust the standard errors. In doing so, estimation of β by means of quasi-maximum likelihood is therefore reasonably simple: the likelihood function is the sum of the aggregate probabilities, interpreted as how the expected value of y varies with x (Verbeek, 2004).

As already said, conflict variable is a binomial variable based on the number of deaths in each year (more than 25 or 1000 battle deaths over a year) and we cannot have more than one civil war in a given country. Therefore, conflict variable can be considered as a random event with rare occurrence[28] and occurrences in the beginning or previous period are independent events, since conflicts are only recognised if the threshold has been reached by the end of a calender year.

Each time an armed conflict occurs, it is classified as either a type I (minor intensity) or a type II (high intensity) conflict[29]. Type I has a probability p and type II has a probability (1 p), independently of all other events. We can thus consider a civil war as a Poisson process $N(t), t \geq 0$ with a rate λp and $\lambda(1-p)$ (Ross, 2007). In other words, conflict events that occur are both stationary and independent.

If the Poisson distribution is correct, this produces a consistent, asymptotically efficient and asymptotically normal estimator for β.

Richardson (1960) was the first who used the theoretical Poisson distribution of rare events in civil war; he was then followed by Wilkinson (1980) and Benoit (1996). However, the majority of econometric studies still use linear models or probit specification.

Zero-Inflated Model

As previously mentioned, in many applications the equality of the conditional mean and variance of the distribution is rejected. For this reason, a wide range of alternative count distributions have been proposed [30]. Among them, there is the Zero-Inflated Model (ZIP). This model has been applied to capture the overdispersion caused by an incidence of zeros greater than what would have been expected by a Poisson distribution.

ZIP has been introduced by Lambert in 1992 and then it has been applied in several different fields. In essence, this approach inflates the number of zeros by mixing point mass at 0 with a Poisson distribution. This approach is characterized by a dual-stage process: in the first one we

[28] After all, the classic Poisson example is the chance of a Prussian soldier to be killed by the kick of its horse (Bortkiewicz, 1898).

[29] We will specify different minor and high intensity thresholds.

[30] See and Trivedi (1998) or Winkelmann (2003) for an overview.

observe only zero values and in the second stage we analyse a Poisson distribution with both zero and non-zero values.

In ZIP regression, the vector Y is independent and Poisson distributed with probability (*1-p*), so that

$Y_i = 0$ with probability $p_i + (1 - p_i)e^{-\lambda_i}$ and

$Y_i = k$ with probability $(1 - p_i)e^{-\lambda_i}\frac{\lambda_i^k}{k!}$ with k= 1,2

Y_i has as mean and variance $E(Y_i) = (1 - p_i\lambda_i)$ and $Var(Y_i) = (1 - p_i)\lambda_i(1 + p_i)$

We need a parameter that can transform our mean Poisson distributed and our probability into a linear distribution; these parameters are

$Log(\lambda)$ and $logit(p) = log\frac{p}{1-p}$

which are assumed to be linear function of our n covariates. These covariates can influence λ and p.

Therefore, we have $\lambda = exp(x\beta)$ and $p = \frac{exp(v\gamma)}{1 + exp(v\gamma)}$

Thus, γ is interpreted as factor level effect of the covariates on the likelihood to have zero value, while β is related to the likelihood to have 1.

Then we can run our estimates by using the maximum likelihood estimation method with an Expectation-maximum (EM) algorithm or with the Newton-Raphson algorithm. Both algorithms are used to maximize the log-likelihood but the latter has shown to be faster, when the convergence is found.

To conclude, Lambert (1992) has proved that maximum likelihood estimators for the ZIP models are not biased and are approximately normal.

Using the ZIP method allows more accurate estimates to be obtained than using standard probit or logit models. It should also be noted that Bagozzi et al (2014) argue that when we have less than 10% or more than 90% of zero observations, we may risk to have biased estimates. Unbiased estimates decline when the size of the split in the sample population becomes very big or very smal.

2.6.1 Replication with Non-Linear Models

In this section we will first regress non-linear models with the same variables in order to see whether estimates change and ameliorate compared to IV2SLS.

The underlying table (Table 2.10) shows parameter estimates using the conventional variable of internal armed (i.e. we take the UCDP threshold of 25 battle-deaths) as the dependent variable. Although MSS's instruments have proven to be weak, we cannot use it anyway because it does not exist an instrumental variable Poisson or ZIP approach.

In probit models, the estimated marginal effect on civil war of a unit increases in current GDP growth ranges from -1.4 to -2.6. In the case of Poisson models, the first model uses time trend and the second specification uses time dummies.

As we can see, excepts for the first specification, all cases have significant GDP per capita growth estimates. On the contrary, previous GDP per capita growth does not seem to have an impact on the likelihood of civil war. This finding goes in the opposite direction of our previous results, but remind that here we are not running instrumental variables models, so it can make sense that current GDP growth impacts the likelihood of civil war. When we instrument GDP growth by using rainfall variation over a year, it is more plausible that previous drought period affects negatively peace, while current drought should be less related to civil war. The ratio comes from the fact that during a drought people can still survive with their provisions or by developing emergency resilient activities. On the contrary, when we cannot use rainfall variation as instrument of economic shock, there is a more direct relationship between economic shocks and civil war. Hence, these results are not so unlikely.

As expected, country control variables have a very different effect compared to previous findings. Both probit and Poisson models show that covariates have a crucial impact on the likelihood of civil war. In particular, policy, religious fractionalization, terrain and population are significantly related to civil war. Quality policy seems to have also a parabolic effect (first increasing and then decreasing).

Therefore, in the standard probit, current GDP per capita growth decreases the probability of civil conflict with a high level of significance. Also mountainous terrain and policy are highly significant and non linear (because there is a change of sign in the quadratic parameter).

Table 2.10: Probit and Poisson with 25-death threshold

	Probit1		Poisson1		Probit2		Probit3		Poisson2	
war										
GDP Growth	-1.956	***	-2.336	**	-1.878	**			-1.920	*
	(0.739)		(0.999)		(0.755)				(1.052)	
GDP Growth, t-1	0.351		-0.120		0.471		0.657		0.420	
	(0.683)		(0.972)		(0.694)		(0.710)		(0.989)	
Oil export	0.112		-0.562		0.085		0.020		-0.065	
	(0.155)		(0.450)		(0.154)		(0.159)		(0.255)	
Quality Policy	-0.012		-0.047	*	-0.006		-0.021	*	-0.075	***
	(0.010)		(0.028)		(0.010)		(0.011)		(0.021)	
Quality Policy^2	0.000		-0.000		0.000		0.000		-0.001	***
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Religious Fractionalization	-0.544	*	-52.668		-0.918	**	-0.852	**		
	(0.317)		(157.493)		(0.373)		(0.382)			
(Log)Population	0.175	***	-3.436	*	0.127	**	0.095		0.148	
	(0.051)		(1.765)		(0.062)		(0.064)		(0.104)	
(Log)Terrain	0.169	***	17.982		0.234	***	0.233	***	0.204	***
	(0.038)		(17.967)		(0.057)		(0.058)		(0.079)	
Ethnic Fractionalization					-0.696		-0.554		-1.521	*
					(0.427)		(0.446)		(0.778)	
Ethnic Fractionalization^2					1.324	***	1.237	***	1.702	**
					(0.421)		(0.437)		(0.718)	
N	1018		1018		960		928		960	

In Table 2.11, we perform probit and Poisson models by applying time dummies (column 1) and country fixed effects (column 2). As we can clearly see, current GDP growth is always highly significant and negative related to the likelihood of civil war but, also mountainous terrain confirms its crucial role. In the third probit specification (with country fixed effects and time trend), several covariates are highly significant: Quality Policy, ethnic and religious fractionalization, population and terrain.

When, instead, we assume a Poisson distribution, estimates change. First of all, only GDP growth remains significant. Particularly, estimates of GDP growth tell us that one point estimate change in GDP growth affects negatively the likelihood of peace of 2.1%. Contrary to the probit, grievance variables are not significant when we use fixed effects and time trend.

In a panel set, probit regressions are more suitable and provide a different picture on civil war, where both economic determinants and social-institutional determinants are relevant for the likelihood to be in war or in peace. In numerical terms, if a country increases its real GDP growth by one percent, the likelihood of the country being in peace would decrease by a factor between 1.7 and 3.8 point estimates. Generally speaking, the more a country is poor, densely populated and with mountainous terrain, the more chance it has of living a conflict. Moreover, from probit specification we can see that Quality Policy has a parabolic trend, first increasing and then decreasing; in particular, lagged and contemporaneous Quality Policy is significant and negatively related to the likelihood to be in peace.

Table 2.11: Probit and Poisson with 25 battle-death threshold and Fixed Effects

	probit1		probit2		probit3		poisson1	
Conflict								
GDP Growth	-1.731	*	-3.855	***	-1.779	***	-2.112	**
	(0.901)		(1.019)		(0.679)		(0.863)	
GDP Growth, t-1	0.796		-0.424		0.263		-0.270	
	(0.836)		(0.847)		(0.650)		(0.883)	
Oil export	-0.171		0.738		0.218		0.235	
	(0.213)		(0.514)		(0.155)		(0.406)	
Quality Policy	-0.034	**						
	(0.014)							
Quality Policy^2	-0.000							
	(0.000)							
Quality Policy, t-1			0.039	**	-0.012	**	0.001	
			(0.018)		(0.006)		(0.006)	
Ethnic Fractionalization	0.278		0.000		1.004	***	0.000	
	(0.520)				(0.256)			
Ethnic Fractionalization^2	0.383							
	(0.490)							
Religious Fractionalization	-1.205	**	0.000		-1.056	***	0.000	
	(0.508)				(0.306)			
(Log)Population	0.312	***						
	(0.084)							
(Log)Terrain	0.278	***	0.000		0.315	***	0.000	
	(0.070)				(0.044)			
GDP, 1979			0.000		-0.185	***	0.000	
					(0.047)			
(Log)Population			-0.295		0.122	**	-0.308	
			(0.246)		(0.052)		(0.276)	
Time Trend					0.001			
					(0.006)			
Constant	-6.784	***	6.639		-5.261		5.155	
	(1.198)		(4.321)		(12.221)		(4.812)	
N	927		813		1017		1017	

In Table 2.12, we run ZIP models. Here, we follow Dunne and Tian (2015) procedure, so we have coded a new conflict variable which can assume 2 values: the dependent variable takes on a value of 0 for all peace year observations and a 1 for civil war years with combat deaths ranging between 25 and annual battle deaths of above 1000. we first regress probit and Poisson models and then we use ZIP regression to make see differences among different approaches. In the context of the inflation equation, the coefficients represent the factor change in the probability of being always peaceful compared to unstable peace. Therefore, in the first part of the table we have the response variables predicted by the full model. Here, the coefficients of the output are interpreted as we would interpret coefficients from a standard Poisson model. In the second part, instead, output refers to the logistic model predicting whether or not a country is always zero. So, the higher the value, the more likely the country is likely to be in peace.

When we use probit models, GDP growth has a negative impact. On the contrary, results reveal that in the case of the ZIP equation, GDP growth has a positive effect on the likelihood that a country-year to be among the always zero group (i.e. peaceful countries). In numerical terms, if a country increases its real GDP by one percent, the likelihood of the country being peaceful would increase by a factor ranging from 1.8 to 3.3. Oil exports as a share of GDP has a negative and significant effect on the odds of being always zero. Assessing the non-economic variables reveals some more valuable insight on the differences between the two types of zeroes or peace observations. In fact, each control variable now has an impact on the likelihood of being

Table 2.12: Probit and Poisson with New Threshold

	probit1		poisson1		probit2		probit3		probit4		poisson2	
Civil War												
GDP Growth	-1.846	***	-2.312	***	-1.808	***	-1.941	***			-1.650	**
	(0.677)		(0.686)		(0.691)		(0.694)				(0.753)	
GDP Growth, t-1	0.374		-0.339		0.439		0.361		0.459		0.940	
	(0.642)		(0.681)		(0.651)		(0.655)		(0.649)		(0.688)	
Oil export	-0.026		-0.047		-0.079		0.207		-0.051		-0.023	
	(0.142)		(0.320)		(0.143)		(0.157)		(0.143)		(0.162)	
Quality Policy	-0.019	**	-0.011		-0.019	**	0.001		-0.013		-0.038	***
	(0.009)		(0.016)		(0.009)		(0.013)		(0.009)		(0.013)	
Quality Policy^2	0.000		-0.000		0.000		0.000		0.000		-0.000	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Religious Fractionalization	-0.664	**	248.931	**	-0.935	***	-1.060	***				
	(0.286)		(101.095)		(0.331)		(0.307)					
(Log)Population	0.276	***	0.347		0.222	***					0.371	***
	(0.046)		(1.021)		(0.056)						(0.066)	
(Log)Terrain	0.211	***	-14.604		0.268	***	0.320	***	0.302	***	0.236	***
	(0.034)		(11.317)		(0.050)		(0.044)		(0.037)		(0.049)	
Ethnic Fractionalization					0.287		1.022	***	0.590	*	0.422	
					(0.358)		(0.257)		(0.347)		(0.416)	
Ethnic Fractionalization^2					0.393				0.260		-0.202	
					(0.341)				(0.332)		(0.380)	
Time Trend							-0.002					
							(0.007)					
GDP, 1979							-0.200	***				
							(0.049)					
Quality Policy, t-1							-0.003					
							(0.009)					
(Log)Population							0.121	**				
							(0.052)					
Constant	-5.176	***	-85.317		-4.648	***	-0.016		-1.776	***	-8.017	***
	(0.695)		(62.377)		(0.788)		(13.571)		(0.182)		(1.033)	
N	1018		1018		960		1017		923		960	

completely peaceful. Among them, population results to be always highly significant, both with and without time dummies.

The results reveal that in the case of ZIP models, GDP growth is mostly always significant and positively affects the likelihood to be in peace. Together with economic variables, also grievances variables prove to be much significant.

Finally, a Vuong (1989) test is run, rejecting the hypothesis that the traditional probit or Poisson models are better, thus favouring the zero-inflated models as a less biased estimator.

Empirical estimations using the MSS updated data provide a strong case for arguing that the determinants of conflict literature should consider moving from standard probit models to some form of a ZIP model. If not, researchers risk both underestimating the risk of civil conflict and making erroneous conclusions regarding its significance.

2.7 Conclusion

This chapter addresses three main issues: (i) the reciprocal relationship between economic growth rate and civil war; (ii) the weakness of instrumental variable; and (iii) a debate about the definition of civil war.

In the first part of this chapter we have reviewed first attempts to deal with the problem of endogeneity of economic factors used as explanatory variables. In particular, we have seen

Table 2.13: ZIP Model with New threshold

	Probit and ZIP1		Probit and ZIP2		Probit and ZIP3	
Civil War						
GDP Growth	-5.363		-2.339		-3.661	
	(3.384)		(3.652)		(3.386)	
GDP Growth, t-1	0.756		0.173		-0.545	
	(0.711)		(0.726)		(0.730)	
Oil export	0.011		-0.286		-0.129	
	(0.187)		(0.186)		(0.186)	
Quality Policy	-0.065	***	-0.058	***	-0.089	***
	(0.012)		(0.012)		(0.014)	
Quality Policy^2	-0.001	***	-0.000	***	-0.001	***
	(0.000)		(0.000)		(0.000)	
Religious Fractionalization	-0.665	*	-0.397		-0.365	
	(0.375)		(0.425)		(0.379)	
(Log)Population	-0.081		0.126		0.067	
	(0.081)		(0.082)		(0.070)	
(Log)Terrain	0.280	***	-0.047		0.227	***
	(0.053)		(0.059)		(0.051)	
Time Trend					-0.025	***
					(0.009)	
Constant	0.538		-2.276	*	48.679	***
	(1.283)		(1.330)		(17.757)	
inflate						
GDP Growth	3.253	*	5.178	***	1.804	
	(1.722)		(1.718)		(1.419)	
GDP Growth, t-1	0.378		2.463	*	-1.318	
	(1.596)		(1.358)		(1.288)	
Quality Policy	-0.023		-0.017		-0.422	***
	(0.015)		(0.011)		(0.112)	
Oil export	-0.953		-1.650	***	-0.908	*
	(0.674)		(0.502)		(0.468)	
Religious Fractionalization	0.373		0.976		0.892	
	(0.709)		(0.643)		(0.636)	
(Log)Population	-1.975	***	-0.838	***	-0.919	***
	(0.481)		(0.160)		(0.178)	
(Log)Terrain	-0.038		-0.980	***	-0.138	
	(0.132)		(0.203)		(0.093)	
Quality Policy^2					-0.005	***
					(0.002)	
Constant	29.693	***	13.692	***	11.902	***
	(7.046)		(2.465)		(2.463)	
N	979		979		979	

that most economists have not tackled this issue or, at least, have lagged the economic variable one or two years. Miguel, Satyanath and Sergenti (2004) have published a very important and influencing study in which they use rainfall variation and rainfall level as instrument for economic growth rate. We have discussed the logic and theoretical strength of this instrument in the case of developing countries and, aboveall, in the case of Africa.

In the second section, we have replicated the above-mentioned study (MSS) in a longer dataset (from 1981 to 2009) by applying Stock and Yogo (2005) for overidentification and instrumental weakness test. Our findings are in line with those of MSS. Therefore, our early conclusions are that rainfall shocks as instrumental variables for economic growth have a even more dramatic causal impact on the likelihood of civil war, compared to the impact found by MSS. Among social, political, geographical and historical characteristics, only oil export, the quality of institutions and mountainous terrain result to be significantly related to civil war.

However, the impact is quite small, compared to the the value of GDP per capita. In fact, in our findings, one-percentage point decline in the quality of polity increases the likelihood of civil conflict by only 0.005 percentage points. This result supports the Greed Theory (chapter 1) where only economic determinants matter in civil war onset.

Following Bazzi and Clemens (2013), we test the potential weakness of the instrument by applying Stock and Yogo's test (2005) based on on the maximum IV estimator bias and the Cragg–Donald (1993) statistic. We find out that rainfall variation is a weak instrument and so, we may have produced biased IV estimators and hypothesis tests with large size distortions.

Nevertheless, rainfall variation seems to be perfect to represent economic growth in Africa, since the lack of irrigation system and the dependence on agriculture of most African families. Therefore, we have hypothesised that the weakness of the instrument is actually due to the coding rule of the definition, rather to the instrument.

Social scientists in general and economists in particular have chosen to base the definition of civil war on the number of deaths. In this chapter we have criticised this choice with different tools and from more than one direction.

First of all, we have explained that nowadays wars are fought among disaggregated entities, such as small militias, private mercenaries, official army, foreign fighters and so on. This not only complicates an already opaque picture, but adds new difficulties on counting battle-deaths. Moreover, the main definitions of civil war, ignore indirect deaths of war, that is starved people, massacres, burnt villages during the transit of an armed group and so on. They are victims of the war as well but are not counted as deaths of a civil war, rather they are included into another dataset (for example UCDP Non-State Conflict Data). Only people dead during a battle are counted.

More importantly is that in developing countries it is bold to base a definition on a quantitative threshold, especially when we deal with conflictual countries or, even worst, with civil wars. Governments are unable to properly collect data about killings and battle-deaths. In the most malicious perspective, governments are unwilling to provide such data, when they are battling an internal rebelling group against whom there are, for instance, some severe human rights violations. We have seen that three main dataset collecting systematic data on armed conflicts provide very different information about conflict onset and about battle-deaths. Therefore, how can we rely on a such problematic variable?

In fact, we have proven that the definition of civil war, based on battle-deaths threshold is very unstable. By replicating the same instrumental variable two stage-least squares, we have showed that small variations to the coding rule of civil war variable, yield big changes on the estimated impact of economic growth on civil war. For example, UCDP defines civil war if there are at least 25 battle-deaths during a year in a country. We have run the same IV2SLS with a threshold of 30 battle-deaths and we have shown that lagged economic growth assumes a value of -1.682 which is significant at 95% level, while in the original model it had a non significant coefficient of -0.983. Hence, we cannot rely on a such arbitrary definition to develop policies which are supposed to prevent and avoid civil wars.

Finally, we have hypothesised that official definitions are adequate but the model is wrong. In literature we usually find linear regressions, probit regressions and, as in MSS, IV2SLS. However, if we have a closer look at the distribution of the dependent variable (based on UCDP or COW dataset), we clearly see that there is a majority of zeros, compared to the presence of ones. This means that civil wars are rare events. In statistics, when we deal with uncommon events, we approximate with a Poisson distribution which is not symmetrical and goes to infinity. In the last part of this chapter we have considered civil war as a Poisson process, that is a stationary and independent rare event in order to run Poisson regression and the Zero-Inflated Poisson regression. The latter is an extension of the Poisson distribution able to capture the overdispersion caused by an high incidence of zeros.

Our findings tell that economic growth increases the likelihood of civil war but, at the

same time, also other social determinants can increase or reduce this probability. In particular, countries exporting oil, densely populated countries, and mountainous countries increase the likelihood of civil war. Also the quality of policy has a negative impact on the likelihood, meaning that bad institutions increase the likelihood of civil war. A vuong test reveal that a Zero-Inflated Poisson model is preferable to a traditional probit but we could not test weather estimates are less or more biased compared to an IV2SLS. In any case, from this study we have found out that not only economic determinants have a crucial role in the onset of civil war, but also geographical, political and trade reasons can cause a civil war.

To conclude, in this chapter IV2SLS, probit regression and ZIP regression provide a new picture in the Economics of Conflicts. In fact, in every model we find a severe impact of economic growth on the likelihood of civil war, but also population growth, oil-exporting countries and mountainous terrain are related with higher probability of civil war. Therefore, although we have not solved the problem of endogeneity, we can state that economic reasons are not the only determinants of civil war.

2.7.1 Appendix A: Available Database and Indicators of Conflict

Since there is no agreement over a unique definition of conflict, we have also several different databases and indicators of conflict. Of course, as we have clearly seen in the previous paragraph, COW Database is the pioneering dataset and it still influences this research field. Among many, we have selected four important databases[31] of conflict:

1) **The Uppsala Conflict Data Program** (UCDP) Armed Conflict Dataset (ACD) at the Department of Peace and Conflict Research (Uppsala University) in cooperation with The Center for the Study of Civil War (CSCW) at the Institute of Peace Research in Oslo, PRIO);

2) **The Armed Conflict Location and Event** (ACLED) Data Project;

3) **The Social Conflict in Africa Database** (SCAD) at the University of North Texas and the University of Denver.

4) **The International Country Risk Guide** (ICRG)

Then, several other researchers have produced their own dataset, coherent with their definition of conflict. Among many, we find Collier and Hoeffler (2004), Fearon and Laitin (2005), and Sambanis (2004).

Among these datasets, the main differences are in: (we) thresholds of violence required to be defined as a civil war; (ii) coding rule of war beginnings and endings; (iii) their treatment of internationalised civil war (where there is some involvement by outside parties); (iv) their treatment of related forms of conflict (e.g. communal violence or State repression); and (v) the underlying data sources they draw from.

Correlates of War Database -COW

COW is a research project that is collecting systematic aggregated data on contentious issues in world politics. This Database covers years from 1816 to 2007, different types of war and related categories of war. In fact, COW provide specific dataset on different typology of war, but also it hosts a variety of datasets related to the study of conflict such that world religion, colonial dependency, diplomatic exchange, bilateral trade, intergovernmental organizations, militarized interState disputes, and others.

[31] For a comprehensive review, see Eck (2005) for a list of databases dealing with conflicts and wars; Kauffmann (2008) discuss important databases on conflict and highlights the issue of comparability across databases due to distinct operational definitions and divergent coding rules.

COW has four different datasets according to the typology of conflict (intra-State wars; inter-State wars; extra-State wars; and non-State wars). The dataset regarding civil war is "intra-State wars" and inside we have another differentiation of type of war: Civil war for central control, civil war over local issues, regional internal and inter-communal war.

Within intra-State (civil war) dataset, we can find several criteria, such that name of war, fatalities (where the requirement for 1,000 battle-related deaths per year is considered to be an average of 1,000 battle-deaths per year in circumstances in which there was evidence of significant sustained combat), opposing actors involved, war duration, start and end of conflict, type of conflict, which party started the war, outcome of war, location by region, system membership status of State,pre-war population, pre-war armed forces and outside intervention.

COW applies the battle-death threshold only to inter-State conflicts. Thus, for example, in intra-State conflicts this criteria is dropped and they record each event where civilians are violently killed, excepts for massacre.

This project was founded at the University of Michigan but in 2001 has been transferred to the The Pennsylvania State University. It is funded by the United States Institute of Peace and the National Science Foundation.

To sum up:

Timespan: 1816-2007

Geographical Coverage: World (both historical and present countries)

Access Conditions and Data Format: Free from their website. Comma-separated variables (CSV).

Civil war Definition: Sustained combat between the armed forces of the government and forces of another entity for central control or for local issues which reach a violence threshold of 1000 battle-related fatalities per year (military and civilians are counted).

Topics: Time span, location, and a set of conflict-specific variables.

The Uppsala Conflict Data Program (UCDP/PRIO)

The dataset was first presented in Gleditsch, Wallensteen, Eriksson, Sollenberg and Strand (2002) as one of the several dataset developed by UCDP/PRIO. UCDP/ACD and CSCW strictly collaborate for producing a comprehensive dataset on conflict in the period 1946 to the present: CSCW provides a specific dataset regarding civil wars, while UCDP/ACD concerns both internal and external conflicts. The data provided by these two Centres are the most accurate and well-used data-sources on global armed conflicts and their definition of armed conflict is the most used in literature.

The main aim of UCDP is the collection of detailed data of minor and major conflicts, in order to allow researchers to deeply understand armed conflicts. In fact, UCDP not only provides information about the onset and the end of competing countries/parties, but it contains also data on the location of the conflict, actors, levels, and years of activity is given, and the name of the opposition organisations in the local language, if available, and in English.

Although they provide a unique dataset for every typology of war, the structure is the same as in COW. So, the calendar year is the basic unit of every observation but they consider a conflict onset when in a certain year it is reached 25 battle-related death. The date of the first battle-related death recorded in the conflict is coded as the "Startdate" in the dataset. If the conflict does not reach the required 25 battle-related deaths threshold, it is coded as inactive in that year. When the conflict is inactive, they use a dummy variable called "EpEnd", where we have a 1 if the conflict is inactive.

They provide also a variable, called "CumInt", which takes into account the temporal dimension of the conflict. To be clearer, this variable is a dummy that codes whether the conflict since the onset has exceeded 1000 battle-related deaths. Thus, if a conflict results in more than 1000 deaths they code 1, if not it is coded as 0. Hence, they record both minor armed conflict (at least 25 deaths but less than 1000 deaths), and intermediate armed conflict (at least 25 battle-related

deaths but less than 1000 deaths per year and an accumulated total of 1000 deaths) and war (at least 1000 fatalities).
As in COW, this database includes also information on the incompatibility, opposition organisation, year, intensity level, location, region, warring parties, and change in intensity from previous year.

UCDP annually updates its data and releases new dataset; for example, in 2015 UCDP has released a new interesting database in which they record georeferenced event-based information. Here each unit of analysis represents a single event of armed violence in which at least one person was killed. The aim of this new database is to provide disaggregated data of organised violence.

UCDP is located at the Department of Peace and Conflict Research, at Uppsala University in Sweden but it collaborates with the Peace Research Institute in Oslo (PRIO) and the Human Security Report Project, based within the School for International Studies at Simon Fraser University in Vancouver.

To sum up:

Timespan: 1946-2016

Geographical Coverage: World

Access Conditions and Data Format: Free from their website. Comma-separated variables (CSV).

Civil war Definition: An armed conflict is a contested incompatibility which concerns government and or territory where the use of armed force between two parties, of which at least one is the government of a State, results in at least 25 battle-relate deaths.

Topics: Time span, location, incompatibility and a set of conflict-specific variables.

Armed Conflict Location and Events (ACLED)

The dataset ACLED is built on the UCDP/PRO armed conflict database. This allows ACLED to be associated and matched with the UCDP/PRIO data.
This dataset is also part of the larger GROW-Net project. The GROW-Net project aims to supplement the study of civil war with models and data that refer to other geographical units than the State.
ACLED is considered the most comprehensive public collection of political violence data for developing States: it contains information on the specific dates and locations of political violence, the types of event, the groups involved, fatalities and changes in territorial control. It records information on battles, killings, riots, recruitment activities of rebels, governments, militias, armed groups, protesters and civilians. ACLED data cover all countries on the African continent from 1960-2016.
This dataset records single events in which all actors have an official name, a political purpose and use violence or protest for political means. For inclusions, organisations must be cohesive and are not assembled for single events, with the exception of riots and protests. Further, the events of organisations must be connected to each other as a means to achieve a larger political purpose.
Thus, the fundamental unit of observation in ACLED is the event. Events must occur between designated actors at a specific named location (identified by name and geographic coordinates) and on a specific day. This allows researchers to track a rebel group over time, to see and map their territorial gains and losses.
ACLED does not use fatalities as the basis for event inclusion. Moreover, they use death-data from other sources, thus they cannot verify the information. The only way for controlling is by matching different sources, so if source reports differ, or a vague estimate is provided, they report the lowest number of fatalities.
Each event is composed from at least one source. Sources come from local, regional, national and continental media; from NGO reports; and from journals specialized in Africa news.
ACLED has been developed because research on conflicts needed to have more disaggregated

data in order to deeply understand conflicts, especially when we deal with civil conflicts/wars. In fact, often macro studies suffer from using aggregated data to explain more local phenomena (as we will explain better in the following paragraph) and in turn it severely limits the power of statistical studies.

To sum up:

Timespan: 1960-2016

Geographical Coverage: Africa and Asia

Access Conditions and Data Format: Free from their Ibsite. Comma-separated variables (CSV) and excel format (xls).

Conflict Definition: the use of force by one or more groups for a political end, although some instances -including protests and non-violent activity- are included in the dataset to capture the potential precursors or critical junctures of a conflict.

Topics: Time span, location, typology, and a set of conflict-specific variables.

The Social Conflict in Africa Database (SCAD)

SCAD lists social conflict events across Africa from 1990 to 2011, including riots, strikes, protests, coups, and communal violence. Each event record contains information on the location, timing, and magnitude of social conflict events, as well as the actors, targets, issues of contention and government response.
SCAD database includes all countries with more than one million people and compiles event by the Associated Press and Agence France Presse.
This dataset adopts the definition of civil war given by CSCW/UCDP/ACD, this implies that if a study uses SCAD and UCDP dataset, there will be repeated information in civil conflict cases. In fact, this dataset is independent from other conflict datasets, but can be associated both with COW and UCDP. This is possible because SCAD uses the same country code as COW and same definition of start and end dates of conflict as in the UCDP/PRIO.
Conceptually, this dataset is similar to ACLED, but then SCAD uses more information related to local conflict. Namely, they list a series of events such as "organized demonstration", "spontaneous demonstration", "organized violent riot", "strike", "pro-government violence", "intra-government violence" and others. Then, they also provide a variable of escalation which informs us whether a conflict changes its type of organisation or not. This variable ranges from "no escalation" to "intra-government violence".
For each event, they record the number of participants (when known), the number of deaths and what kind of repression was used.
They design and list also a new category of reasons for conflicts, which includes 14 reasons (amongst others, elections, environmental degradation, human rights, economic resources, etc.). In order to take into account every issues from each rebelling groups, they have 3 (identical) variables related to the reasons of conflict.
Finally, one other useful variable is the last one, called "notes", which provides additional information related to the event. This variable allows researchers to better understand the background of the violent event, because usually it is an extract from a newspaper.

SCAD is funded by the University of North Texas, the University of Denver, the Robert S. Strauss Center for International Security and Law and the Climate Change and African Political Stability (CCAPS).

To sum up:

Timespan: 1946-2011

Geographical Coverage: Africa and Latin America

Access Conditions and Data Format: Free from their website. Comma-separated variables (CSV).

Conflict Definition: SCAD includes protests, riots, strikes, inter-communal conflict, government violence against civilians, and other forms of social conflict not systematically tracked in other conflict datasets. SCAD excludes armed conflict such as organized rebellions, civil wars, and international war.

Topics: Time span, location, repression, escalation and a set of conflict-specific variables.

The International Country Risk Guide (ICRG)

This dataset is not a strict conflict dataset, but it provides useful information regarding the conflictual situation of a country. This dataset is particularly suitable for a conflict escalation study.

Since 1980, ICRG presents a comprehensive risk structure for the country with ratings for its overall, or composite, risk, for its political, financial, and economic risk. ICRG produced ratings affecting three main categories: political risk, economic risk and financial risk. Within this three categories, they insert 22 variables or risk components. This risk ratings is then combined on the basis of a formula to provide the country's overall, or composite, risk rating. The higher the rating computed for the political, financial, economic, or composite rating, the lower the risk, and vice versa. (International Country Risk Guide Methodology, 2012).

The most useful component in conflict analysis is the Political Risk Components, which includes 12 risk components varying from government stability, to socio-economic conditions, to internal conflict, democratic accountability and so on.

Then, each component has one or more subcomponents. Each component receive some points reflecting the level of risk. These point range from zero to 6 or 12 (it depends on the fixed weight that component is given in the overall political risk assessment). As said, 12 point means that the country is highly stable, whereas 0 point means that there is a very high risk of conflict.

Among the database mentioned in this paper, this database is the only one that is not open source because it is mainly used by firms as well as by researchers at the IMF in order to develop country risk analysis before investments.

To sum up:

Timespan: 1980-2016

Geographical Coverage: World

Access Conditions and Data Format: Upon payment. Comma-separated variables (CSV), excel format (xls) and stata format.

Topics: political risk, economic risk and financial risk and their components.

Collier and Hoeffler (2004)

This database starts from their definition of civil war, seen as an internal conflict with at least 1000 combat-related deaths per year, where both government forces and an identifiable rebel organisation must suffer at least 5% of these fatalities. Collier and Hoeffler (CH) consider a conflict to be over if a peace treaty, ceasefire or military defeat is signed or if there is a long inactivity (in terms of fatalities).

They list 73 civil wars in 161 countries over the period 1960-1999, measured at intervals of five years.

CH take conflict data mainly from COW and from the International policy interventions in civil war (Regan, 2002). Then, they use some control variables taken from The Commodity Price Index, World Development Indicators and Penn World Tables 5.6 for producing GDP, the CIDCM for political variables, Barro (1997) Mauro (1995) and Barret (1982) for producing ethno-linguistic and religious fractionalization, FAO for country's terrain, Gini Coefficient, World Bank for education, primary commodity export and population.

Fearon and Laitin (2003)

Fearon and Laitin (FL) focus on civil wars but decided to develop their own dataset because they found several constraints in COW.
First of all, FL'dataset covers the time-period 1945-1999 in order to include anti-colonial wars. In fact, FL underline the importance of anti-colonial wars as civil wars. Then, they use different criteria to deal with other coding issues. For example, the start year is the first year in which 100 people were killed or in which a violent event occurred that was followed by a sequence of actions that came to satisfy the primary criteria. If an armed group is replaced by a new one, they code a new war start. And, if multiple groups are fighting against a government, they code different wars in the same country-period. They code the end of a war is a victory is observed (through a peace agreement followed by two years of peace).
The other important difference with COW, is that they include a civil war when at least 100 people are killed on both sides or, as in COW, if it is reached 1000 battle-deaths over the course of the conflict.
Their dataset identifies 127 civil wars and 13 of them are anti-colonial wars.
Then, they add several other control variables, such as ethnolinguistic fractionalization (ELF) index based on data from Atlas Narodov Mira 1964 and from CIA Factbook, religious fractionalization from CIA Factbook, the share of population belonging to the largest ethnic group, the number of distinct languages spoken by groups exceeding 1% of the country's population based on Grimes and Grimes (1996), GDP growth from WDI, Penn World Development Indicators and Energy consumption estimates from COW, rough terrain from A.J. Gerard, political variables from Polity IV Index, country population from WDI, fuel exports and primary commodities from WDI, non-contiguous territory and the creation of a new State.

Sambanis (2004)

He develops a long definition of civil war that we are going to cite. According to him, in order to distinguish a civil war from other types of violence, it is necessary to meet several criteria:

(a) The war takes place within the territory of a State that is a member of the international system with a population of 500,000 or greater.

(b) The parties are politically and militarily organized, and they have publicly Stated political objectives.

c)The government (through its military or militias) must be a principal combatant. If there is no function in government, then the party representing the government internationally and/or claiming the State domestically must be involved as a combatant.

(d) The main insurgent organisation(s) must be locally represented and must recruit locally. Additional external involvement and recruitment need not imply that the war is not intra-State. Insurgent groups may operate from neighbouring countries, but they must also have some territorial control(bases) in the civil war country and/or the rebels must reside in the civil war country.

(e) The start year of the war is the first year that the conflict causes at least 500 to 1,000 deaths. If the conflict has not caused 500 deaths or more in the first year, the war is coded as having started in that year only if cumulative deaths in the next 3 years reach 1,000.

(f) Throughout its duration, the conflict must be characterized by sustained violence, at least at the minor or intermediate level. There should be no 3-year period during which the conflict causes fewer than 500 deaths.

(g) Throughout the war, the weaker party must be able to mount effective resistance. Effective resistance is measured by at least 100 deaths inflicted on the stronger party. A substantial number of these deaths must occur in the first year of the war. But if the violence becomes effectively one-sided, even if the aggregate effective-resistance threshold of 100 deaths has already been met, the civil war must be coded as having ended, and a politicide or other form of

one-sided violence must be coded as having started.

(h) A peace treaty that produces at least 6 months of peace marks an end to the war.

(we) A decisive military victory by the rebels that produces a new regime should mark the end of the war. Because civil war is understood as an armed conflict against the government, continuing armed conflict against a new government implies a new civil war. If the government wins the war, a period of peace longer than months must persist before we code a new war (see also criterion k).

(j) A cease-fire, truce, or simply an end to fighting can also mark the end of a civil war if they result in at least 2 years of peace. The period of peace must be longer than what is required in the case of a peace agreement because we do not have clear signals of the parties intent to negotiate an agreement in the case of a truce/cease-fire.

(k) If new parties enter the war over new issues, a new war onset should be coded, subject to the same operational criteria. If the same parties return to war over the same issues, he generally codes the continuation of the old war, unless any of the above criteria for coding a war's end apply for the period before the resurgence of fighting.

Using these coding rules, Sambanis identifies 145 civil wars between 1945 and 1999 in the world. He uses two different coding war starts: in the first one he considers simply civil war in a specific country-period. This means that if in a country there are more than one conflict, he does not distinguish them. In the second version, on the contrary, he takes in consideration each civil war that starts, even if another war is going on. Of course, conflict onset is a dummy variable, where 1 means that a new war has started.

As in the previous dataset, also Sambanis inserts several control variables. These variables are the same as in FL. He adds only a new variable which measure time at peace since the last war and excludes the dummy variable of new states from FL.

Of course, since Fearon and Laitin, Sambanis, Collier and Hoeffler datasets are all replication datasets, they are not annually updated. But they work a lot on conflicts, so they update their dataset when they publish a new paper.

Other explanatory variables

As we could see, when we study civil war we must take into account country characteristics. The majority of the above mentioned variables are taken from the World Bank Database (WDI) which has a specific dataset for the African Continent. In this database we can download contents such as: population, natural resource exports/imports and production, education, infrastructures, trade, gdp growth and per capita, agriculture, commodities, percent mountainous terrain and many others.

Usually, economic information are taken from the Penn World Table, which provides also information on the population in order to produce also per capita income.

Ethnic, religious and linguistic information are given by three main dataset: the ethnolinguistic fractionalization (ELF) index based on data from Atlas Narodov Mira 1964, Reynal-Querrol dataset, CIA Factbook, Alesina et al. (2003), Grimes and Grimes (1996), and Fearon and Laitin (2003).

Political information are provided mainly by the Polity IV Project and by the Database of Political Institutions (DPI).

2.8 Appendix B: a different replication of MSS

The following tables present same models of before, but here we cluster by the mean level of GDP, instead of country level and we use time dummies instead of time trend.

Table 2.14 shows the relationship between rainfall variation and economic growth. The first specification is the simplest model, while in the second specification we include country control

variables. The last three specifications use both country fixed effects and country specific time trends, but in the fourth and fifth we include a specification test (as in MSS).

Table 2.14: Rainfall and Economic Growth: First-Stage
(Dependent Variable: Economic Growth Rate, t)

	I		Ia		II		III	
GDP Growth	-0.676		-1.517		-2.644	***	-2.644	***
	(2.140)		(1.263)		(0.960)		(0.960)	
GDP Growth, t-1	-2.484	***	-1.545	***	-1.729	***	-1.729	***
	(0.843)		(0.265)		(0.356)		(0.356)	
GDP, 1979					3.122		3.122	
					(2.563)		(2.563)	
Quality Policy					-0.001		-0.001	
					(0.001)		(0.001)	
Ethnic Fractionalization					17.195		17.195	
					(26.443)		(26.443)	
Religious Fractionalization					41.081	*	41.081	*
					(22.887)		(22.887)	
Oil export					0.142	**	0.142	**
					(0.065)		(0.065)	
(Log)Population					0.006		0.006	
					(0.020)		(0.020)	
(Log)Terrain					-3.202		-3.202	
					(3.262)		(3.262)	
N	1071		1071		959		959	
R square adj	0.310		0.442		0.322		0.322	

* p<0.1, ** p<0.05, *** p<0.01

From this first stage, we can see that the instruments are highly significant in almost each specifications. Even if rainfall variation shows a lower effect, compared to MMS, lagged rainfall variation are strongly and positively related to income growth. This is true also when we include country controls (regression 3 and 6) and fixed effects (regression 2, 3, 4, 5 and 6). As expected, future predictions of rainfall variation do not affect income growth (regression 6). This confirms the identification check of MSS. Coherently with MMS, also growth in terms of trade is insignificantly related to economic growth (regression 5).

Regarding the covariates, polity, oil exports, population and terrain variables change the sign (respect to MSS).

In this first stage I do not use dummies for time period but, I can expect that some years might be particularly important for conflict onset. Over the African history, there have been some years during which some exogenous events have changed the conditions of some countries. In order to establish if small changes to the model influence the robustness of empirical results, I have replicated the same model with different time periods and then I drop, one by one, each country.

In general, we can say that the first-stage relationship between rainfall and income growth is strongly positive and stable. Both current and lagged rainfall growth are positively and significantly related to income growth at over 95% confidence level, and this relationship is robust to the change of time period and also to the inclusion of country controls and time trends.

Hence, so far I can confirm the output of MSS: higher levels of rainfall are associated with positive economic growth.

Following MSS, in the following table (Table 2.15) I perform both linear least squares and non-linear models. Now my dependent variable is civil war. As we have seen in literature, I expect that gdp growth is the most important cause of civil war onset. In particular, I expect

that when there is an economic shock or a slow economic growth, the following year there are more possibilities of conflict. Therefore, lagged economic growth rates should be significantly related to civil war onset.

When I run an OLS regression of the incidence of civil war on economic growth, results change drastically. In MSS any contemporaneous or lagged economic growth rates are insignificant, while with my data each current gdp growth, both in probit (column 2, 4 and 6) and OLS (column 1, 3 and 5), is significant and negatively correlated with the incidence of civil conflict.

Table 2.15: Probit and OLS: Economic Growth and Civil War

	OLS		probit1		OLS2		probit2		OLS3		probit3	
GDP Growth	-0.474	***	-2.484	***	-0.374		-1.694	**	-0.419	*	-0.495	**
	(0.150)		(0.809)		(0.232)		(0.816)		(0.227)		(0.224)	
GDP Growth, t-1	-0.038		0.036		0.148		0.395		0.115		0.073	
	(0.187)		(0.728)		(0.236)		(0.822)		(0.229)		(0.219)	
GDP, 1979					-0.022	*	-0.195	*	-0.023	*	-0.052	*
					(0.012)		(0.112)		(0.012)		(0.030)	
Quality Policy					-0.004	*	-0.011		-0.004	*	-0.003	
					(0.002)		(0.008)		(0.002)		(0.002)	
Ethnic Fractionalization					0.219		0.997		0.230		0.280	
					(0.242)		(0.800)		(0.236)		(0.215)	
Religious Fractionalization					-0.212		-1.087		-0.212		-0.294	
					(0.201)		(0.711)		(0.197)		(0.191)	
Oil export					0.074		0.250		0.065		0.061	
					(0.153)		(0.483)		(0.151)		(0.132)	
(Log)Population					0.036		0.139		0.032		0.034	
					(0.037)		(0.133)		(0.035)		(0.035)	
(Log)Terrain					0.081	**	0.320	**	0.083	**	0.088	**
					(0.037)		(0.128)		(0.037)		(0.034)	
N	1177		974		1017		1017		1017		1017	
R square adj	0.443				0.106				0.105			

Notes: Robust standard errors in parentheses. Significant at * p<0.1, ** p<0.05, *** p<0.01

Another difference with MSS is that in my estimates, lagged economic growth rates are all positive, excepts for the first OLS specification (which uses time dummies and country fixed effects). On the contrary, in MSS, previous gdp growth is positively correlated with civil war only in the last two OLS specification (where we use within transformation). Among the covariates, as in MSS, terrain is statistically greater than zero at the 5% significance level.

According to the results, civil war onset is related to current rainfall levels and shocks but not significantly likely following low rainfall levels and negative rainfall shocks.

Only the first OLS (which uses country fixed effect and time dummies) tells us that ten-percentage point drop in previous annual economic growth increases the likelihood to have a civil conflict around 0.037 percentage points (with a standard error of 0.18).

In Table 2.16 the first column reports a IV-2SLS with time dummies and country fixed effects. If I follow MSS's procedure (who cluster by country), both current and lagged economic growth is non significant. Here, on the contrary, I have clustered by the mean level of GDP.

In the second column (Table 2.16) I report the same model with country fixed effects and time trend. As before, previous economic growth is highly significant and negatively related to civil war onset. According to the adjusted R-square, this model fits very well our data. This is confirmed by the Kleibergen-Paap LM test which tells us that the structural equation is not overidentified. However, lagged gdp growth is badly instrumented. In fact, this instrument cannot refuse any statistical test because its F-statistic is far from the 25% maximal IV size and also p-value is low in both first stage and second stage. Similarly, also here when I drop countries, I find out that always Niger, Swaziland, Djibuti and Congo change drastically estimates. For

Table 2.16: IV2SLS: Economic Growth and Civil Conflict

	I		Ia		II		III	
GDP Growth, t	-0.676		-1.517		-2.644	***	-2.644	***
	(2.140)		(1.263)		(0.960)		(0.960)	
GDP Growth, t-1	-2.484	***	-1.545	***	-1.729	***	-1.729	***
	(0.843)		(0.265)		(0.356)		(0.356)	
GDP at 1978					3.122		3.122	
					(2.563)		(2.563)	
Quality Policy					-0.001		-0.001	
					(0.001)		(0.001)	
Ethnic Fractionalization					17.195		17.195	
					(26.443)		(26.443)	
Religious Fractionalization					41.081	*	41.081	*
					(22.887)		(22.887)	
Oil export					0.142	**	0.142	**
					(0.065)		(0.065)	
(Log)Population					0.006		0.006	
					(0.020)		(0.020)	
(Log)Terrain					-3.202		-3.202	
					(3.262)		(3.262)	
N	1071		1071		959		959	
R-square adj	0.310		0.442		0.322		0.322	

* p<0.1, ** p<0.05, *** p<0.01

instance, when I drop Niger, one-point decline in (current and lagged) gdp growth increases the likelihood of civil conflict by over two percentage points.

In the last two columns I have added country controls. The difference between the two specifications is that in the first one I use country fixed effects, while in the second one I use only time trend. As we can see, current and lagged economic growth is highly significant and much more bigger than previous estimates. Hence, if I take into account country characteristics, the impact of economic variables become deep. At the same time, also oil exports and religious fractionalization show to affect civil war. Nevertheless, I have some doubts on these models, since religious fractionalization has strange values with huge standard error and because instruments are weak also in these cases. In fact, in the first stage the structural equations are identified but the actual size of the t-test tells us that the point estimates on the endogenous variables equal zero at 25%. In the second stage, the Cragg-Donald Wald F statistic performs better, showing that the bias of the IV estimates are greater than 20% of the OLS bias.

In these two last specifications, variations in the set of countries do not lead to strong changes. Only Niger shows to affect deeply estimates, because, as before, when we remove this country, estimates change.

Each specification shows the same situation, excepts for the last two specifications: models are identified, because null hypothesis that the structural equation is underidentified is rejected for the Kleibergen-Paap LM test p-value. Nevertheless, instruments are weak. In fact, both the Kleibergen-Paap and the Cragg-Donald test show high levels of p-value, far from the desired 0.05.

In the case of the last two IV2SLS, the Kleibergen-Paap LM test cannot reject the null hypothesis, meaning that the models are overidentified and have weak instruments.

2.9 Appendix C: Replication with other Dataset

If we apply the same instrumental variable model to the dataset of Fearon and Laitin (2003) and of Sambanis (2004), we can see some little differences. First of all, we have to remind that MSS

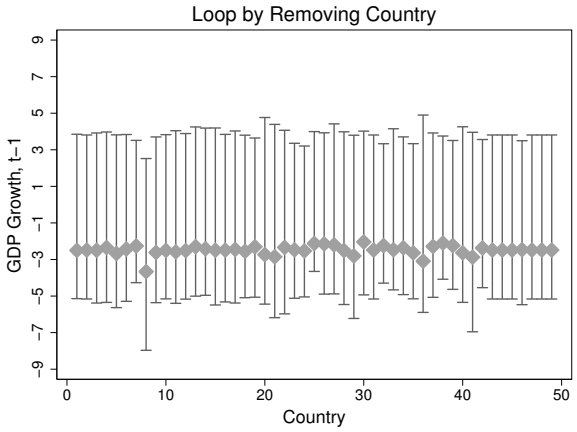


Fig. 2.9: *Loop removing countries*

and Sambanis (2004) use some variables taken from Fearon and Laitin (2003), but some other variables are conceived by the authors. For example, the dataset of Sambanis (ibidem), differ from the dataset of Fearon and Laitin (ibidem) for 5 variables: civil war onset, population, oil, ethnic and religious fractionalization.

From now on, we will call the work of Fearon and Laitin (2003) FL.

In the first stage, where we study the causal relation between rainfall variation and GDP growth, we see substantial differences between our results and those from FL and from Sambanis.

In Sambanis's estimates, the effect of rainfall variation seems to be much higher (compared to our output). In FL, instead, estimates are higher than our results.

All specifications in both authors, show a very significant and positive impact of rainfall variation on economic variables. About the control variables, only in Sambanis oil is highly significant and goes in the opposite direction of our estimates. In fact we estimate a positive and non significant relationship between oil-exporting countries and GDP growth, while in Sambanis this relationship is negative but not very high.

When we regress the probit model, in Sambanis we lose several observations because of collinearity of oil variable. First of all, in Sambanis GDP growth (both contemporaneous and lagged) is positive (though non significant), while in FL is negative (and non significant). This is very strange, since they use the same data for GDP and, of course, for GDP instrument. Beside that, this output is completely different from our estimates; in fact, we found a negative probability of civil war related to economic variables, which has proved to be stable. In FL, this probability is doubled compared to mine but is not significant. Moreover, country controls are insignificant in both authors and also the value is low in every variables (while in our model, we found mountainous terrain significant and positive related to civil war).

we have a similar behaviour for the OLS; the first OLS uses only country controls and in Sambanis contemporaneous and previous economic growth is very small and positive, while in FL the effect is negative but much more smaller than our estimation. Again, both authors do not find significant control variables in this first OLS.

The second OLS uses country and time trends effect; in this case, Sambanis has the same sign and similar value of FL. Returning to the covariates, in Sambanis any control variable is not significant, while in FL population has a positive effect on civil war (significant at 5% confidence level).

Only in the last OLS, Sambanis obtains a negative sign for GDP growth rates, which is, in turn, much more smaller than our estimate. Hence, GDP growth has a negative effect on civil war, but coefficient estimates are very low and are not significant. FL, on the contrary, estimate that a 10% variation in contemporaneous or previous GDP growth rates causes a 24% increase

in the incidence of civil war.

Finally, we run a IV 2SLS. For the first time, both Sambanis and FL produce a negative impact of GDP growth rates on civil war. Estimates from FL are pretty similar to our estimates, even if in FL are lower and non significant. In fact, the first specification has country control variables and in FL any variable seems to impact particularly (and significantly) civil war. In the second specification, FL have a larger impact of contemporaneous GDP growth, though insignificant. Regarding Sambanis, the first IV 2SLS is underidentified and with weak instruments; hence, we can not rely on its estimates which have, also, very high standard errors.

Comparing these outputs with those of MSS, we can see that in the case of FL, the first stage which estimates the effect of rainfall variation on GDP growth, has similar results. The first OLS is the simplest, without covariates and within effects. Here, the effect is positive and significant as in MSS, but it is lower. On the contrary, in the second OLS with control variables and time trends, the effect of rainfall variation on GDP growth is bigger and significant. The other OLS specifications provide similar results. In the case of Sambanis, the impact of rainfall variation on economic growth is even bigger and more significant, excepts for the second specification (with country controls and time trends effect).

When we estimate the relationship between GDP and civil war, on the contrary, results differ substantially. In fact, with FL'data, both probit specification and OLS specifications, estimates are much more smaller than MSS's results. Then, the size of the estimated impact of economic growth on civil war is huge; in particular, according to FL'data, a one percentage point decline in GDP increases the likelihood of civil war by over 1 point, both taking into account country characteristics or without. In any case, any variable is significant. In the case of Sambanis, we still not have significant variables, but the impact of economic variables seems to be smaller in every specifications.

Hence, from this comparison, we can see that the definition of civil war proposed by Sambanis changes substantially the results of our study, by showing a smaller effect of the economic conditions on civil war. It is also true, that also other country characteristics do not show significant causal relationship with civil war.

Chapter 3

Markov Transition Probabilities: An Application to the Analysis of Civil War in Africa

Abstract

We develop a new indicator of civil war, based on the concept of violence escalation. Taking information from the Social Conflict in Analysis Database Version 3.1 (SCAD), from the Armed Conflict Location and Event Data Project 2015 (ACLED), and from the Uppsala Conflict Data Program (UCDP) we design a violence indicator ranging from 1 (peace) to 3 (civil war). We use the new indicator to estimate Markov transition probabilities for 50 African countries, 479 ethnic groups and 50 non-ethnic groups in Africa from 1975 through 2014 as function of observable characteristics. We implement 3 methods to construct these Markov probabilities. The first method is a counting method, the second predicts transition probabilities using ordered logit regression models and finally, we derive hazard rates from a non-parametric Kaplan-Meier estimator and a semi-parametric proportional hazard (Cox) model. We also test whether the Markov assumption holds.

Civil War; Africa; Markov Transition Probabilities; Survival Analaysis; Ethnic and non-ethnic groups.

3.1 Introduction

The African Continent is an immense block (8000 km width) divided into 55 countries (including South Sudan, which became an independent country in 2011) and surrounded by austral oceans. Tropical and equatorial by definition, the African Continent extends across a 30% of desert area, although it has some of the biggest rivers of the world. Africa represents the second lung of the planet, thanks to its 28% of surface covered by forests (World Bank Indicator, 2010) and its amazing reserves of natural deposits.

Underpopulated in countryside[1] and overpopulated in towns[2], urbanization in Africa has largely been translated into rising slum establishments, high pollution, increasing poverty and inequality. Although strong urban population growth is not necessarily a significant threat to peace and stability, yet these conditions have created new reasons for grievances which, eventually, break out into a war. At the same time, population growth is affected by wars. Africa is a sad theatre of several internal conflicts. Angola, Mozambico, Sierra Leone, Lybia, Liberia, Congo, Somalia are only the most famous bloody countries. Every African conflict is a huge weight in the path of development, whatever the shape of development is.

Conflict studies have traditionally covered reasons for the breakout of civil war in numerous ways (see Chapter One). Current theories and econometric models of civil war assume that civil war is a particular category of violence. This assumption is clear in the arguments, but it ignores conflictual events which occurred before the break out of civil wars, and takes into account only years in which violence is very high. This implies to discard a lot of useful information that explain how we end up having a civil war. On the contrary, if we study civil war as an escalation process we can collect more information on the duration of conflicts and so it is helpful to manage civil wars in order to prevent and make them end quickly.

Moreover, this approach leads to think that grievances are not important and our consequential policies lack of attention to everyday troubles for the people whch, in turn, can translate into armed redemption request. Studying the causes of civil wars should include analysis of the actors involved in the debate and their specific interests. Actors can be individuals, or a group, a community or a country. Similarly, motivations can be at local, national, regional and international levels. As Sambanis (2004) explains we should "consider a wider array of both micro- and macro-level theories, including ones that explain how emotions, ideology, revenge, or coercion can interact to produce collective action that culminates in a civil war".

Of course, violence escalation studies are complementary to conflict onset studies and both literatures help us to predict and prevent civil wars. However, few insight has been given to escalatory process that leads from one form of contention to civil war (Fearon and Laitin, 2003; Collier et al., 2003; Cunningham et al., 2010). Nevertheless, usually civil wars do not erupt without warning: as a general rule, armed conflict get the headlines, but non-violent forms of conflicts also abound in history. The action repertories may include formal claim-making, petitions, demonstrations, boycotts, strikes, legal actions, civil disobedience, international campaigns and much more. In the act of claiming their will, these conflicts are often part of, or lead to larger struggles. For example, Davenport et al. (2005) examine 149 countries from 1976 to 1999 and find out that most civil wars took place under contexts that were identified as repressively "inflammatory". The authors do not use the traditional civil war variable, rather they operationalize the concepts of repressive inflammation, incapability, and ineffectiveness, by employing three different variables: repression, guerrilla war and protest[3]. A more sophisticated model based on Skocpol's theory of maladaptive state (Skocpol, 1979; Goodwin and Skocpol,

[1] However, in 2016 around 80% of working people are still employed in agriculture with archaic tools. In parallel tsetse fly, malaria and trypanosomiasis have slowed down livestock farming.

[2] Although urban fertility is lower, this is countered by lower death rates and youthful and fertile urban age profiles compared to rural areas, which boosts birth rates (Potts, 2009).

[3] They use data from Banks Cross National Time Series Data Archive and from Amnesty International version of Gibney's Political Terror Scale.

1989) has been developed by Rouen and Sobek (2004). By using a multinomial logit and a competing risk survival analysis on Doyle Sambanis (2000) data on 53 states, they find out that effective state bureaucracy undermines rebel victory. In addition, regime type and government army size do not directly help the government to win. On the contrary, the intervention of the UN plays a crucial role in the likelihood of transition toward the two extreme cases: a truce or a treaty.

Given this reasoning and the literature on violence escalation, our questions of interest in this chapter are: (i) can we predict a civil war from a study of violence escalation? And, (ii) do we infer different conclusions when we study different actors? In other words, if we study violence escalation taking into account different actors, such as countries, ethnic groups and non-ethnic groups (i.e. organized group of people belonging to the same country but with different ethnic roots), do we reach same results? Since we want to understand why civil wars break out in order to avoid them, we cannot make a micro analysis. We need a general explication. However, we cannot ignore micro motives for violence. Here, we try to combine these two levels by taking into account three different actors: countries, ethnic groups and non-ethnic groups. As argued by Sambanis (2004), "it is the interaction between micromotives and macrostructures that determines the expression of violent conflict". We expect that a violence pathway study, combined with contextual characteristics, helps us to predict a civil war and develop public policies to prevent conflicts in time.

In order to verify our hypothesis we have created a new yearly-based conflict indicator: 1. peace, peaceful demonstrations and strikes; 2. armed conflict and riots; and 3. civil war. The first two states are derived from the Social Conflict in Analysis Database Version 3.1 (SCAD) and from the Armed Conflict Location and Event Data Project 2015 (ACLED), while the third degree of violence (civil war) is taken from the Uppsala Conflict Data Program (UCDP) and ACLED. This construction makes suitable our analysis, since it reports three possible outcomes for its violence status variable.

Moreover, each actor and degree of violence is linked to a particular root of violence: political conflict, religious conflict and environmental conflict.

In this chapter we estimate transition probabilities among the three degrees of violence in the African context. 50 African countries, 479 ethnic groups and 50 non-ethnic groups in Africa are covered from 1975 to 2014. This strategy allows us to adopt a dynamic approach, where violence is understood as a part of a process, and countries, with a certain socio-economic-political context, might be at risk of different forms of violence. We may guess that a country starts a civil war after a period of turbulence, in which people claim their rights, needs and grievances. People organize themselves into a group and once they are an armed group, a war begins.

By following the econometric procedures of Jung (2006) and French (2005), the originality of this chapter is twofold: (i) we develop a country-level analysis, an ethnic-level and a non-ethnic-level analysis; and (ii) we implement 3 methods to construct the Markov probabilities: first, we apply a simple counting method, the second method predicts transition probabilities using ordered logit models and, lastly we derive hazard rates from a semi-parametric proportional hazard (Cox) model.

As is known, Markov switching models make the assumption that tomorrow's state is a function of today's state only. Of course, this assumption is quite strong, however we can consider today's state as a summary of previous states. Since civil war is a complex event that depends on many more factors than just war itself, it is important to condition civil war transition probabilities on additional factors such as economic conditions, public expenditures, soil fertility, autocracy and quality of political rights, etc.

This chapter is organised into 5 sections: in the first section we (i) explain in detail our conflict indicator, (ii) the roots of conflicts we have designed, and (ii) our overall dataset covering the African Continent from 1975 to 2014. In the second section we apply the counting model which

is further compared with the Markov transition probabilities in section three. The fourth section develops a survival analysis with several models and lastly we conclude.

3.2 A New Conflict Indicator for Africa

In the previous chapters we have largely discussed about the main used definitions of civil war and related coding rules. In this section we suggest and explain a new indicator of civil war which does not depend on a quantitative threshold.

A conflict arises when people hold incompatible needs, interests, desires and objectives. Conflict might occur within individuals, families, communities, workplaces, and indeed within nations and regions. It may be managed constructively by negotiation or cooperation, or destructively through force or threat.

Whether an internal dispute becomes an armed conflict depends in large part on the stuck between a State and the civil society. Even a mass protest with one dead people points out that institutions distance themselves from civil societies, failing to properly and democratically recognize and address important valued issues in public policy. When a State is far from its people, there is a stuck in governance and this takes the society into conflict which can explode into mass protest and eventually to civil war.

As the 2001 World Development Report suggests, we can imagine a conflict as a of normal curve with peaks and lows. This curve creates the idea of a conflict as a continuum in which active fighting represents a peak period, but not the whole conflict cycle. Even during the low, we can see powerful forces of latent conflict brewing under the surface, which puts it at risk of war (USAID CAF, 2012).

Similarly, although the guns may have stopped firing, the conflict *per se* may not be over. During the time it takes a country to recover from armed conflict, the risk of re-escalation is high, particularly when the issues driving the conflict have not been fully solved. Moreover, there might be some actors interested on prolonging a war for their own profits. Those actors organize terrorist attacks or other violent events in order to destabilize the State. The more a State is living a chaotic situation, the more its economic growth is affected, the more rebel groups can profit from the grievances of people to recruit militants or to receive community's support. This means that we need to analyse conflicts as part of a dynamic process (Sambanis, 2004) where multiple actors and backgrounds are not monolithic, but change over time.

Cramer (2007) highlights that civil war can be considered as phenomena not distinct from other forms of political violence, such as communal riots, state massacres and coup d'Etat. The author suggests that we should collect new data on non-state armed conflict and state violence. Following this perspective, when in a country there is a long period of mass protests which eventually fall in violence, we might imagine a probable escalation of violence over time, if policy makers do not try to negotiate with the society.

Moreover, when a conflict is over, we speak of post-conflict or fragile societies[4] because usually there is a transition period in which the war can break out again or violence has not completely ceased in all corners of a country's territory (Brinkerhoff, 2005). Even after the signature of a peace agreement by belligerents, low-intensity hostilities might continue (Nkurunziza, 2008). Broadly speaking, a country is considered as post-conflict after the conflict is coded as inactive for a certain time period (Nkurunziza, 2008) and the specific attributes inherited from the conflict cease to have influence on the affected country. In literature, the post-conflict period is defined as the 10-year period following the end of a conflict (see, for example, Collier and Hoeffler, 2004) but despite its apparent simplicity, this concept faces problems related to the timing: as we

[4]The Failed States Index 2015, a joint research by Foreign Policy (FP) and the Fund for Peace (FfP), categorizes 107 states as critically fragile. The African continent is the only one that has not seen significant improvements since 2005. Only 3 African countries have succeeded in strong improvements against state fragility. On the contrary, 11 African countries out of 15 world countries have been significantly worsening since 2005.

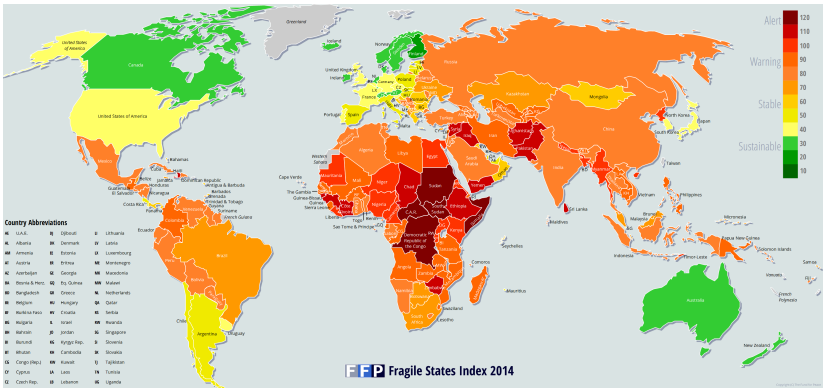


Fig. 3.1: *Fragile States Index 2015*

have already seen, it is very difficult to determine precisely when a conflict is over and when the post-conflict period ends. This is due to the fact that post-conflict peace is typically fragile[5].

As Doyle and Sambanis (1991) observe, no peace is perfect. Public violence never gets completely eliminated. Once again, the idea of the curve renders well the context: we should thus consider peace to be a spectrum ranging from insecure to secure.

Given the economic literature about violence escalation and our viewpoint on civil war explained so far, we have conceived a new indicator of conflict by making use of three conflict dataset: (i) Social Conflict in Analysis Database Version 3.1 (SCAD), (ii) Armed Conflict Location and Event Data Project 2015 (ACLED) and (iii) Uppsala Conflict Data Program (UCDP)[6].

We will not give more information on UCDP, since it has been largely discussed in the second chapter and, aboveall, it is one of the most used Dataset in conflict studies. Therefore, we mainly focus on the other two databases.

According to the official ACLED website, ACLED is the most comprehensive public collection of political violence data for developing states (so far, ACLED has recorded over 90,000 individual events, with ongoing data collection focused on Africa). It contains information on the specific dates and locations of political violence, the types of event, the groups involved, fatalities and changes in territorial control. Information is recorded on the battles, killings, riots, and recruitment activities of rebels, governments, militias, armed groups, protesters and civilians.

SCAD includes social conflict events across Africa from 1990 to 2015, including riots, strikes, protests, coups, and communal violence. Each event record contains information on the location, timing, and magnitude of social conflict events, as well as the actors, targets, issues of contention and government response.

We have inspected the information provided by these two dataset by looking for other non-academic available (printed and electronic) sources. The sources include news agencies, journals, research reports, public statements, documents of international and multinational organizations and NGOs. Global, regional and country-specific sources are used for all countries[7].

[5]While there is no formal consensus within the international community on exactly what constitutes a fragile state, there is general agreement on some key characteristics: fragile states are those with weak institutions. Examples are states unable to provide public services and deliver public goods to their non-ethnic groups; states unable to recover from a shock and states lacking authority or control over the whole of their territory and of monopoly over the legitimate use of violence (see Thurer, 1999; Milliken and Krause, 2002; Rotberg, 2002; Menocal, 2010.)

[6]SCAD and ACLED contain information on a range of violent and non-violent actions, such as protests, riots, strikes and other social disturbances in Africa (and other developing countries) while UCDP provides data on civil war.

[7]we are aware that these sources may have or may represent some private interests; that is why we have taken into account several sources which have helped us to judge sources according to the context in which it has been published.

Since most sources are secondary sources, we attempt to trace reports back to the primary source in order to decide whether they are reliable. In front of ambiguous cases, we cancel out the observation.

Finally, we have controlled the information on conflicts by taking also peace agreements from the UN Peacemaker Database of Peace Agreements and the Uppsala Conflict Data Program Peace Agreement Dataset (UCDPPA) v. 2.0, 1975-2011. However, we have to be aware that the inclusion of an agreement in these database does not imply that it was implemented or that the peace process itself was successful.

The UN Peacemaker Database of Peace Agreements is an electronic tool providing around 800 documents regarding peace agreements. Their electronic database records peace treaty in Africa from 1962, reporting decolonisation treaty to civil war end treaty.

The other dataset is the UCDPPA which covers peace agreements signed between at least two opposing primary warring parties in an armed conflict from 1975 to 2011. The dataset is compatible with the UCDP/PRIO Armed Conflict Dataset. The unit of analysis is the peace agreement; consequently more than one agreement can be registered for one conflict. Each agreement is categorized as a comprehensive agreement, a partial agreement or a peace process agreement, depending on if the agreement is seen as a final product in a peace process or if the parties still have outstanding issues that have to be solved.

Excepts for UCDP which is annual data, the other two conflict databases collect event-based information. This obliges us to create an aggregate annual indicator at country level for both SCAD and ACLED. In order to capture the different situations in which a country can find itself after a turbulent period, we first establish a classification of five main degrees of violence: 0. peaceful country; 1. peaceful demonstrations; 2. strikes; 3. riots and violent demonstrations; 4. armed conflict or low-profile-war; 5. civil war.

Since some modalities have few observations, inference is not always possible. Therefore, in a second stage, we have aggregated the 5 degrees of violence into 3 degrees: 1. peaceful country; 2. armed violence; 3.civil war. In particular, we have put together peaceful countries with peaceful demonstrations; riots is with armed conflict and; finally we have civil war. The majority of information are taken from SCAD and ACLED but the fourth and fifth degree of violence (civil war) have been filled mainly with UCDP.

We measure a weighted mean of the degree of violence over a year in each country and we fill our ranking from 1 (peace) to 3 (civil war). In order not to lose all the information provided by SCAD and ACLED, we also create a maximum and minimum variable, corresponding to the maximum/minimum degree of violence reached during a year. In fact, sometimes it happens that a country has a low degree of violence during a certain year but it experiences also one single very cruel attack during which many people die. Hence, we measure on average what degree of violence a country has during a year and, when we have an ambiguous mean, we check each singular event over a year to understand the real degree of violence.

3.3 The Roots of Conflict in Africa

SCAD and ACLED provide detailed information about the conflictual event. For example, according to SCAD, in 1990 in Algeria there was an event in which "Citizens boycott vote in protest of unfair elections"; or in Angola in 2004 "Riot over the sale of a government generator. Local residents accuse the administrator of selling the generator for personal gain."; or, to conclude, in Congo in 1992 "Protesters riot, calling for the ouster of Mobutu. Military forces fire into the crowd, killing 5.".

SCAD divides conflicts into 10 typologies, ranging from organized demonstration, to general strike, repression, until government violence. This latter is further classified into: intra, extra, anti and pro government violence. Moreover, SCAD provides detailed information about actors and number of people involved in the event, with the latitude and longitude coordinates, number

of deaths and, very interesting, they provide the two main reasons for protesting. This latter categorical variable ranges from 0 to 14 and concerns elections, environmental degradation, human rights and so on.

Similarly, ACLED provides 9 event types covering a "violent interaction between two politically organized armed groups at a particular time and location" (ACLED Codebook, 2015). In ACLED, typically these interactions occur between government militarises/militias and rebel groups within the context of a civil war. However, these interactions also include militia violence, rebel on rebel violence and military on military violence. As in SCAD, there is no minimum causality necessary for being included in the database.

UCDP, instead, suggests two types of incompatibility: government incompatibility and territory incompatibility.

In this study we have divided conflicts according to the primary reason of fighting by combining details from several sources: (i) we have collected and analysed information regarding typology of conflicts provided by ACLED, SCAD and UCDP databases, (ii) we have verified information with websites, historical book, newspapers and communiqué and (iii) we have collected the main determinants of civil war identified in literature. In particular, our purpose was to develop a general classification of primary roots of conflict and we have conceived three main groups:

Political conflict: conflicts related to the governance of a society, i.e. groups who struggle for rights, reforms, democracy, self-determination, basic needs, corruption and state-violence. Hence, according to our perspective, political purposes are not only formal -such as become politician and rule a government- but it can be also the informal management of communities aimed at general well-being.

Environmental conflict[8]**:** this category concerns groups reclaiming rights over natural resources available in their territory, such as share of profits, rehabilitation and recovery of polluted lands/waters from anthropic activities, management of natural resources, land/water grabbing and forced expropriation of land.

Religious conflict: groups who fight for the defence, determination and recognition of their faith.

As we have already explained in the first chapter, usually it is not easy to understand primary reasons for civil war, especially if we run a country-level analysis. For example, the relationship between religion and conflict is that groups specializing in the provision of religious goods and services often branch out to produce secular goods and services and can be extremely effective when doing so (Mcbride and Richardson, 2012). Historically, religions stay afloat on empty political spaces or collaborate with governments. For instance, governments can grant privileges to certain religions while outlawing others (Mcbride and Richardson, 2012). When, instead, governments are poor providers of social services, we have seen in the first chapter, that religious groups can produce goods and enforce the discipline necessary to institutionalize violence (Iannaccone and Berman, 2006). At the same time, religious conflicts often interrelate with political and territorial grievances. Somalia gives us a clear example: territorial reclaims, linked to the colonial organization of Africa, have made break out dramatic civil wars in 1991. After that war, there was the collapse of the federal government and the emergence of numerous autonomous polities, including the Puntland administration in the North-East and the Somaliland, an unrecognised self-declared sovereign State that is internationally recognised as an autonomous region of Somalia, in the North-West. After that, an orthodox religious group came to light among some Somalia's inhabitants, suggesting to come back to customary norms, either Islamic and secular law, to run communities. This group, called Islamic Court, started a fight against the Federal Government to take the power. Finally, the government won the war establishing an autocracy, meanwhile, Islamic Court's ideology, spread around the Horn Of Africa and farther (reaching even Europe), becoming religious fanaticism (and terrorism) with

[8]For the environmental conflict we rely on the Environmental Justice Atlas.

Al Shabab[9] . Therefore, in Somalia, do we have religious or political conflict?

Another important root of conflict is the environmental issue; across the world, communities are struggling to defend their land, air, water, forests and their livelihoods from damaging projects and extractive activities with heavy environmental and social impacts (such as mining, dams, tree plantations, fracking, gas flaring, incinerators, etc). Access to justice is often elusive for impacted communities, as governments and companies enjoy impunity for grave human rights[10], corruption and other abuses[11]. Through subsidiaries, for example, mother companies can escape prosecution for criminal acts. Local governments are often not able or willing to prosecute environmental crimes because they are desperate for much needed investment in strategic sectors or have come to exchange agreements with them or feel under threat by creditors and international finance institutions[12]. Increasing financialization of the economy has made such justice issues much more complicated, as the actors behind many decisions related to investments and projects are unknown (private investments funds, private equities, pension funds, etc). To deal with this lack of accountability, civil society organizations try first to get a seat at the negotiation table, but often there is any table of negotiation. For example, according to the Environmental Atlas Justice, amongst the world environmental conflicts, only around 18% have been qualified as "successful" for environmental justice.

As before, the environmental issue can be mixed also with political reasons or with fundamental cultural differences. In the process of competing for resources and gaining independence these cultural differences can intensify and become more salient. This is more likely especially when a political resource is manipulated for personal and political ends (Spalding, 2000).

3.4 Dataset

3.4.1 Country Level, Ethnic Level and Non-Ethnic Level Dataset

Some problems can be addressed at the country level, but others need to be addressed at a regional level. Our dataset consists of 3 different panel dataset: a first dataset at country level, a second dataset at ethnic level and, finally, a third dataset at non-ethnic level. By relying on Morelli and Rohner (2015), we link each ethnic and non-ethnic group with its country, with a degree of violence and related root of conflict.

[9] Al Shabab represents the armed section of Islamic Court. Al Shabab (which can be translated as "the Youths") is much more radical than Islamic Court, especially because they refuse foreign military participation in Somalia and they want to take again political control.

[10] For example, in South Africa, the mining industry corrupted the medical examination boards ostensibly in charge of mineworkers' health. The boards then underreported cases of silicosis, decreasing workers' eligibility for compensation. Together with the apartheid government, the industry set up a distinct and difficult to use compensation scheme. The 2017 Deloitte Report found that less than 1.5% of claims had been paid out to eligible miners, while almost all miners had symptoms of respiratory illness. Only from 2009 two South African NGOs – the Treatment Action Campaign (TAC), and Sonke Gender Justice– have been proving evidence on the social costs of silicosis and are obtaining some compensation.

[11] For example, in Nigeria, oil companies have been accused of several grave abuses, such as severe environmental destruction, forced emigration of communities, violation of basic needs -such as the right to drinking water and food, and a decent standard of living-, killing of some leader activists, financial crimes and structural corruption (Nigeria has occupied for many years one of the last places on Transparency International's Annual Corruption Perception Index). Among many, the biggest case of environmental corruption goes back to 2012, and gets involved a multinational oil consortium TSKJ, which paid bribes to Nigerian government officials between 1995 and 2004 with the final aim to facilitate the award of the 6 billion dollars liquefied natural gas contract in a new oil project in Niger Delta. Several peaceful and violent organization put the blame on oil companies for their culpability in that are. For example, Friends of the Earth and Amnesty International always accuse oil companies to actively contribute to the human rights violations in Niger Delta region (see http://star.worldbank.org/corruption-cases/node/18445)

[12] Among many examples, one of the latest regards Nigeria in 2016: the Nigerian Parliament reported that between 2011 and 2014 ENI, Shell and Chevron have stolen 17 million dollars in oil and natural gas.

Although there are several case study articles, most economic studies develop a country-level analysis. This is useful to get main trends and general causal relationships. However, it is interesting to analyse more in details actors of war[13] at macro-level. This means that we run macro-analysis but we consider ethnic and non-ethnic groups rather than countries. Non-ethnic groups represent an organized group reclaiming social issues. Therefore, within this group, we find students, workers in public sector, workers in private sector, etc. As we will explain in this paragraph, in our Century we cannot ignore this social group because it is a big group organizing the majority of peaceful or violent events.

We have chosen to run our analysis at ethnic and non-ethnic level for several reasons. In the case of ethnic-level analysis, we have two main reasons: first of all, because economics of conflicts undercover ethnic level analysis by preferring studies at country level. Secondly, because ethnicity is a crucial concern when we deal with Africa. Of course, talking about ethnicity means try to cover a huge topic. In Africa, as in other traditional societies such as those in India or China, ethnicity, meant as shared cultural attributes and consciousness, is a central argument and older people have traditionally been viewed as repositories of information about ancestral and ethnic history and wisdom. A great respect for age, elders, and ancestors as bases of rights and solidarity (Therborn, 2004).

Ethnicity is a sort of social capital. North (1990) and Olson (1982) define social capital as a big container including trust, norms, networks but also the socio-political environment that shapes norms and social structures. Therefore, North and Olson's view encompasses more formalized institutional relationships and structures such as government, political regime, market, rule of law, court system, and civil and political liberties (Grootaert, 1998).

Recognizing the central role of ethnicity in the formation of African capital is important because, if properly managed and protected, social capital is a key element to prevent violent conflict (Bates, 1999). The greater the degree to which vertical linking and horizontal bridging social capital integrate, the more likely it is that the society will be cohesive and will thus possess the inclusive mechanisms necessary for mediating or managing conflict before it turns violent. The weaker the social cohesion, the weaker will be the reinforcing channels of socialization (value formation) and social control (compliance mechanisms). Weak social cohesion increases the risk of social disorganization, fragmentation, and exclusion and the potential for violent conflict (Sen, 1999).

So far we have argued that ethnicity is a very important element, especially in Africa and in a context of civil wars. However, we do not have to risk to insert this debate into the "ethnic issue" (Gallissot et al., 2001): i.e. the belief that civil wars in Africa occurs because of ethnicity. We are saying exactly the opposite. The intensity of primordial identification such as ethnicity is not unique to Africa, and the existence of primordial identities does not create conflict; conflict arises for many reasons and the so called ethnic conflicts hide deeper problems (Gallissot et al., 2001). Furthermore, ethnicity is not a monolithic and rigid reality and does not inevitably lead to conflict (Hislope, 1998). For this reason we have not included an "ethnic root of conflict", rather we think it is useful to study at ethnic level, in order to come near to the primary reasons for fighting.

However, we remind a crucial issue: data on ethnic groups are biased. We have already covered this concern in previous chapters, explaining that ethnicity data cannot catch the fluidity of ethnic groups and, for the sake of simplicity, these data treat ethnic groups as monolithic and unchangeable entities. It is sufficient to think that the Geo-referencing of ethnic groups" (GREG) dataset relies on the Soviet Atlas Narodov Mira (Bruk and Apenchenko, 1964) which dates back to 1964[14].

[13]Since the majority of African States are immense, often an armed conflict take place in a single and marginal region, while the rest of the country lives in peace.

[14]From a statistical point of view, this creates another source of problem, as it is pointed out by Morelli and Rohner (2015). They argue that "the fact that the group border information is not time-varying lowers accuracy and hence adds noise to our estimations, which biases the magnitude of coefficients and the significance levels

At the same time, we cannot ignore the empirical fact that societies are changing. Internal migration is very high in Africa because of poverty, wars and desertification and people think that urban centres tend to offer better health care and other social services (while personal insecurity, poverty, and environmental degradation may force people to flee the countryside). Actually, most Sub Saharan Africa cities are characterized by insufficient basic infrastructure, particularly in low-income areas. Only 20% of Sub Saharan Africa's population has access to electricity, and in 2010, 3% of Africans had access to fixed telephone (while 53% could afford mobile phones); 84% of the continent's urban dwellers have access to potable water while 54% to sanitation (AfDB et al., 2012). More broadly, 60% of African non-ethnic groups live in places where water supplies and sanitation are inadequate.

Lastly, African cities represent a rundown and unhealthy development. Cities, in Africa, can look like European cities but are much more unbearable: crowed of people, heavy traffic, and full of stalls in the streets, which are one long puddle of floating garbage. Everyone makes noise (informal buses and taxis always spread music at high volume while busmen shout the direction of the bus; cars always blare -even when there is no reason to use the horn -; and pitchmen always have something to offer in their stores -often built out of rusted shipping containers, junked cars, and jumbles of wire mesh) by creating an unbelievable atmosphere, where the famous English novelist Dickens himself would never have given credence.

Living in such conditions create frustration and reasons for complaining or, worst, for joying a rebel group. At the same time, in cities people quickly become acquainted of government decisions, compared to countryside-people. Citizens organized in groups demonstrate against government spendings, labor rights, reforms, quality of governance and elections, economic reasons, press freedom, and many more. In fact, in the 2000s, protests take place mainly in cities. This is true also for Africa, even if often clashes happen in remote areas of the country.

This idea is supported by data and by a report of the North Atlantic Treaty Organization (NATO) which is studying urban operations in order to deal with armed conflictual situations in cities (NATO Technical Report 71, 2003). In the report, called "Urban Operations in the year 2020" (NATO Technical Report 71, 2003) they report that future conflicts and wars will take place in cities. Hence, NATO is reinventing itself and works out to face conflicts in which usual battle strategies cannot be employed anymore.

Data confirms this idea. For example, SCAD collects mainly disorders in towns. For these reasons, we have developed a non-ethnic dataset in which we have inserted for each country a variable called "citizens" standing for a non-ethnic group responsible of a particular conflictual event. For each record, we have linked also the related root of conflict depending on the specific event.

Given these theoretical intuitions, our analysis will make use of the three dataset, in order to study civil war at aggregate level but also at ethnic and non-ethnic level.

Each dataset uses same variables, covering conflicts, sociological and economic conditions, institutional and geographical context, environmental resources and ethnic divisions. Explanatory variables which help us to contextualize the conflict and the condition of countries are taken from Morelli and Rohner (2015), Freedom House, Peace Research Institute Oslo (PRIO), Polity IV Project and WDI.

For our analysis we use several variables. Some of them belong to the standard battery of control variables, some others are new to conflict studies.

3.4.2 Main Variables

We have a panel dataset with 50 African Countries, 479 ethnic groups and 50 group of non-ethnic groups, tracked over 39 years (from 1975 to 2014).

downwards. This means that using GREG will tend to bias the results against us and this attenuation bias makes them appear less strong than they are".

Table 3.1: Summary statistics in Country-level Analysis Dataset

Variable	Mean	Std. Dev.	N
Conflict	2.025	0.748	1407
Political Rights Quality	2.602	0.686	1923
Oil Production (Lag)	0.157	0.364	1438
Autocracy	0.408	0.492	1923
Population Growth (Lag)	15.662	1.323	1587
Mountainous Terrain	0.113	0.196	1519
Gini Indicator	0.202	0.333	1493
Soil Fertility	0.303	0.204	1795
Est Africa	0.248	0.432	1795
Central Africa	0.173	0.378	1795
Gold Production	0.491	0.5	1325
Diamond Production	0.356	0.479	1553
Economic Growth (Lag)	0.032	0.073	1672
Time Span	4.242	5.338	1923

Table 3.2: Summary statistics in Ethnic-level Analysis Database

Variable	Mean	Std. Dev.	N
Conflict	1.598	0.807	9892
Political Rights Quality	2.668	0.609	9988
Oil Production (Lag)	0.194	0.395	9437
Autocracy	0.246	0.431	9988
Population Growth (Lag)	16.134	1.253	9986
Mountainous Terrain	0.103	0.152	9808
Gini Indicator	0.29	0.374	9982
Soil Fertility	0.316	0.185	9970
Est Africa	0.296	0.457	9970
Central Africa	0.194	0.395	9970
Gold Production	0.662	0.473	8222
Diamond Production	0.364	0.481	9836
Economic Growth (Lag)	0.009	0.085	6696
Time Span	2.389	2.555	9988

Table 3.3: Summary statistics in Non-Ethnic-level Analysis Dataset

Variable	Mean	Std. Dev.	N
Conflict	1.735	0.818	604
Political Rights Quality	2.635	0.676	1111
Oil Production (Lag)	0.153	0.361	691
Autocracy	0.474	0.5	1111
Population Growth (Lag)	15.223	1.291	754
Mountainous Terrain	0.096	0.176	713
Gini Indicator	0.139	0.287	667
Soil Fertility	0.301	0.208	1003
Est Africa	0.26	0.439	1003
Central Africa	0.14	0.347	1003
Gold Production	0.468	0.499	570
Diamond Production	0.361	0.481	732
Economic Growth (Lag)	0.028	0.07	915
Time Span	3.657	5.033	1111

Dependent Variable

Conflict Indicator: as showed in previous section, we have developed a conflict indicator by aggregating information from SCAD, ACLED and UCDP. In particular, we have measured a weighted mean of violent event over every year covering the timespan 1975 - 2016. This variable ranges from 1 to 3 (respectively, peace and civil war, passing through armed conflict).

Commodities

As broadly showed in economic literature, many conflicts in Africa are related to commodities and to a balance of strength and balance of control on resources.

Oil exporter: a dummy variable taking a value of 1 if in a given country and year the fuel exports (in % of merchandise exports) are above 33%. Variable from Fearon and Laitin (2003), but updated with recent data of "fuel exports (in % of merchandise exports)" from World Bank Indicator (2015).

Oil Production (Lag) per capita: From Humphreys (2005) we take the average amount per capita of oil extracted per day in a given year, measured in millions of barrels per day.

Gold production dummy: takes a value of 1 when there is gold production in a country year, and 0 otherwise. From Lujala et al.(2005).

Diamond production dummy: takes a value of 1 when there is diamond production in a country year, and 0 otherwise. From Lujala et al.(2005).

Oil Gini: developed by Morelli and Rohner (2015), this indicator is a time-varying measure of the unevenness of oil field distribution across ethnic groups for a given country and year.

Ethnic Oil Concentration: developed by Morelli and Rohner (2015), this variable is created by interacting oil exporter countries with the oil Gini Indicator. It reflects the surface of an ethnic group's territory covered with oil and gas as a percentage of the country's total surface covered with oil and gas.

Institutional Variables

We use few institutional variables to contextualize conflictual countries. Usually, conflict studies use only indicators from Polity IV. Here, instead, we use other Databases.

Political and Civil Rights Quality[15]*:* is taken from Freedom House (2016). This score is based on a rating from 1 to 7 for Political Rights and civil liberties, with 1 representing the most free and 7 the least free. We have revised the score, by aggregating this variable into 3 scores of right quality.

Public Expenditure[16]*:* From WDI we take data on African general government final consumption expenditure (% of GDP)[17] includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defense and security, but excludes government military expenditures.

Autocracy: we have created a dummy variable of autocracy from Polity IV(2015). In this indicator, democracy variable ranges from -10 (strongly autocratic) to +10 (strongly democratic). We have created autocracy variable from democracy, so if democracy in previous year in a given country is low, we assign to autocracy the value 1. Otherwise, it is 0.

Population Growth (Lag): from WDI, we measure Population Growth (Lag) from the total population. Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship.

Political, Environmental and Religious Conflict: each root of conflict is a distinct dichotomous variable assuming 1 when the country, or the ethnic or the non-ethnic group is experiencing that specific root of conflict (namely, political, or environmental or religious conflict). These variables have been designed as explained in section 3.4.

Geographical Variables

Est Africa: Dichotomous variables assuming 1 if the country is located in East Africa.

Central Africa: Dichotomous variables assuming 1 if the country is located in Central Africa.

Mountainous terrain: percentage of territory covered by mountains. From Collier et al. (2009). This variable is broadly covered in economic literature. Fearon and Laitin (2003) are the first who have found that mountainous terrain is one of the main driver to civil war.

Soil Fertility[18]*:* From the Harmonized World Soil Database (Nachtergaele et al., 2008). Their complete global grid of nutrient availability is ranked from 1 ("no or slight constraints") to 4

[15]This variables is really important for our analysis. As we have previously said, often non-ethnic groups protest for political, labour, press freedom. Therefore, this variable helps us to understand whether it exists a link between the escalation of violence and the quality of rights.

[16]We find important also military spending. However, this variable has too many missing. This is a shame, since of course it is important to take into account the militarisation process of a country at risk of civil war. , missing data on weapons are related to the fact that Africa has a huge weapons black market coming from all over the world. For instance, after Gheddafi's collapse, Libyan weapons have been dispatched to various destinations, such as Syria, Nigeria, Tunisia, Mali and more. In Libya there were 22.000 MANPADS (Man-portable air-defense systems) and 450000 military weapons. Only 5000 MANPADS and 12000 weapons are still in Libya, the others are disappeared. We do not know for sure where these weapons are, but if we have a look at the recent history, we can imagine who are the new owner: many armed groups live above and under Sahara desert. Therefore, it is difficult to have credible data on military expenditures and, aboveall, on weapons market. However, this variable is crucial for predicting civil wars.

[17]This variable is crucial for our analysis. Whether a government spends its budget for public interest reason may foster a conflict. However, public spending is an ambiguous variable since if it is true that more money for public services reduce grievance, it is also true that it is important as well to know how these money are used. Corruption in developing countries is a concern and corruption may affect good governmental intervention.

[18]This is an important variable because in Africa the majority of people rely on agriculture for their daily diet and, often, for their income. Moreover, climate change is affecting the fertility of many lands and desertification is a cruel cause to poverty and conflict. The link between Soil Fertility and conflict is both direct and indirect: communities are forced to emigrate to find fertile lands. They might bump into other communities who do not want to share their land. In history, we have several cases of communities fighting each other because one group uses the land for livestock and the other for agriculture. Usually, we interpret these kind of wars as ethnic conflicts, because two ethnic groups are competing, but actually it is simply a conflict for the survival. Some other communities prefer to escape to cities, already crowed, and this increases tensions in towns or illegal emigration problems (with European countries complaining about emigrates and greedy people profiting from this illegal business).

("very severe constraints"), and also including categories 5 ("mainly non-soil"), 6 ("permafrost area") and 7 ("water bodies"). Our dummy takes a value of 1 for categories 1 and 2, categories 3 to 6 get a value of 0, and category 7 is set to missing.

Economic Growth (Lag): from Penn World Tables, we measure the lag of Purchasing Power Parity adjusted GDP per capita at constant prices. When there are missing, we use estimates of growth rate of per capita income provided by the World Development Indicators.

3.5 Counting Model: Theory

The first method calculates the one-step transition probability; this is a simple counting procedure of the probability of transition from one violent state to another in a single step without consider any explanatory variable.

Count variables indicate how many times something has happened. The linear regression model (LRM) has often been applied to count outcomes, resulting in inefficient, inconsistent, and biased estimates. Even though there are situations in which the LRM provides reasonable results, it is much safer to use models specifically designed for count outcomes. Although the use of regression models for counts is relatively recent, it is widely applied in statistical analysis (Long, 1997; Cameron and Trivedi, 1998).

The (average) transition probability matrix, P , is the matrix consisting of the one-step transition probabilities, p_{ij} .

$p_{ij} = pr\{X_n = j|X_{n-1} = i = \frac{N_{hj}}{\sum_{n=1}^{N}\sum_{t=1975}^{T} I(y_{it-1}=h)}\}$

The *v-step* transition probability is the probability of transition from state i to state j in *v-step*. In the following equation, we show the *v-step* transition matrix whose elements are the mv-step transition probabilities p_{ij}^{v} is denoted as P^{v} .

$p_{ij}^{v} = pr\{Xn + v = j|X_n = i\}$

Hence, we count the realization of a particular transition as follows. We assume that violence degrees can only obtain three possible outcomes, because for the sake of simplicity we have aggregated our indicator into 3 modalities[19]. Then, we define the random variable of a violence state at time t as *Y(t)* where the realizations of this variable is $y(t) \in 1, 2, 3$

$N_{hj} = \sum_{i=1}^{N}\sum_{t=1975}^{T=2014} I(y_i(t) = j, y_i(t-1) = h)$

Next we define the realization of a particular transition from state h to state j as where i counts for all individuals and t counts for the time periods from 1975, 1976, ..., 2014 in one year increments and $y_i(t)$ is the realization of the violence state of country i in year t. Thus N_{hj} registers the direct transition from h $\rightarrow j$ over all years.

3.5.1 Counting Model: Empirical Analysis

In this section we report transitions probabilities among degrees of violence with the simple counting model applied to our three dataset (tables are showed in the Appendix A). This method allows us to have an overall and simple description of the likelihood of civil war. We will use these results as baseline for next and more elaborated econometric models.

Results are similar at country, ethnic and non-ethnic level. Generally speaking, the economic literature is somehow confirmed: each degree of violence is persistent and when a country or an ethnic group is in civil war, it can be trapped into civil war or it can reach peace. However, we observe an evident difference in results between a country-level analysis, ethnic / non-ethnic level analysis: both ethnic and non-ethnic groups are more likely to experience peace compared to countries, and there is a small probability of persistence of violence at ethnic-level analysis.

Another important detail to underline is that when we study the different roots of conflict we find out some interesting differences; for example, the case of religious conflict is striking.

[19] In particular, we have put together peaceful countries with peaceful demonstrations, riots is with armed conflict and finally we have war.

At country level, we have a tendency to violence while at ethnic level the tendency is toward peace. Hence, if an ethnic group is experiencing an armed conflict for religious reasons, it is much more likely to move to peace and remain in peace, than to go to war. At the same time, if tensions are higher and we have a religous civil war, an ethnic group has a 36% probability to remain in war and a 52% to go to peace. At country level, on the contrary, a country has a 63% probability to experience an armed conflict, which however, does not break out in a war but remains in a low-profile conflict. Civil war is persistent also in this case, which is in line with our current history (where religious conflicts are quite widespread in Africa, as well as in the Middle East).

Useful models of the real world have to satisfy two crucial requirements: they must be sufficiently complicated to describe complex systems, but they must also be sufficiently simple for us to analyse them. In the following sections we will add some contextual variables which will make our analysis more realistic.

3.6 Predicted Markov Switching Probabilities from an Ordered Logit Model: Theory

In previous section we have explained that ordered response variables might produce biased estimates and we can avoid such bias with count models. However, we have to take into account not only the fact that responses are ordinal but also the possibility of dependence or correlation. Different models can be used to handle such dependence (Agresti, 1999; Kim, 1995; Liang et al., 1992). Among them, one possibility is to use Markov transition models where we consider the effect of previous response on current response. Therefore, our second method uses Markov switching model with ordered logit model. This is a more complex and sensitive approach to take in social sciences, especially when we run longitudinal analysis. Because Markov chains combine tractability with almost limitless complexity of behaviour, they are the most useful and important class of stochastic models. The underlying rationale of Markov chains is the observation that many real-world processes have this property: If you have a complete description of the state of the process at time t, then its future development is independent of its track record before t.

Formally, consider a stochastic process $X_n, n = 0, 1, 2, ...$ that takes on a finite, integer or countable number of possible values. If $X_n = i$, then the process is said to be in state i at time t with a fixed probability p_{ij} that it makes a transition to state j. That is:

$P\{X_{n+1} = j | X_n = i, X_{n-1} = i_{n-1}, ..., X_1 = i_1, X_0 = i_0\} = P_{ij}$

for all states $i_0, i_1, ..., i_{n-1}$, i, j and all $n \geq 0$

Such a stochastic process is called Markov chain and is telling us that the conditional distribution of any future state X_{n+1} given the past states and the present state X_n is independent of past states and depends only on the present state. Of course, P_{ij} is non-negative and

$\sum_{j=0}^{\infty} P_{ij} = 1, i = 0, 1, ...$

However, actually it is more likely that a process starting in i will go to state j in $n + m$ transitions through a path which takes it into state k at the nth transition. Hence, summing over all intermediate states k yields the probability that the process will be in state j after $n+m$ transitions.

This is called Chapman-Kolmogorov equations:

$P_{ij}^{n+m} = \sum_{k=0}^{\infty} P_{ik}^{n} P_{kj}^{m}$

for all $n, m \geq 0$, all i, j. and

$P_{ij}^{n+m} = \sum_{k=0}^{\infty} P_{kj}^{m} P_{ik}^{n}$

Ordered logit models imply a parametric estimation and can be specified by a likelihood function. This function contains the conditional probability distribution of the vector of all observations Y given the vector of all parameters θ . We denote the probability $p_i(s|j)$ as the

probability that a country i has a certain degree of violence s in period t, conditional on having a j violence status in $t1$.

In addition, we allow transition probabilities to vary with several country characteristics, such as: autocracy, oil exporter, population growth (Lag), roots of conflicts, mountainous terrain, oil concentration, soil fertility, gold and diamond production, public expenditure and economic growth.

To define the data probability distribution, we first introduce an unobserved (latent) state variable s_t , which determines the state during time period t, and can assume only two values: $s_t = 0$ corresponds to one state and $s_t = 1$ corresponds to the other state ($t = 1, 2, ..., T$) see Palumbo (1999), Casasnovas and Nicodemo (2012). We define $s_{ti}(s|j)$ as:

$s_{ti}(s|j) = \{^{exp(x_{it}\beta_{sj}) for s=1,2,3,....}_{exp(x_{it}0_{sj}) for s=0}\}$

Then the Markov Transition Probability for the violence status of individual i in time t, is

$$s_{ti}(s|j) = \frac{s_{ti}(s|j)}{\sum_{j=1}^{T} s_{ti}(s|j)}$$

Finally, in the logit model we will have a transition probability as:

$$Pr[y_i = j] = \frac{exp(\gamma_j - x_{it}\beta_{sj})}{1 - exp(\gamma_j - x_{it}\beta_{sj})} - \frac{exp(\gamma_{j-1} - x_{it}\beta_{sj})}{1 - exp(\gamma_{j-1} - x_{it}\beta_{sj})}$$

The state st is assumed to follow a stationary two-state Markov chain process in time, which can be specified by time-independent transition probabilities. This model allows us to predict the probability to transit from state to another.

3.6.1 Predicted Markov Switching Probabilities from an Ordered Logit Model: Empirical Analysis

This section proceeds as follows: firstly, as before, we develop three level of analysis (country, ethnic and non-ethnic groups level), then we run ordered and multinomial logit by imposing the Markov Assumption in order to see general transitions when we add explanatory variables[20].

Ethnic Level Analysis

In Table 3.16 we show predicted probabilities of ordered logit and multinomial logit. The interpretation for ordered and multinomial are similar but we have to remind that when the dependent variable equals one we have no results for multinomial logit because it is treated as the baseline result (or as categorical). When the dependent variables assumes value 2 or 3, instead, we interpret the result as a comparison with the baseline result. Namely, we will estimate a model for armed violence relative to peace and a model for civil war relative to peace.

As we can see, several variables affect the likelihood of transition. We are confident at 99% that soil fertility, timespan, population growth (Lag), diamond production and the low quality of political rights, affect the likelihood to transit among levels of violence. This means that when fertile lands (or political rights) enlarge, the likelihood to transit decreases. Therefore, if we are in peace, more fertile lands help to maintain peace because everyone can afford food security. If, instead, we have some degree of violence, even if there is more fertile land, people will fight to gain this extra-productive land. On the contrary, the more an ethnic group is steady, the more it is likely to transit. In other words, an ethnic group living since long-time a certain degree of violence, is more likely to change its condition in a new level of violence. At first sight, this result might appear as contradictory, but it makes sense because after years in which there is any change, a community is more pushed to turn around.

Another important variable is population growth (Lag), which seems to positively affect the likelihood to transit within different degrees of violence. The reason why population growth

[20]We find interesting to include in the analysis public spending as well. However, analysis with the non-ethnic groups and country dataset could not find convergence, so we had to remove this variable. In the Appendix we have included further specifications in which public spending is included only for the case of ethnic-level analysis.

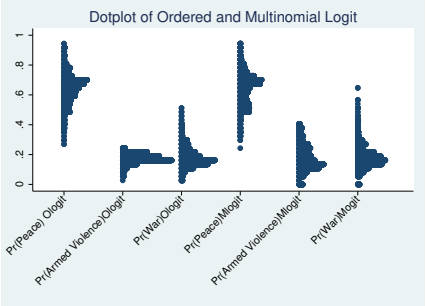


Fig. 3.2: *Dotplot of Ordered Logit and Multinomial Logit*

(Lag) has a significant effect relies on the fact that a more populated community has to deal with more troubles, such as food security, spaces, cares and so on. This might raise some tensions, especially in a poor context.

Finally, we are confident at 90% that economic growth and the natural resource inequality affect negatively the transition, regardless of its degree of violence.

In the case of multinomial logit, an increase in mountains for armed violence relative to peace, given other variables constant, is associated with an impressive decrease. This means that mountains can really affect the likelihood to move from armed violence. Soil fertility shows, once again, a significant and negative effect, together with religious conflict which seems to decrease the preference of armed violence compared to peace. This root of conflict assumes an even more important role when we are in civil war. In fact, if a religious group is fighting a war, the multinomial probability for preferring the war is expected to decrease by 1.05 unit, holding all other variables constant. Also political conflict has a significant effect but in the opposite direction; in fact, political conflicts have more probabilities to remain in civil war than to go to peace, compared to other root of conflict. Other results mean that a growing and stagnant community are more likely to remain in war, holding all other variables in the model constant. When political rights, soil fertility and diamond increase, instead, the probability to transit to peace decreases.

To sum up, from this first stage of analysis, we infer that we have different drivers able to foster a transition. Religious conflicts are more likely to be steady, compared to political and environmental ones. This result seems to be coherent with out Era, where religious (namely, Islam) conflicts are considered the worst and persistent root of conflict.

In figure 3.2 we illustrate how predictions differ in the case of a ordered logit and multinomial logit (when the models are applied to the same data) with a dot plot. As we can see from this graph, the predicted probabilities for our sample clearly shows that the predicted probabilities for individual observations span almost the entire range from 0 to 1 and we have similar predicted probabilities for both models.

In Table 3.17 we have reported the probabilities to transit among states. As we can see, results are pretty coherent with the simple counting method. Therefore, civil war has a high probability to go to peace, although it has also a 32% probability to remain in war. Therefore, war is persistent but we are equally likely to reach peace. Peace is more probable also when a community is living an armed conflict and peace shows to be persistent.

In Table 3.18 we report the marginal effects using the same specification as ordered logit. The first quarter represents the transition from peace to armed violence and to civil war. The second part from armed violence to peace and to civil war, and the third from civil war to peace and armed conflict. Hence we have to read this able horizontally. For example, in the case of peace, economic growth (lag) increases the probability to remain in peace and to go to war. Again, we find a persistence of peace. This is coherent with the economic result. A community living in a territorial with a religious (low) conflict, a growing diamond production is more likely

Table 3.4: Ordered Logit at Ethnic Level

	Ologit	
Conflict		
Low Political Rights Quality	-1.319	***
	(0.358)	
High Political Rights Quality	-0.229	
	(0.358)	
Oil Production (Lag)	0.062	
	(0.308)	
Autocracy	0.058	
	(0.252)	
Population Growth (Lag)	0.365	***
	(0.104)	
Religious Conflict	-1.053	***
	(0.238)	
Environmental Conflict	-0.165	
	(0.206)	
Political Conflict	0.815	***
	(0.206)	
Mountainous Terrain	0.563	
	(0.919)	
Oil Gini	-0.810	*
	(0.466)	
Soil Fertility	-2.152	***
	(0.577)	
Africa Region (Est)	-0.241	
	(0.283)	
Africa Region (Center)	0.365	
	(0.299)	
Gold Production	0.309	*
	(0.182)	
Diamond Production	-1.059	***
	(0.199)	
Economic Growth (Lag)	-1.914	*
	(1.118)	
Time Span	0.247	***
	(0.045)	
N	999	

Table 3.5: Probabilities to transit among states: Peace - Armed Violence - War

	Peace	Armed Violence	Civil War	N
Peace	.688	.145	.163	3202
Armed Violence	.517	.305	.178	982
Civil War	.511	.165	.324	1010

to remain in peace (actually, in diamond production case we have also a positive effect in the transition to other degree of violence. This means that diamond production can both foster a conflict and maintain a peaceful *status quo*.). However, a growing community (in terms of its members) is more at risk of moving from peace. Also the time span is important; i.e. the more peaceful an ethnic group is, the more it is probable that it remains in peace, while it is less probable to go to war.

When we look at the marginal probabilities (Table 3.18) from peace, we realize that there are more reasons to go to war than to remain in peace. In fact, the Gini indicator in terms of natural resources increases the probability to go to war. This clearly makes sense: a more unequal community is more likely to opt for war. However, also soil fertility increases the likelihood of war. This can be explained with the land grabbing phenomenon: when a community has more fertile lands, it can attract the attention from other communities or from international companies, interested on buying those lands for their business. This can raise tensions. On the contrary, gold production seems to be correlated with a turmoil and not with war. If we are already in a turmoil, population growth (lag) has an ambiguous role, because it can both foster peace or war. Time, instead, clearly shows an effect toward war.

Finally, when a community is fighting a war, soil fertility and diamond production reduce the persistence of war, but economic growth reduces the probability of peace.

In the Appendix we have provided also the same specification by using ethnic fixed effects (Table 3.45); results change moderately. For example, economic growth only affect the likelihood to remain in peace (when we are in peace), while when we are in turmoil economic growth reduces reduces the likelihood of peace and war as well.

Table 3.6: Transition Probabilities, Ordered Logit - Marginal Effects

	Peace		Armed Conflict		Civil War	
Peace						
Political Rights Quality	-0.009		-0.078	*	-0.041	
	(0.018)		(0.041)		(0.041)	
Oil Production (Lag)	0.014		-0.008		-0.001	
	(0.033)		(0.052)		(0.073)	
Autocracy	0.001		-0.042		0.045	
	(0.025)		(0.054)		(0.057)	
Population Growth (Lag)	-0.025	**	-0.045		-0.111	***
	(0.012)		(0.029)		(0.024)	
Religious Conflict	0.054	**	0.280	***	0.266	***
	(0.023)		(0.048)		(0.047)	
Environmental Conflict	0.024		0.044		0.055	
	(0.025)		(0.055)		(0.049)	
Political Conflict	0.027		-0.098	**	-0.154	***
	(0.020)		(0.042)		(0.046)	
Mountainous Terrain	0.102		-0.286		-0.304	
	(0.088)		(0.201)		(0.218)	

Table 3.6: (Continues in Next Page)

Table 3.6: (Continues from Previous Page)

Oil Gini	0.016		0.053		0.217	**
	(0.046)		(0.090)		(0.106)	
Soil Fertility	0.053		0.055		0.540	***
	(0.056)		(0.142)		(0.134)	
Africa Region (Est)	0.018		0.095		0.161	**
	(0.030)		(0.061)		(0.069)	
Africa Region (Center)	0.034		-0.055		-0.087	
	(0.034)		(0.090)		(0.068)	
Gold Production	-0.028		0.103	**	-0.069	
	(0.022)		(0.043)		(0.043)	
Diamond Production	0.057	**	0.115	**	0.210	***
	(0.025)		(0.052)		(0.045)	
Economic Growth (Lag)	0.240	**	0.101		0.572	**
	(0.111)		(0.207)		(0.263)	
Time Span	0.070	***	-0.003		-0.064	***
	(0.007)		(0.007)		(0.011)	
Armed Conflict						
Political Rights Quality	0.004		0.034	*	0.006	
	(0.007)		(0.019)		(0.006)	
Oil Production (Lag)	-0.006		0.003		0.000	
	(0.014)		(0.022)		(0.011)	
Autocracy	-0.000		0.018		-0.007	
	(0.011)		(0.023)		(0.010)	
Population Growth (Lag)	0.010	**	0.020		0.017	***
	(0.005)		(0.013)		(0.005)	
Religious Conflict	-0.023	**	-0.152	***	-0.063	***
	(0.010)		(0.033)		(0.015)	
Environmental Conflict	-0.010		-0.021		-0.010	
	(0.010)		(0.027)		(0.009)	
Political Conflict	-0.011		0.043	**	0.023	***
	(0.008)		(0.019)		(0.008)	
Mountainous Terrain	-0.042		0.127		0.047	
	(0.037)		(0.090)		(0.034)	
Oil Gini	-0.006		-0.023		-0.033	*
	(0.019)		(0.040)		(0.017)	
Soil Fertility	-0.022		-0.024		-0.083	***
	(0.023)		(0.063)		(0.025)	
Africa Region (Est)	-0.008		-0.043		-0.028	**
	(0.013)		(0.029)		(0.014)	
Africa Region (Center)	-0.014		0.023		0.010	*
	(0.015)		(0.035)		(0.006)	
Gold Production	0.012		-0.042	**	0.012	
	(0.009)		(0.018)		(0.008)	
Diamond Production	-0.024	**	-0.053	**	-0.040	***
	(0.010)		(0.024)		(0.011)	
Economic Growth (Lag)	-0.100	**	-0.045		-0.088	**
	(0.046)		(0.092)		(0.043)	
Time Span	-0.029	***	0.001		0.010	***
	(0.003)		(0.003)		(0.002)	

Table 3.6: (Continues in Next Page)

Table 3.6: (Continues from Previous Page)

War						
Political Rights Quality	0.005		0.043	**	0.034	
	(0.010)		(0.022)		(0.034)	
Oil Production (Lag)	-0.008		0.004		0.001	
	(0.019)		(0.029)		(0.062)	
Autocracy	-0.000		0.024		-0.038	
	(0.015)		(0.031)		(0.047)	
Population Growth (Lag)	0.015	**	0.025		0.094	***
	(0.007)		(0.016)		(0.021)	
Religious Conflict	-0.031	**	-0.128	***	-0.203	***
	(0.013)		(0.019)		(0.034)	
Environmental Conflict	-0.014		-0.024		-0.045	
	(0.014)		(0.029)		(0.039)	
Political Conflict	-0.016		0.054	**	0.131	***
	(0.011)		(0.023)		(0.039)	
Mountainous Terrain	-0.060		0.160		0.258	
	(0.051)		(0.112)		(0.185)	
Oil Gini	-0.009		-0.029		-0.184	**
	(0.027)		(0.050)		(0.090)	
Soil Fertility	-0.031		-0.031		-0.456	***
	(0.033)		(0.079)		(0.114)	
Africa Region (Est)	-0.011		-0.052		-0.132	**
	(0.018)		(0.032)		(0.055)	
Africa Region (Center)	-0.019		0.032		0.076	
	(0.019)		(0.055)		(0.063)	
Gold Production	0.016		-0.061	**	0.057	
	(0.012)		(0.027)		(0.035)	
Diamond Production	-0.033	**	-0.063	**	-0.170	***
	(0.014)		(0.028)		(0.036)	
Economic Growth (Lag)	-0.140	**	-0.056		-0.484	**
	(0.065)		(0.116)		(0.223)	
Time Span	-0.041	***	0.002		0.054	***
	(0.004)		(0.004)		(0.009)	
N	3152		975		999	

Table 3.7: Summary of Results

more diamond production	→	more peace and less persistence of war
more inequality	→	more war
more fertility	→	more war
more gold production	→	more violence
more economic growth	→	less peace

Non-Ethnic Group Analysis

In this subsection we report estimated probabilities when we take into consideration only non-ethnic groups. Before we analyse our result, we have to clarify one important point: in this sample we have less observations. In fact, when we analyse ethnic groups within a country, we have of course more than one ethnic group over the same time period. Here, instead, we

only have non-ethnic groups fighting or reclaiming different issues (always grouped into political, religious and environmental root of conflict).

We apply a unique specification to each level of analysis, but less observations limit our analysis anyway. Therefore, in the Appendix we have included also a reduced form in which we use less explanatory variables in order to use more observations.

As before, we start with a simple ordered logit (Table 3.20).

Table 3.8: Ordered Logit at Non-Ethnic Groups Analysis

	OLogit	
Conflict		
Low Political Rights Quality	0.000	
High Political Rights Quality	12.980	***
	(2.692)	
Oil Production (Lag)	-0.606	
	(0.526)	
Autocracy	-1.443	
	(1.882)	
Population Growth (Lag)	0.189	
	(0.447)	
Religious Conflict	0.000	
Environmental Conflict	0.000	
Political Conflict	0.000	
Mountainous Terrain	0.620	
	(2.007)	
Oil Gini	1.893	***
	(0.628)	
Soil Fertility	-5.703	*
	(3.118)	
Africa Region (Est)	-1.776	***
	(0.552)	
Africa Region (Center)	-2.912	***
	(0.869)	
Gold Production	0.757	
	(1.248)	
Diamond Production	-0.653	
	(0.974)	
Economic Growth (Lag)	-3.618	
	(9.484)	
Time Span	0.472	
	(0.385)	
cut1		
Constant	13.501	***
	(4.278)	
cut2		
Constant	14.599	***
	(4.193)	
N	39	

We see that when we analyse from non-ethnic groups perspective, inequality in terms of natural resources and the quality of political rights increase a lot the probability to move among different levels of violence. On the contrary, soil fertility helps to be stable, especially if we are in Central or Eastern Africa.

We study in depth this model with the purpose to understand what stable or unstable means:

do we move toward peace or war? In order to understand these questions, we firstly calculate probabilities from ordered logit and then we use switching probabilities with an ordered logit specification.

Table 3.9: Probabilities to transit among states at Non-Ethnic Groups Level: Peace - Armed Violence - War

	Peace	Armed Violence	Civil War	N
Peace	.638	.139	.223	111
Armed Violence	.476	.400	.124	42
Civil War	.322	.199	.479	49

When we study how conflicts evolve in urban context (Table 3.21), we discover that war is more persistent compared to conflicts managed by ethnic groups. However, if non-ethnic groups are living in a peaceful country, they are more likely to remain in peace and, even when there are some turbulences, they do not escalate toward war.

If we look at marginal effects (Table 3.22[21]), we see that economic growth affects equally the probability to remain in peace or to shift toward a more violent conflict. This is plausible: if non-ethnic groups can enjoy a GDP growth they are more likely to remain peaceful but, if this growth is not used for public purposes, some grievances may arise. In fact, if we are in turmoil, economic growth reduces the likelihood to reach peace. Of course, also autocracy fosters a transition toward armed violence but, if we are already in a violent conflict, autocracy reduces the likelihood to remain in this stage. This is so because autocracy can use governmental forces to repress or control the conflictual mass. Finally, population growth (lag) has a positive effect on the likelihood to reach peace if we are in war.

Table 3.10: Transition Probabilities, Ordered Logit at Non-Ethnic Groups Level - Marginal Effects

	Peace		Armed Conflict		Civil War
Peace					
Political Rights Quality	0.074		0.257		0.039
	(0.296)		(0.326)		(0.173)
Oil Production (Lag)	-0.189		-0.061		-0.013
	(0.257)		(0.213)		(0.156)
Autocracy	0.195		0.654	***	-0.088
	(0.167)		(0.146)		(0.229)
Population Growth (Lag)	-0.218	*	-0.057		-0.008
	(0.113)		(0.136)		(0.061)
Mountainous Terrain	0.016		0.504		-0.331
	(0.539)		(0.933)		(0.288)
Oil Gini	0.172		-0.056		0.003
	(0.321)		(0.330)		(0.216)
Soil Fertility	0.220		0.180		0.381
	(0.345)		(0.749)		(0.460)
Africa Region (Est)	-0.098		0.286		0.157
	(0.302)		(0.323)		(0.181)
Africa Region (Center)	-0.322	*	-0.127		0.081
	(0.176)		(0.184)		(0.148)

Table 3.10: (Continues in Next Page)

[21] Three variables have been dropped by the model: political and environmental conflicts and gold production.

Table 3.10: (Continues from Previous Page)

Diamond Production	-0.072		0.039		0.135
	(0.168)		(0.177)		(0.125)
Economic Growth (Lag)	1.974	***	1.857	***	0.226
	(0.525)		(0.697)		(1.387)
Time Span	0.026		-0.007		-0.068
	(0.042)		(0.058)		(0.049)
Religious Conflict			-0.238		
			(0.170)		
Armed Conflict					
Political Rights Quality	-0.035		-0.087		0.000
	(0.144)		(0.141)		(0.003)
Oil Production (Lag)	0.069		0.017		-0.000
	(0.074)		(0.039)		(0.004)
Autocracy	-0.104		-0.406	***	-0.007
	(0.104)		(0.129)		(0.039)
Population Growth (Lag)	0.102		0.019		-0.000
	(0.075)		(0.052)		(0.001)
Mountainous Terrain	-0.007		-0.170		-0.004
	(0.252)		(0.331)		(0.024)
Oil Gini	-0.081		0.019		0.000
	(0.160)		(0.108)		(0.002)
soil	-0.103		-0.061		0.004
	(0.172)		(0.265)		(0.030)
Africa Region (Est)	0.043		-0.140		-0.010
	(0.118)		(0.206)		(0.027)
Africa Region (Center)	0.088	*	0.026		-0.003
	(0.053)		(0.034)		(0.013)
Diamond Production	0.033		-0.013		0.000
	(0.075)		(0.064)		(0.010)
Economic Growth (Lag)	-0.924	**	-0.628		0.002
	(0.453)		(0.493)		(0.024)
Time Span	-0.012		0.002		-0.001
	(0.019)		(0.019)		(0.005)
Religious Conflict			-0.045		
			(0.140)		
Civil War					
Political Rights Quality	-0.039		-0.170		-0.039
	(0.153)		(0.197)		(0.175)
Oil Production (Lag)	0.120		0.044		0.013
	(0.190)		(0.176)		(0.160)
Autocracy	-0.090		-0.248	***	0.095
	(0.070)		(0.060)		(0.267)
Population Growth (Lag)	0.116	**	0.038		0.009
	(0.048)		(0.086)		(0.061)
Mountainous Terrain	-0.008		-0.334		0.335
	(0.286)		(0.623)		(0.283)
Oil Gini	-0.092		0.037		-0.003
	(0.164)		(0.222)		(0.218)
soil	-0.117		-0.119		-0.386

Table 3.10: (Continues in Next Page)

Table 3.10: (Continues from Previous Page)

	(0.178)		(0.487)		(0.470)
Africa Region (Est)	0.055		-0.147		-0.147
	(0.184)		(0.127)		(0.157)
Africa Region (Center)	0.234		0.101		-0.078
	(0.149)		(0.168)		(0.136)
Diamond Production	0.039		-0.026		-0.135
	(0.095)		(0.113)		(0.126)
Economic Growth (Lag)	-1.050	***	-1.230	***	-0.228
	(0.261)		(0.463)		(1.405)
Time Span	-0.014		0.004		0.068
	(0.024)		(0.039)		(0.050)
Religious Conflict			0.284		
			(0.299)		
N	117		63		67

Table 3.11: Summary of Results

more resources inequality	→	more violence
more soil fertility	→	more stability
more autocracy	→	more violence and persistence of violence
more population growth	→	less peace
more economic growth	→	more peace or violence

Country Level Analysis

As before, it is interesting to have a look at the probabilities to transit among different degrees of violence at country level. In the first Table (3.22) we run a simple ordered logit in which only economic growth results to affect transitions. This is perfectly coherent with the economic literature, but this result is clearly very different compared to previous results. However, we use same dataset but taking into account countries instead of ethnic groups or non-ethnic groups. We now study in depth this relationship by estimating transition probabilities and marginal effects.

In Table 3.23 we report related probabilities and we can see that there is a high persistence for each degree of violence. Moreover, the persistence of armed violence and war is much more evident compared to other analysis and also the probability to shift to peace is much more smaller. Therefore, when we analyse how countries behave in a conflictual situation, we find out that violence is very persistent.

We have to remind that in the first chapter of this dissertation, we have illustrated the overall agreement upon the result regarding the persistence of civil war.

Our first step of analysis makes us aware of the probable carelessness of economic analysis: we should expand our studies with a closer examination of conflicts, of actors involved and their original reasons for fighting.

Table 3.24 reports marginal effects of transitions from our three degrees of violence. Results tell us that population growth (lag) affects negatively the persistence of peace and mountains increase the likelihood to move to turmoil. This is coherent with previous results and, aboveall, to economic literature: more populated countries with many mountains increase the probability of war.

Moreover, previous economic growth reduces the likelihood of war, even if it can cause a turmoil. When we are in peace, an economic growth creates some changes that, if not properly

Table 3.12: Ordered Logit at Country Level

	OLogit	
Conflict		
Low Political Rights Quality	-0.256	
	(0.520)	
High Political Rights Quality	-0.029	
	(0.541)	
Oil Production (Lag)	0.411	
	(0.552)	
Autocracy	0.613	
	(0.534)	
Population Growth (Lag)	0.255	
	(0.194)	
Religious Conflict	0.334	
	(0.698)	
Environmental Conflict	1.152	
	(0.942)	
Political Conflict	0.000	
Mountainous Terrain	-0.837	
	(1.546)	
Oil Gini	0.629	
	(0.886)	
Soil Fertility	-2.241	
	(1.762)	
Africa Region (Est)	0.409	
	(0.635)	
Africa Region (Center)	-1.478	*
	(0.867)	
Gold Production	-0.541	
	(0.514)	
Diamond Production	1.039	
	(0.769)	
Economic Growth (Lag)	2.977	***
	(0.754)	
Time Span	-0.041	
	(0.062)	
cut1		
Constant	1.731	
	(2.887)	
cut2		
Constant	3.249	
	(2.814)	
N	176	

Table 3.13: Probabilities to transit among states at Country level: Peace - Armed Violence - War

	Peace	Armed Violence	Civil War	N
Peace	.77126795	.12416925	.10456279	221
Armed Violence	.05982125	.82505542	.11512333	305
Civil War	.11642744	.21728759	.66628497	177

addressed, can rise some grievances. If, instead, we are in war, (previous) economic growth causes civil war breakout and only economic growth results to be highly related to the persistence of civil

war. Religious conflicts and population growth (lag), instead, help to reach peace. Therefore, when we analyse at country level, it seems that religious conflicts are more resolvable even if, when we are in peace, they destabilise a country.

Table 3.14: Transition Probabilities at Country Level, Ordered Logit - Marginal Effects

	Peace		Armed Violence		Civil War	
1						
Political Rights Quality	0.141		-0.012		-0.030	
	(0.095)		(0.014)		(0.026)	
Oil Production (Lag)	0.075		0.016		-0.027	
	(0.119)		(0.018)		(0.034)	
Autocracy	-0.114		-0.021		-0.061	
	(0.140)		(0.015)		(0.040)	
Population Growth (Lag)	-0.129	***	-0.028	***	-0.024	
	(0.031)		(0.010)		(0.017)	
Religious Conflict	-0.353	***	0.017		-0.024	
	(0.136)		(0.021)		(0.045)	
Environmental Conflict	-0.030		-0.004		-0.072	*
	(0.133)		(0.011)		(0.038)	
Mountainous Terrain	0.024		0.048	**	0.055	
	(0.105)		(0.022)		(0.111)	
Oil Gini	-0.079		-0.011		-0.035	
	(0.161)		(0.027)		(0.071)	
Soil Fertility	0.199		-0.040		0.167	
	(0.128)		(0.040)		(0.155)	
Africa Region (Est)	-0.094		-0.019		-0.018	
	(0.075)		(0.015)		(0.047)	
Africa Region (Center)	-0.111		-0.024	*	0.170	
	(0.153)		(0.014)		(0.133)	
Gold Production	0.264	***	0.006		0.046	
	(0.087)		(0.015)		(0.036)	
Diamond Production	-0.055		0.003		-0.086	
	(0.073)		(0.021)		(0.054)	
Economic Growth (Lag)	0.404		0.323	**	-0.255	***
	(0.667)		(0.137)		(0.086)	
Time Span	-0.003		0.001		0.003	
	(0.006)		(0.001)		(0.004)	
2						
Political Rights Quality	-0.077		-0.017		-0.049	
	(0.056)		(0.024)		(0.045)	
Oil Production (Lag)	-0.042		0.014		-0.047	
	(0.069)		(0.012)		(0.068)	
Autocracy	0.059		-0.037		-0.100	
	(0.067)		(0.031)		(0.075)	
Population Growth (Lag)	0.071	***	-0.040	**	-0.039	*
	(0.021)		(0.020)		(0.022)	
Religious Conflict	0.137	***	0.016		-0.041	
	(0.042)		(0.016)		(0.080)	
Environmental Conflict	0.016		-0.006		-0.137	
	(0.071)		(0.019)		(0.091)	

(Continues in the next page)

(Continues from previous page)

Mountainous Terrain	-0.013		0.070		0.091	
	(0.058)		(0.053)		(0.190)	
Oil Gini	0.043		-0.016		-0.058	
	(0.089)		(0.036)		(0.118)	
Soil Fertility	-0.109		-0.058		0.274	
	(0.071)		(0.066)		(0.232)	
Africa Region (Est)	0.050		-0.047		-0.031	
	(0.039)		(0.049)		(0.088)	
Africa Region (Center)	0.058		-0.083		0.172	**
	(0.078)		(0.093)		(0.075)	
Gold Production	-0.134	***	0.010		0.078	
	(0.046)		(0.024)		(0.064)	
Diamond Production	0.030		0.005		-0.135	
	(0.041)		(0.027)		(0.093)	
Economic Growth (Lag)	-0.222		0.469	**	-0.418	***
	(0.359)		(0.209)		(0.142)	
Time Span	0.001		0.002		0.005	
	(0.003)		(0.002)		(0.007)	
3						
Political Rights Quality	-0.064		0.029		0.079	
	(0.042)		(0.036)		(0.070)	
Oil Production (Lag)	-0.033		-0.030		0.074	
	(0.050)		(0.028)		(0.101)	
Autocracy	0.055		0.058		0.161	
	(0.074)		(0.043)		(0.112)	
Population Growth (Lag)	0.058	***	0.068	***	0.062	*
	(0.016)		(0.021)		(0.037)	
Religious Conflict	0.215	**	-0.033		0.065	
	(0.109)		(0.035)		(0.124)	
Environmental Conflict	0.014		0.010		0.209	*
	(0.063)		(0.030)		(0.124)	
Mountainous Terrain	-0.011		-0.118	*	-0.146	
	(0.047)		(0.068)		(0.300)	
Oil Gini	0.036		0.027		0.093	
	(0.073)		(0.062)		(0.188)	
Soil Fertility	-0.090		0.098		-0.441	
	(0.061)		(0.102)		(0.379)	
Africa Region (Est)	0.045		0.066		0.050	
	(0.038)		(0.062)		(0.134)	
Africa Region (Center)	0.053		0.107		-0.343	*
	(0.076)		(0.104)		(0.196)	
Gold Production	-0.130	**	-0.016		-0.124	
	(0.051)		(0.038)		(0.097)	
Diamond Production	0.025		-0.008		0.221	
	(0.033)		(0.048)		(0.143)	
Economic Growth (Lag)	-0.183		-0.793	***	0.673	***
	(0.311)		(0.239)		(0.192)	
Time Span	0.001		-0.003		-0.008	
	(0.003)		(0.003)		(0.011)	

(Continues in the next page)

(Continues from previous page)

N	221	300	176

Table 3.15: Summary of Results

more mountains	→	more violence
more population growth	→	less peace
more economic growth	→	less war

3.7 Hazard Model

In this last part of the thesis, we use the survival analysis to estimate transition probabilities among different degrees of violence with a more accurate model.

We find the survival analysis a proper model for studying conflicts because it is concerned with analysing the time to the occurrence of a specific event (usually this methodology is employed in medical analysis, therefore the "event" may be the time until a cancer patient dies). In our case, given a certain set of characteristics and a given period of peace or war, we analyse the time until a war breaks out and we are able to estimate the probability of future conflict. In other words, each subject is analysed according to its violent events over time and additional variables help us to explain these times and probability. Hence, our analysis returns the probability of experiencing a violent event for those who did in fact fail at that time.

Hazard model is widely used to describe data involving time to the occurrence of an event. Usually, events are death, the development of some disease, recurrence of a disease, and so on (Allison, 1984). For this reason these models are called "survival analysis". Here we look at violent incidents as events leading to civil war. However, in the past decades, applications of the statistical methods for hazard data analysis have been extended beyond biomedical and reliability research to other fields, as social sciences, engineering, criminology, insurance, and others. This method has been already used also in the Economics of Conflicts (Rouen and Sobek, 2001; Lindsay et al., 2008; Davenport et al., 2005; Lindsay and Enterline, 2000; Raknerud and Hegre, 1997).

Survival analysis is a *sui generis* analysis with its own language. In fact, usually when we use the therm "years or time" we refer to a given calendar year or a given calendar day. Here, instead, we consider time as the time before an event occurred. For example, if a country is in peace from 2000 to 2003 and than a war breaks, we consider "time" as 1, 2, 3 and then we start counting again because a war has occurred and so on. Therefore, we can call it a sort of duration time. Another important feature is the so called failure, which is the event that we are studying. Therefore, time and failure are strictly related each other and they will provide the hazard function. Each state has its own failure indicator, hence in our case we have 3 failure indicators for every subject.

Following the exposition in Anderson, Hansen and Keiding (1991) we first estimate a standard cumulative hazard rate (which is strictly related to Markov switching models). Then, since we do not know the shape of our survival time, it is preferable to run a cause-specific hazard Cox model (Cox, 1972), which is by far the most popular of choices, especially in case of doubt about the distribution of the hazard. Cox model does not make any assumptions and whatever the the shape of the hazard is, it is assumed to be the same for everyone and constant over time.

In Cox regression the dependent variable is the transition between states of violence - the transition from peace to civil war (or vice versa) being of this type.

A central concept in survival analysis is the hazard function (also known as the failure rate or hazard rate or the survival function). The hazard function is closely related to the concept of

transition probability: *h(t)* is approximately the probability of a transition in the time interval $(t, t + \delta t)$ given that the subject under study is at risk of transition at t. In Cox regression it is assumed that the hazard of war *h(t)* can be factorized into a parametric function of (time-dependent) variables and a non-parametric function of time itself (the baseline hazard, which is an arbitrary function reflecting unobserved variables at the system level). We can write the hazard function H(t) in terms of linear regression:

$h_j(t) =$ some function of $(h_0(t), \beta_0 + x_j \beta x$

In the case of Cox model, we have

$h(t|x_j) = h_0(t) exp(\beta_0 + x_j \beta x$

which is called also the Cox proportional hazards model. By performing this model for each failure, we yield the overall probability of failing for those who did in fact fail at that time. The estimation is run by maximizing the likelihood.

Estimating this model involves estimation of the regression coefficients $\beta = (\beta_0, ..., \beta_x)$ and estimation of the baseline hazard of war *h(t)*. These two tasks are quite different, since the latter is an unknown function - not a parameter. However, for inference it is more interesting β parameters which can be made by conditioning on the time-points of transitions. Therefore, we can consider time of transitions as stochastic, without losing any information about the structural parameters.

The interpretation of coefficients in the Cox Model is the interpretation of the ratio of the hazards for a one-unit change in the corresponding covariate. We may interpret the parameter β in terms of a relative probability of transitions. Therefore, β is the log of the relative risk between two subjects which are identical, except for the variable explanatory variable, which differs by one unit. Similarly, the hazard rates can be interpreted as a simple rate whit units *1/t* and can be understood as the risk of civil war at time t, given that the civil war has already lasted until time t.

We define

$N_{hji}(t) =$ number of transition h to j observed in $[0, t]$ for country i

and

$Y_{hi} = I$

where I is a indicator function and stands for the country i observed in state h at time t.

Some tests are provided for the adequacy of the proportional hazards assumption. The first method is by means of time-varying covariates (also known as time-dependent covariates). These variables allow the constant term in the hazard regression to differ over time. In other words, time dependent covariates are interactions of the predictors and time. By doing so, the marginal effect remains the same but the variable changes and the aggregate effect as well. Clearly, we are relaxing the Markov assumption by allowing the hazard ratio to depend on time, so we do not have a proportional hazard model anymore. If any of the time dependent covariates are significant then those predictors are not proportional and we do not verify the fundamental proportional assumption.

We remind that the verification of the PH assumption is far from being systematic. In a 1995 review of five clinical oncology journals including about 130 papers, Altman et al. reported that only 2 out of the 43 papers which relied on a Cox model, mentioned that the PH assumption was verified. Similarly, about ten years later Mathoulin et al. (2008) assessed the quality of reporting of survival events in randomized clinical trials in eight general or cancer medical journals. The authors reported that only 10 of the 123 papers that used a Cox model mentioned verifying the PH assumption. Hence, we should be not surprised if our model does not pass the test.

However, one of the benefits of the proportional-hazards model with all fixed covariates is the ability to give individualized predictions of the estimated time to the event of interest. Curves with different covariate values can illustrate the interaction between multiple risk factors. With time-dependent covariates the ability to predict is usually lost. One reason is that, because the model depends on the value of a changing quantity (the time-dependent covariate), future values

are usually unknown until they are actually observed. Further, the use of time-varying covariates is much more complicated to fit computationally and interpret than the fixed (time-independent) covariates, leading to potential erroneous inference and modeling.

Another method for checking the proportionality assumption is with the analysis of residuals by using the Schoenfeld and scaled Schoenfeld residuals test. Again, if the tests in the table are not significant we can not reject proportionality and we assume that we do not have a violation of the proportional assumption.

3.7.1 Hazard Model: Empirical Analysis:

We use identical set of regressors as in the ordered logit model, but in this case we use a Cox proportional hazard model in order to estimate the risk of the hazard to transit from a certain level of violence to another. As said in the previous section, semiparametric models combine individual binary-outcome analysis at each of the failure times.

After setting our dataset with the "survival language", we first run a specification test where each type of violence is included. Hence, we estimate the probability that a country shifts from any level of violence to another. Before running the "full" specification, we do some univariate analysis in order to explore whether or not to include the predictor in the final model. For the categorical variables we use the log-rank test of equality across strata which is a non-parametric test. For the continuous variables, instead, we use a univariate Cox proportional hazard regression. If the variable shows a p-value of 0.2 or less, it means that it is relevant to the model. From these tests, we realize that dummy variables related to gold and diamonds production, the Gini indicator for oil and the indicator of autocracy should not be included in the model. Other two variables show a p-value greater than 0.25 in the univariate analysis: economic growth and the dummy for environmental conflict. Of course, these two variables are important from a theoretical point of view, so we will include them as control variables anyway.

Another important element concerns the number of observations. Our ethnic-level dataset include 9988 observations. Yet in the ordered logit we have seen a deep reduction of observations used in the regressions. This was simply due to missing values in some variables. In the hazard model, the number of observations is even more reduced because of the imposed condition in the model: since we set our analysis starting from a particular degree of violence and experiencing a transition to a specific other degree of violence, the algorithm needs to find the exact correspondence in order to estimate the likelihood to transit. This is data consuming and limits our analysis to few observations (compared to our overall dataset). This problem becomes much more serious when we apply survival analysis to the dataset of non-ethnic groups and country. Therefore, we cannot run survival analysis in the case of country and non-ethnic groups dataset.

As stated above, in the Cox proportional hazard model, covariates act as factors multiplying the hazard rate, which is the probability of experiencing the event in question during the next interval.

In Table 3.25 we have reported our estimates in four different specifications, all of them representing the general case. Although different specifications, we have similar results: economic growth, soil fertility and diamond production always affect the likelihood to verify a transition toward peace, regardless the starting point. On the contrary, population growth (lag), autocracy and public spending reduces this probability. Excepts for public spending, other coefficients confirm previous results and are absolutely plausible.

We run some tests in order to verify our analysis. The first test is a simple linktest, which does not provide any significant p-value in each specification. We will report also a plot of the scaled Schoenfeld assumption in order to see graphically if our predictors are good or not.

We test for the adequacy of the proportional hazards assumption (Table 3.51), by estimating the same regression with time-varying covariates. Time-varying test tells us that public spending, population growth (lag) and diamond production vary over time but Schoenfeld and scaled

Table 3.16: Cox Proportional Hazard Model: General transitions toward Peace

	1		2		3		4	
Low Political Rights Quality	0.127		0.199		0.264		0.193	
	(0.164)		(0.208)		(0.202)		(0.159)	
High Political Rights Quality	-0.118		-0.085		0.063		0.020	
	(0.192)		(0.240)		(0.240)		(0.196)	
Public Spending	-0.018	***	-0.017	**				
	(0.007)		(0.007)					
Oil Production (Lag)	-0.130		-0.159		-0.183		-0.179	
	(0.179)		(0.185)		(0.178)		(0.171)	
Autocracy	-0.312	**	-0.324	**	-0.159		-0.155	
	(0.154)		(0.161)		(0.159)		(0.152)	
Population Growth (Lag)	-0.176	***	-0.157	**	-0.097	*	-0.119	**
	(0.061)		(0.067)		(0.058)		(0.052)	
Religious Conflict	0.472	***	0.482	***	0.351	***	0.388	***
	(0.108)		(0.146)		(0.114)		(0.096)	
Environmental Conflict	-0.032		-0.026		0.113		0.082	
	(0.124)		(0.149)		(0.114)		(0.099)	
Political Conflict	-0.142		-0.195	*	-0.090		-0.057	
	(0.106)		(0.111)		(0.107)		(0.097)	
Mountainous Terrain	0.215		0.267		-0.307		-0.369	
	(0.389)		(0.411)		(0.296)		(0.289)	
Oil Gini	0.219		0.255		0.257		0.295	
	(0.240)		(0.276)		(0.245)		(0.231)	
Soil Fertility	0.805	***	0.749	**	0.669	**	0.705	**
	(0.282)		(0.317)		(0.322)		(0.278)	
Africa Region (Est)	0.068		0.089		-0.007		-0.024	
	(0.154)		(0.169)		(0.143)		(0.132)	
Africa Region (Center)	-0.167		-0.144		-0.082		-0.159	
	(0.163)		(0.204)		(0.185)		(0.163)	
Gold Production	0.140		0.197		0.023		-0.000	
	(0.131)		(0.145)		(0.132)		(0.124)	
Diamond Production	0.402	***	0.456	***	0.277	**	0.275	**
	(0.121)		(0.133)		(0.141)		(0.127)	
Economic Growth (Lag)	1.850	**	1.792	**	0.748	*	0.754	*
	(0.757)		(0.804)		(0.408)		(0.408)	
Fixed Effects	No		Yes		Yes		No	
N	489		489		604		604	

Schoenfeld residuals test for proportionality assumption is verified, meaning that any variable violets the assumption, both globally and one by one[22].

In the graph, a slope significantly different from zero would be evidence against proportionality: an increasing trend would indicate an increasing hazard ratio over time. The horizontal line in graph 3.3 is the indication that there is no violation of the proportionality assumption and in the second graph, the lines are parallel, so we have further indication that the predictors do not violate the proportionality assumption.

We run also a log-log plots to test proportionality which gives us a further indication that the predictors do not violate the proportionality assumption.

In Table 3.26 we report estimated transitions toward armed violence and in Table 3.27 those related to civil war, with same specifications as before. Here, public spending, population growth (lag) and oil exports increase the transition likelihood toward armed violence and civil war. On the contrary, only inequality in terms of natural resources and mountainous terrain result to reduce the probability to experience armed violence. Economic growth, soil fertility and diamond production reduce the odds of war.

[22]In the Appendix we have included Tables and 3.49 and Figure 3.2 where test results are shown.

Table 3.17: Cox Proportional Hazard Model: Genereal Transitions toward Armed Violence

	1		2		3		4	
Low Political Rights Quality	-0.033		0.156		0.296		0.188	
	(0.480)		(0.513)		(0.509)		(0.493)	
High Political Rights Quality	0.455		0.522		0.491		0.440	
	(0.573)		(0.572)		(0.678)		(0.700)	
Public Spending	0.060	***	0.053	***				
	(0.020)		(0.021)					
Oil Production (Lag)	0.666	*	0.668		0.921	**	0.953	**
	(0.401)		(0.408)		(0.400)		(0.392)	
Autocracy	0.462		0.279		0.197		0.406	
	(0.437)		(0.428)		(0.550)		(0.571)	
Population Growth (Lag)	1.059	***	0.961	***	0.218		0.322	
	(0.230)		(0.255)		(0.211)		(0.200)	
Religious Conflict	-2.938	***	-2.688	***	-1.827	**	-2.239	***
	(0.874)		(0.883)		(0.758)		(0.769)	
Environmental Conflict	0.889		0.765		-0.529		-0.374	
	(0.600)		(0.585)		(0.602)		(0.596)	
Political Conflict	-0.101		-0.226		-0.066		0.051	
	(0.391)		(0.448)		(0.371)		(0.362)	
Mountainous Terrain	-22.952	***	-21.319	***	-5.903		-6.992	
	(4.094)		(4.134)		(5.410)		(5.379)	
Oil Gini	-2.085	**	-1.754	*	-1.280		-1.706	*
	(0.837)		(0.972)		(1.046)		(0.933)	
Soil Fertility	0.351		-0.110		-0.398		0.263	
	(0.923)		(0.982)		(0.826)		(0.784)	
Africa Region (Est)	2.096	***	1.745	**	0.706		1.090	
	(0.666)		(0.696)		(0.742)		(0.714)	
Africa Region (Center)	2.111	**	1.474		-0.132		0.625	
	(0.928)		(0.998)		(1.046)		(0.957)	
Gold Production	-0.184		-0.142		0.332		0.323	
	(0.359)		(0.393)		(0.395)		(0.362)	
Diamond Production	-0.324		-0.124		0.073		-0.080	
	(0.412)		(0.406)		(0.341)		(0.347)	
Economic Growth (Lag)	-4.668		-3.825		-2.546		-3.312	
	(3.232)		(3.105)		(2.186)		(2.424)	
Fixed Effects	No		Yes		Yes		No	
N	489		489		604		604	

Tests are done as before. Briefly, the linktest on armed violence is not verified for the last two specifications.

Time-Varying and Residual Test, instead, provide good results, because each variable respects the proportionality assumption.

Same test for transitions to war, instead, are less good, because several variables seem to change over time (Table 3.53 and figure 3.4 and 3.5).

Also the Residual Test tells us that some variables vary over time, namely we cannot rely on oil production (lag), population growth (lag), mountainous terrain, diamond production and economic growth.

Hence, in the following section we refine these results by imposing specific directions of transition.

From Peace to other Degree of Violence

In this section we study the likelihood of violence transitions in case of peaceful countries. In other words, we study the probability of violence escalation when there is peace. We will proceed as before. In order to have comparable estimates, we report specification without public

Table 3.18: Cox Proportional Hazard Model: General Transitions toward War

	1		2		3		4	
Low Political Rights Quality	-0.529		-0.833		-1.081	*	-0.699	
	(0.612)		(0.611)		(0.641)		(0.637)	
High Political Rights Quality	0.164		-0.147		-0.701		-0.333	
	(0.663)		(0.681)		(0.655)		(0.658)	
Public Spending	0.065	***	0.063	***				
	(0.019)		(0.021)					
Oil Production (Lag)	-1.414	***	-1.250	**	-0.659		-0.723	
	(0.539)		(0.534)		(0.600)		(0.619)	
Autocracy	0.779		1.018	*	0.393		0.229	
	(0.494)		(0.555)		(0.522)		(0.519)	
Population Growth (Lag)	0.568	**	0.523	**	0.321		0.379	
	(0.249)		(0.247)		(0.214)		(0.237)	
Religious Conflict	-1.378	*	-1.334		-0.674		-0.829	
	(0.776)		(0.879)		(0.576)		(0.544)	
Environmental Conflict	-0.751		-0.758		-0.406		-0.345	
	(0.536)		(0.512)		(0.489)		(0.513)	
Political Conflict	0.578		0.659		0.224		0.174	
	(0.378)		(0.419)		(0.342)		(0.313)	
Mountainous Terrain	4.086	***	3.495	**	1.820		2.826	*
	(1.459)		(1.547)		(1.488)		(1.453)	
Oil Gini	-0.175		-0.210		-0.261		-0.374	
	(1.014)		(1.114)		(1.011)		(0.949)	
Soil Fertility	-3.017	***	-1.842		-0.889		-2.229	**
	(1.082)		(1.483)		(1.258)		(1.008)	
Africa Region (Est)	0.021		0.336		0.149		-0.112	
	(0.545)		(0.559)		(0.486)		(0.532)	
Africa Region (Center)	1.228		1.409		1.093		1.010	
	(0.843)		(0.975)		(0.816)		(0.760)	
Gold Production	-0.411		-0.509		-0.360		-0.223	
	(0.319)		(0.331)		(0.399)		(0.398)	
Diamond Production	-1.174	**	-1.359	**	-0.827	*	-0.700	
	(0.508)		(0.574)		(0.488)		(0.468)	
Economic Growth (Lag)	-5.977	*	-7.145	*	-5.434	*	-4.813	*
	(3.584)		(3.748)		(2.891)		(2.907)	
Fixed Effects	No		Yes		Yes		No	

spending (as previous models), but in the Appendix B we provide other specifications in which also public spending is included[23].

In Table (3.28) each column represents a transition from peace to another degree of violence (namely armed violence and civil war), excepts the first one which reports the persistence probability.

Although different from the general case[24], our result are very plausible and coherent with previous probabilities: if an ethnic group is in peace, an increase in population density reduces the probability of remaining in peace. On the contrary, we are confident at 99% that ethnic groups living in a fertile land, with diamond reserves and with some religious tensions, are more likely to remain in peace if they are already in peace. This makes sense: these variables represent primary drivers to economic and food security. If we are in peace, an increase of these drivers is redistributed within a community, giving less reasons to fight. Moreover, an increase in soil fertility reduces deeply the likelihood of war. On the contrary, an increase in oil production in previous year (because we use lag) increases the odds that an armed conflict will occur. As explained in literature, also a community living in a mountainous area is more likely to move to war, even in peaceful period.

In the Appendix B we show results with time-varying covariates in order to see whether it rejects the proportional assumption.

Several variables result to be significant and so to reject the Markov fundamental assumption. Since diamond production, population growth (lag), autocracy, inequality in terms of natural resources and oil production (lag) are significant as fixed covariates, we cannot rely on their significant effect.

In the second column (i.e. when we take into account the transition from peace to armed violence) we see a significant coefficient (with a strong impact) of economic growth. However, this variable is also highly significant as time-varying variable, meaning that we should be suspicious of its effect.

The linktest (Tukey, 1949) tells us that the prediction squared is not significant, so our specifications do not need to be improved.

As before, we now proceed with the residual test. In the case of transition from peace to peace, the proportionality assumption is never violated. On the contrary, the Chi-squared value is significant for some variables in the last two cases: political rights, oil production (Lag), population growth (lag) and economic growth. Therefore, we should be suspicious about the effect of those variables when we analyse transitions from peace to armed violence and to war. Finally, we plot the test of goodness of fit (Fig. 3.6, 3.7, and 3.8). As we can see, the best result is obtained when we estimate transition probabilities from peace to armed violence.

We have seen that when we are in peace the main root of conflict is the religious determinant. For this reason, we find interesting to study in depth transition probabilities from peace to other degrees of violence taking into account only religious conflicts (Table 3.33). What emerges is that religious conflicts are more likely to occur in a mountainous terrain and if there is an increase in population or an increase in oil production (Lag). On the contrary, the more political rights quality increase, the more we remain in peace. Although economic growth has a large standard error, it has also an impressive effect in the probability reduction of war. Therefore, we have found out that religious conflicts are mainly related to a problem of population growth (Lag) and inhospitable soil fertility.

We think that, although not significant, the other roots of conflict are important as well. Therefore, in Table 3.41 and 3.43 we report also survival analysis for transitions from peace by taking into account only the environmental and political conflicts.

[23] As said before, we find interesting to include in the analysis public expenditures as well. However, analysis with the non-ethnic groups and country dataset could not find convergence, so we had to remove this variable.

[24] In the Appendix B we have included also the case in which we apply fixed effects (Table 3.29) where we have similar results.

Table 3.19: Cox Proportional Hazard Model: Transitions from Peace to other states

	Peace → *Peace*		Peace → *ArmedViolence*		Peace → *CivilWar*	
Low Political Rights Quality	0.227		0.085		-0.749	
	(0.153)		(0.490)		(0.617)	
High Political Rights Quality	0.052		0.365		-0.387	
	(0.192)		(0.727)		(0.670)	
Oil Production (Lag)	-0.228		1.063	***	-0.405	
	(0.158)		(0.380)		(0.541)	
Autocracy	-0.139		0.368		0.221	
	(0.147)		(0.577)		(0.583)	
Population Growth (Lag)	-0.115	**	0.339	*	0.368	
	(0.051)		(0.203)		(0.224)	
Religious Conflict	0.373	***	-2.231	***	-0.776	
	(0.097)		(0.774)		(0.538)	
Environmental Conflict	0.102		-0.390		-0.389	
	(0.098)		(0.595)		(0.487)	
Political Conflict	-0.056		0.038		0.163	
	(0.096)		(0.367)		(0.301)	
Mountainous Terrain	-0.358		-7.529		2.783	**
	(0.287)		(5.528)		(1.371)	
Oil Gini	0.294		-1.712	*	-0.394	
	(0.229)		(0.915)		(0.891)	
Soil Fertility	0.724	***	0.249		-2.312	**
	(0.277)		(0.798)		(0.972)	
Africa Region (Est)	-0.031		1.200	*	-0.110	
	(0.127)		(0.727)		(0.527)	
Africa Region (Center)	-0.140		0.625		0.965	
	(0.160)		(0.991)		(0.750)	
Gold Production	-0.007		0.378		-0.203	
	(0.123)		(0.367)		(0.373)	
Diamond Production	0.290	**	-0.122		-0.752	*
	(0.126)		(0.350)		(0.440)	
Economic Growth (Lag)	0.705	*	-2.806		-4.652	
	(0.391)		(2.024)		(2.899)	
N	604		604		604	

Table 3.20: Cox Proportional Hazard Model stratified with religious conflicts (Ethnic Fixed Effects): Transitions from Peace to other states

	Peace → *Peace*		Peace → *ArmedViolence*		Peace → *CivilWar*	
Low Political Rights Quality	0.287		0.342		-1.111	*
	(0.192)		(0.497)		(0.664)	
High Political Rights Quality	0.102		0.602		-0.864	
	(0.237)		(0.624)		(0.729)	
Oil Production (Lag)	-0.224		0.903	**	-0.381	
	(0.171)		(0.420)		(0.570)	
Autocracy	-0.144		-0.109		0.273	
	(0.157)		(0.549)		(0.572)	
Population Growth (Lag)	-0.101	**	0.316	**	0.279	*
	(0.051)		(0.154)		(0.164)	
Mountainous Terrain	-0.281		-3.662		1.883	*
	(0.261)		(2.342)		(1.093)	
Oil Gini	0.168		-1.532	**	0.676	
	(0.217)		(0.715)		(0.695)	
Soil Fertility	0.721	***	-1.225		-1.296	
	(0.273)		(0.826)		(1.049)	
Gold Production	0.021		0.371		-0.479	
	(0.133)		(0.335)		(0.393)	
Diamond Production	0.281	**	-0.202		-0.668	
	(0.131)		(0.305)		(0.420)	
Economic Growth (Lag)	0.737	*	-1.624		-5.377	**
	(0.389)		(1.607)		(2.601)	
N	457		457		457	

Table 3.21: Descriptive Summary of Results: Transitions from Peace

more population	→	less peace
more diamond production	→	more peace
more soil fertility	→	more peace
more oil production	→	more violence

From Armed Violence to other Degree of Violence

In this section, we study the likelihood of transitions in the case of conflictual countries. Therefore, the starting point is a country living turmoil and we estimate its probability to move toward peace or to civil war. Given previous probabilities, we expect a significant effect of population growth (lag), oil production (lag) and Gini indicator in terms of natural resources.

We proceed as before, so Table 3.30 reports coefficient estimates of transition probabilities from armed violence. Starting from the first column, only population growth (lag) reduces the likelihood to go to peace from armed violence, with a 95% of confidence level. Other relevant results are that ethnic groups joying more fertile lands and more diamond production are more likely to reach peace. Hence, it seems that diamonds foster peace more than oil. Evidently, when we are in turmoil, oil is used as a primary resource of money to buy weapons, both in the legal market (from government) and in the illegal one. Therefore, if there are some violent turbulences, an increase in oil production (lag) can improve the illegal market and so laundering activities.

It is interesting to see that, in such a situation (where people have begun to rebel with substantial violence), soil fertility behaves as in previous case: an increase of fertility helps to control violence because people find in it a chance against their poverty. In other words, people are suffering because of social/political/environmental reasons and are looking for solutions.

Table 3.22: Cox Proportional Hazard Model: Transitions from Armed Violence to other states

	Violence → *Peace*		Violence → *Violence*		Violence → *CivilWar*	
Low Political Rights Quality	0.071		0.076		0.334	
	(0.134)		(0.474)		(0.999)	
High Political Rights Quality	-0.123		0.469		0.664	
	(0.187)		(0.679)		(0.916)	
Oil Production (Lag)	-0.226		1.056	***	-0.845	
	(0.176)		(0.395)		(0.597)	
Autocracy	-0.180		0.598		0.277	
	(0.161)		(0.578)		(0.491)	
Population Growth (Lag)	-0.081	*	0.313		0.066	
	(0.047)		(0.209)		(0.234)	
Religious Conflict	0.326	***	-2.243	***	-0.850	
	(0.097)		(0.753)		(0.630)	
Environmental Conflict	0.082		-0.334		0.007	
	(0.115)		(0.567)		(0.533)	
Political Conflict	-0.050		-0.019		0.071	
	(0.099)		(0.387)		(0.367)	
Mountainous Terrain	-0.249		-7.572		2.719	
	(0.410)		(5.810)		(1.753)	
Oil Gini	0.259		-1.731	*	0.073	
	(0.225)		(0.978)		(0.985)	
Soil Fertility	0.654	**	-0.154		-1.405	
	(0.258)		(0.820)		(1.402)	
Africa Region (Est)	-0.123		1.304	*	0.256	
	(0.124)		(0.730)		(0.670)	
Africa Region (Center)	-0.104		0.387		0.727	
	(0.162)		(1.042)		(0.788)	
Gold Production	-0.019		0.455		-0.155	
	(0.126)		(0.373)		(0.411)	
Diamond Production	0.283	**	-0.030		-0.785	*
	(0.122)		(0.350)		(0.465)	
Economic Growth (Lag)	0.614		-3.001		-5.036	*
	(0.407)		(2.378)		(2.975)	
N	558		558		558	

Often, fertile territories are a crucial richness for poor people.

To conclude this first transition, religious conflict seems to be peace-prone, since we are confident at 99% that this root of conflict increases the likelihood to transit towards peace.

We run the usual test and, although time-varying covariates test (Table 3.35) tells us that autocracy, population growth (Lag) e diamond production vary over time, the residual test does not find any proportionality assumption violation.

Also the linktest does not provide a significant prediction squared meaning that the specification is good. However, the goodness of fit plot (Fig. 3.9) shows pretty far slopes.

The second column confirms the previous one: oil production (lag) increases the odds for armed violence, while religious conflict helps to go back to peace. On the contrary, the Gini indicator reduces the probability of persistence. This result is supported by the time-varying covariates test, because only population growth (lag) has a significant p-value, while the residual test find economic growth and political rights quality changing with time. However, oil production (lag) and religious conflict do not violete the assumption, hence we can trust on the results. Moreover, the goodness of fit shows that our data fits well the specification (although the link test find a significant prediction squared).

For what concerns the probability to go to war, our estimates tell that economic growth and diamonds production reduce the likelihood to transit to war. Therefore, the role of diamonds production is confirmed: holding all other variables constant, a unit-increase in diamond

production, increases the rate of relapse (to peace) by 54.3%[25]. Economic growth, instead, contributes by 99.3%. However, time-varying covariates tell us that economic growth and diamond production vary over time (together with oil production (lag) and gold production).

The residual test confirms that economic growth violetes the proportionality assumption, so we cannot be completely sure about the real (and deep) effect of economic growth to the transition to peace. The residual test find also oil production (lag), mountainous terrain and Gini indicator as critical.

Finally, the link test shows any explanatory power, but the goodness of fit test provides opposite conclusion (Fig. 3.10 and 3.11).

As before, we run same specification by applying ethnic fixed effects. In the Appendix we show results in Table 3.57. However, we see that the only difference with Table 3.30 is on the significant effect of population growth (lag). Therefore, we can consider our results pretty stable.

We include also a survival analysis for the specific case of religious conflicts, since it is the only significant root of conflict. The following Table (3.31) reports estimated transition probabilities from armed conflict to peace and war, when an ethnic group has a religious conflict.

Table 3.23: Cox Proportional Hazard Model stratified with religious conflicts (Ethnic Fixed Effects): Transitions from Armed Violence to other states

	Violence → *Peace*		Violence → *Violence*		Violence → *CivilWar*	
Low Political Rights Quality	0.081		0.216		0.106	
	(0.171)		(0.497)		(0.929)	
High Political Rights Quality	-0.148		0.605		0.265	
	(0.211)		(0.568)		(0.882)	
Oil Production (Lag)	-0.258		0.946	**	-0.792	
	(0.196)		(0.443)		(0.655)	
Autocracy	-0.187		0.053		0.153	
	(0.167)		(0.524)		(0.520)	
Population Growth (Lag)	-0.057		0.305	*	0.019	
	(0.050)		(0.157)		(0.213)	
Mountainous Terrain	-0.491		-3.274		2.637	*
	(0.353)		(2.452)		(1.451)	
Oil Gini	0.272		-1.810	**	0.566	
	(0.229)		(0.713)		(0.656)	
Soil Fertility	0.710	***	-1.610	*	-1.310	
	(0.269)		(0.826)		(1.172)	
Gold Production	-0.018		0.449		-0.263	
	(0.132)		(0.312)		(0.412)	
Diamond Production	0.343	***	-0.194		-0.807	**
	(0.124)		(0.292)		(0.390)	
Economic Growth (Lag)	0.595		-1.601		-5.058	*
	(0.396)		(1.824)		(2.802)	
N	558		558		558	

When an ethnic group is fighting for religious purposes, oil production and population growth are crucial for the continuation of armed violence. This means that oil profits might be used from the government and/or from the ethnic group to finance the fight. Since data on oil production refers to official information, we guess that oil revenues support the fight in the legal market and so it is more probable that it is the government who profits from oil revenues. Other highly significant variables are soil fertility, Gini Indicator and diamond production. As we can see, the Gini indicator reduces the likelihood to remain in armed violence but, at the same time, tough not significant, it increases the odds for war. Diamond production and soil

[25]This value comes from this procedure: we first calculate the hazard ratio as exp(-0.785). Then we subtract 100% - 0.4562973%

fertility, do not seem to be logically related to religious conflicts. However, they help to reach peace. Humans are constantly confronted by scarcity and they are willing to use any means possible, including appeals to the supernatural, to achieve their objectives. Given people's desire for religious goods and services, the appearance of specialist claiming the ability to satisfy these desires is not surprising. As acknowledged by North, Wallis and Weingast (2009) "all of the earliest human civilizations were theocracies, governed by priest-politicians". Of course, religious communities are very close and sympathetic within a community, so soil fertility is a tool for religious community to increase the solidarity and community's strength. Think of the Islamic Courts in Somalia. They are not only a religious community. They are the community. They manage civil rules, taxes, juridical debates, food and markets. More fertile land is a tool to control the community and solve troubles. Of course this is an extreme case, however, Africa is a very spiritual continent in which religion has a crucial role for the community and for linking the living with the dead. As Mcbride et al. (2012) says, religion engenders conflict and cooperation.

Table 3.24: Descriptive Summary of Results: Transitions from Armed Violence

more population	→	less peace
more diamond production	→	more peace
more soil fertility	→	more peace
more oil production	→	more violence
more resources inequality	→	more violence
more economic growth	→	more peace

From Civil War to other Degree of Violence

This is the last section in which we run standard Cox regression in order to estimate the proportional likelihood for an ethnic group to transit from civil war to peace or to remain in violence. We proceed as before. From the univariate analysis we find out that many variables should not be included in the model. Among them, (previous) public spending should not be included. However, we have run the regressions without this "problematic" variables and the models do not result better than the full model. Hence, we will show same specification as before to see what happens when an ethnic group is experiencing a civil war.

From our model (Table 3.32) it turns out that if we are in civil war, a 1-year increase in diamond production is associated with an increase in the hazard rate. This means that if we are in war, diamond production has a crucial impact on the likelihood to reach peace, while economic growth is non-significant. So far, we have coherent results because diamond production is always associated with a return to peace. Other coherent result is population growth (lag), which reduces the likelihood to reach peace, if we are in war. This is not only coherent with previous results, but it is also pretty logical: in war, more population pressure, cannot help to fix problems and more people will be engaged in war.

Time-varying covariates find population growth (lag) and diamond production changing over time, but the Schoenfeld residual test do not support this result. Finally, the goodness of fit, reports a plot in which only in the first part of our estimates, data fit well the chosen model. Generally speaking, we can consider the model pretty good.

As the literature underlines, population growth (lag) and mountainous terrain are important features in civil war. In this analysis we confirm this result, because these two covariates have a positive impact on the likelihood to remain in civil war.

Also in the case of soil fertility, it proves to be always negatively related to war, while positively related to peace. In a banal way, a more fertile land is able to feed more people thus reducing famines, which are linked to conflicts.

For the first time, also political rights quality shows a highly significant effect, meaning that

Table 3.25: Cox Proportional Hazard Model: Transitions from Civil War to other states

	$CivilWar \rightarrow Peace$		Civil War $\rightarrow ArmedViolence$		Civil War $\rightarrow CivilWar$	
Low Political Rights Quality	0.252		0.003		-1.409	***
	(0.162)		(0.612)		(0.506)	
High Political Rights Quality	-0.028		0.355		-0.673	
	(0.215)		(0.862)		(0.525)	
Oil Production (Lag)	0.041		1.243		-0.153	
	(0.218)		(1.087)		(0.547)	
Autocracy	-0.172		0.622		-0.343	
	(0.151)		(0.740)		(0.334)	
Population Growth (Lag)	-0.108	*	0.151		0.364	*
	(0.059)		(0.205)		(0.217)	
Religious Conflict	0.409	***	-1.827	**	-1.454	***
	(0.095)		(0.770)		(0.494)	
Environmental Conflict	0.092		-0.789		-0.358	
	(0.111)		(0.729)		(0.436)	
Political Conflict	-0.143		-0.315		0.630	**
	(0.112)		(0.437)		(0.304)	
Mountainous Terrain	-0.171		-4.184		2.828	***
	(0.311)		(6.184)		(1.087)	
Oil Gini	0.101		-3.059	*	0.581	
	(0.249)		(1.644)		(0.814)	
Soil Fertility	0.623	*	1.433		-3.139	***
	(0.338)		(0.957)		(0.985)	
Africa Region (Est)	-0.119		0.749		0.071	
	(0.189)		(0.916)		(0.509)	
Africa Region (Center)	-0.156		1.133		-0.033	
	(0.170)		(0.926)		(0.754)	
Gold Production	0.060		0.005		0.010	
	(0.136)		(0.440)		(0.345)	
Diamond Production	0.245	*	0.098		-0.866	**
	(0.131)		(0.373)		(0.360)	
Economic Growth (Lag)	0.561		-3.497		-2.174	
	(0.381)		(3.045)		(2.127)	
N	438		438		438	

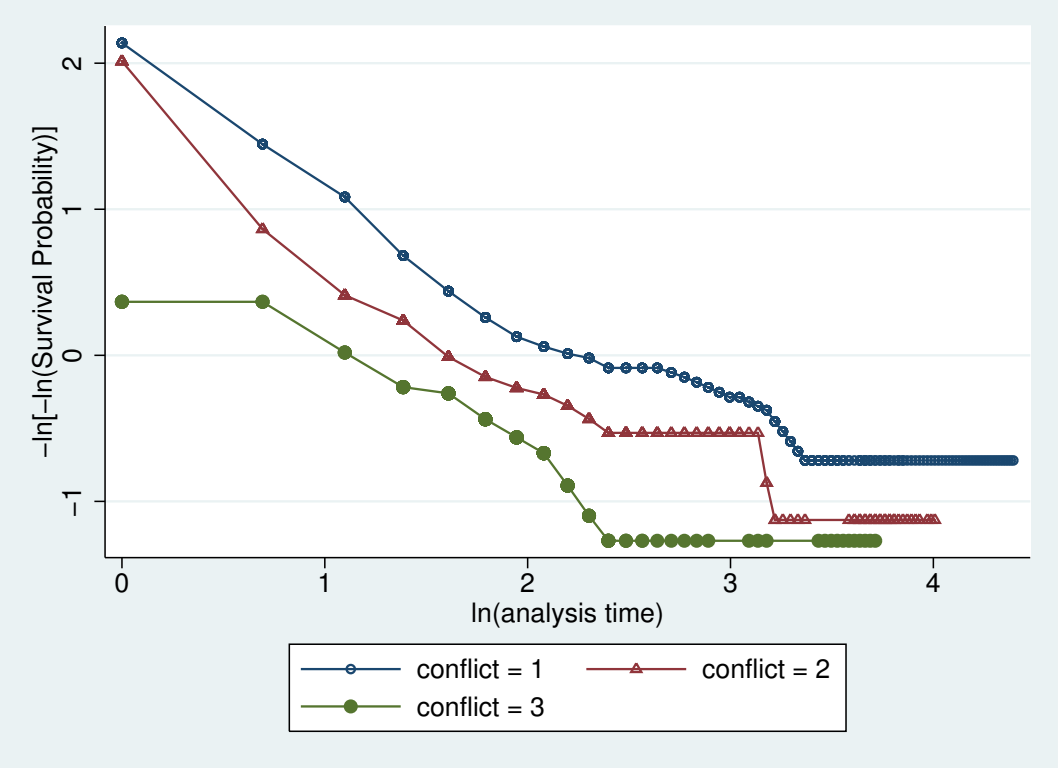


Fig. 3.3: *Plot of Survival Functions: From Civil War*

an increase in the quality of rights, reduces the persistence in war. The last interesting result concerns political conflict: it seems that this root of conflict is more long-lasting, compared to religious conflict which tends to peace (as we notice also in the other transitions). We check these results with the usual tests. Starting with the link test, the prediction squared is significant in each transition regression, so the test is not verified for every specification.

As a second step, we run again the specification looking for time varying variables. From this regression test, we see that population growth (lag), oil production (lag), autocracy, mountains, soil fertility, economic growth and diamond production are significant.

However, in the first transition (Civil War to Peace) we do not find evidence that our specification violates the proportional hazard assumption. Problems arise in the last two transitions, in which oil production (lag), population growth (lag), diamond production, mountains and soil fertility do not refuse the null hypothesis. Of course, this specification cannot be the best functional form and we expect that the martingale residuals will fail to fit well our data.

To conclude, after having checked each test, our final model does not seem to fit the data very well for the analysis of civil war persistence and, in a lower way, for the case of transition from civil war to armed conflict (Fig. 3.12, 3.13 and 3.14).

In Figure 3.15, we show the survival functions of the three typologies of conflict.

Finally, we show estimated probabilities in specific roots of conflict. As we have seen in previous tables, religious and political conflict are the main determinant of civil war. Therefore, in Table 3.33 we see what happens when we take into account only religious conflicts. Results are little different compared to the case of political conflicts (Table 3.34), in fact in the case of religious conflicts, as the literature explains, mountainous terrain fosters civil war, together with population growth (lag). On the contrary, diamond production, fertile lands and the increasing quality of political rights, reduce the persistence of war both in the case of religious conflicts and in political ones. The difference between these two cases is the intensity: quality of political rights affect more in the case of political war, while the impact of diamond production matters

Table 3.26: Cox Proportional Hazard Model stratified with religious conflicts (Ethnic Fixed Effects): Transitions from Civil War to other states

	CivilWar → *Peace*		Civil War → *ArmedViolence*		Civil War → *CivilWar*	
Low Political Rights Quality	0.391		0.375		-1.752	***
	(0.238)		(0.582)		(0.576)	
High Political Rights Quality	0.092		0.889		-1.174	**
	(0.281)		(0.845)		(0.534)	
Oil Production (Lag)	0.134		0.791		-0.105	
	(0.240)		(1.031)		(0.578)	
Autocracy	-0.158		0.370		-0.012	
	(0.166)		(0.774)		(0.393)	
Population Growth (Lag)	-0.069		-0.029		0.340	*
	(0.050)		(0.130)		(0.184)	
Mountainous Terrain	-0.289		-1.817		2.807	***
	(0.274)		(1.784)		(1.003)	
Oil Gini	-0.059		-2.496	*	0.829	
	(0.282)		(1.394)		(0.678)	
Soil Fertility	0.553	*	0.325		-2.166	*
	(0.285)		(0.680)		(1.151)	
Gold Production	0.070		-0.189		-0.201	
	(0.145)		(0.377)		(0.344)	
Diamond Production	0.211		0.338		-1.010	***
	(0.139)		(0.350)		(0.355)	
Economic Growth (Lag)	0.444		-2.622		-1.567	
	(0.367)		(2.641)		(2.297)	
N	438		438		438	

less.

3.7.2 Stratified by Root of Conflict

In this section we study the likelihood of violence transitions by differentiating specific root of conflicts. Therefore, we regress single survival analysis in the case of political, religious and environmental conflict. This analysis can help to develop specific policies, depending on the problem of the ethnic group. As before, we cannot run this analysis at country level or at non-ethnic groups level, because the observations are not enough. Since we study transitions specifically for each root of conflict, we run survival analysis by using the stratified survival model. This model concerns estimation when the hazard is allowed to differ for different groups, even if the hazard functions are constrained to be of the same family. We use same specifications, by applying ethnic fixed effects.

Political Conflict

From our estimates (Table 3.35, 3.36), we find out that population growth (lag) proves to be crucial also when ethnic groups compete for political reasons. As we can see from Table 3.40, population growth (lag) and oil production (lag) are the only significant variables among the variables leading to violence. On the contrary, an improvement in political rights quality and an economic shock help to reduce the conflict. This makes sense: if we are in peace, a political or an economic improvement reduces the reasons to complaint or fight against the government. Soil fertility and economic growth, of course, help in the maintenance of peace. A result which is in line with economic literature is the role of mountains: mountainous territories are, again, more likely to have an armed violence or a war. On the contrary, economic shocks reduce this probability, when an ethnic group has a political fight. The effect of economic shocks on the

Table 3.27: Cox Proportional Hazard Model stratified with political conflicts (Ethnic Fixed Effects): Transitions from Civil War to other states

	CivilWar → *Peace*		Civil War → *ArmedViolence*		Civil War → *CivilWar*	
Low Political Rights Quality	0.448	*	0.086		-2.058	***
	(0.247)		(0.540)		(0.635)	
High Political Rights Quality	0.189		0.291		-1.363	**
	(0.281)		(0.788)		(0.571)	
Oil Production (Lag)	0.128		1.323		-0.225	
	(0.241)		(1.427)		(0.565)	
Autocracy	-0.076		0.133		-0.298	
	(0.179)		(0.814)		(0.395)	
Population Growth (Lag)	-0.054		0.039		0.259	
	(0.048)		(0.160)		(0.181)	
Mountainous Terrain	-0.091		-2.641		1.344	
	(0.254)		(2.638)		(1.020)	
Oil Gini	-0.040		-2.802		0.575	
	(0.280)		(1.869)		(0.640)	
Soil Fertility	0.601	**	0.343		-2.349	**
	(0.305)		(0.845)		(1.071)	
Gold Production	0.082		-0.076		-0.223	
	(0.145)		(0.425)		(0.375)	
Diamond Production	0.071		0.610		-0.726	**
	(0.121)		(0.377)		(0.362)	
Economic Growth (Lag)	0.554		-2.309		-2.612	
	(0.357)		(3.180)		(2.242)	
N	438		438		438	

likelihood to move to war from armed violence is impressive: an economic shock reduces the likelihood by 16.63%. On the contrary, gold and oil production (lag), together with population growth (lag) increase the odds of persistence of armed political conflicts.

Environmental Conflict

Finally, in the Tables 3.37, 3.38 and 3.39 we report transition probabilities in case of environmental conflicts. Surprisingly, soil fertility results to reduce the odds that a war will occur. Gini indicator (in terms of natural resources) together with mountainous terrain and population growth (lag) are positively related to the likelihood of civil war, though not significant. Here economic growth seems to have a much smaller significant effect on the management of environmental conflicts. As before, population growth (lag) and oil production (lag) result to be the most important determinant of armed environmental conflict.

3.8 Conclusions

In this chapter we have suggested a new indicator of civil war which is further applied to three different econometric models. Main indicators of civil war are based on the quantitative threshold of battle-death and very few economists have raised doubts on this way of coding civil wars.

Here, we conceptualize civil war as a final state of a process. Process-driven explanations, best explored through historical narratives that focus on the dynamic interactions among and between actors and countries, can elucidate violence endings. Of course, we do not want to infer that every civil war is the inevitable end of protests. On the contrary, we want to underline the importance of grievances as crucial point from which we can predict a civil war: the more we ignore civil society's reclaims, the more we risk a civil war break out.

Table 3.28: Cox Proportional Hazard Model stratified with political conflicts (Ethnic Fixed Effects): Transitions from Peace to other states

	Peace → *Peace*		Peace → *ArmedViolence*		Peace → *War*	
Low Political Rights Quality	0.345	*	0.228		-1.369	**
	(0.186)		(0.470)		(0.692)	
High Political Rights Quality	0.193		0.348		-1.018	
	(0.233)		(0.665)		(0.724)	
Oil Production (Lag)	-0.161		0.825	*	-0.503	
	(0.183)		(0.474)		(0.580)	
Autocracy	-0.023		-0.595		0.082	
	(0.167)		(0.657)		(0.596)	
Population Growth (Lag)	-0.086	*	0.415	**	0.204	
	(0.052)		(0.171)		(0.149)	
Mountainous Terrain	-0.060		-5.464	**	1.254	
	(0.258)		(2.692)		(0.999)	
Oil Gini	0.164		-1.547	**	0.667	
	(0.227)		(0.731)		(0.713)	
Soil Fertility	0.706	**	-1.506	*	-1.330	
	(0.306)		(0.894)		(1.006)	
Gold Production	0.038		0.503		-0.489	
	(0.139)		(0.406)		(0.456)	
Diamond Production	0.167		0.063		-0.462	
	(0.122)		(0.341)		(0.399)	
Economic Growth (Lag)	0.783	**	-1.973		-5.566	**
	(0.377)		(1.961)		(2.530)	
N	457		457		457	

Table 3.29: Cox Proportional Hazard Model stratified with political conflicts (Ethnic Fixed Effects): Transitions from Armed Violence to other states

	ArmedViolence → *Peace*		Armed Violence → *ArmedViolence*		Armed Violence → *CivilWa*	
Low Political Rights Quality	0.181		-0.001		-0.571	
	(0.155)		(0.475)		(0.854)	
High Political Rights Quality	-0.016		0.255		-0.262	
	(0.206)		(0.580)		(0.755)	
Oil Production (Lag)	-0.196		0.941	*	-0.964	
	(0.203)		(0.510)		(0.637)	
Autocracy	-0.086		-0.349		-0.036	
	(0.179)		(0.583)		(0.545)	
Population Growth (Lag)	-0.038		0.404	**	-0.086	
	(0.051)		(0.174)		(0.203)	
Mountainous Terrain	-0.220		-5.213	*	2.108	
	(0.361)		(2.734)		(1.199)	
Oil Gini	0.217		-1.770	**	0.792	
	(0.240)		(0.727)		(0.743)	
Soil Fertility	0.667	**	-1.791	**	-0.903	
	(0.297)		(0.861)		(1.116)	
Gold Production	-0.009		0.595	*	-0.333	
	(0.139)		(0.359)		(0.478)	
Diamond Production	0.221	*	0.077		-0.555	
	(0.120)		(0.323)		(0.427)	
Economic Growth (Lag)	0.533		-1.497		-4.759	
	(0.371)		(2.030)		(2.734)	
N	558		558		558	

Table 3.30: Cox Proportional Hazard Model stratified with environemntal conflicts (Ethnic Fixed Effects): Transitions from Peace to other states

	Peace → *Peace*		Peace → *ArmedViolence*		Peace → *CivilWar*	
Low Political Rights Quality	0.383	*	0.254		-1.434	**
	(0.199)		(0.511)		(0.647)	
High Political Rights Quality	0.256		0.467		-1.039	
	(0.249)		(0.645)		(0.658)	
Oil Production (Lag)	-0.258		1.006	**	-0.673	
	(0.165)		(0.424)		(0.541)	
Autocracy	-0.036		-0.351		0.159	
	(0.166)		(0.588)		(0.584)	
Population Growth (Lag)	-0.094	*	0.371	**	0.163	
	(0.052)		(0.158)		(0.140)	
Mountainous Terrain	-0.072		-4.160	*	0.850	
	(0.267)		(2.131)		(1.055)	
Oil Gini	0.182		-1.584	**	0.959	
	(0.219)		(0.738)		(0.691)	
Soil Fertility	0.761	***	-1.250		-1.745	**
	(0.290)		(0.863)		(0.835)	
Gold Production	-0.030		0.556		-0.391	
	(0.142)		(0.379)		(0.366)	
Diamond Production	0.203	*	-0.112		-0.443	
	(0.119)		(0.328)		(0.384)	
Economic Growth (Lag)	0.628	*	-1.788		-4.473	*
	(0.349)		(1.768)		(2.500)	
N	604		604		604	

Table 3.31: Cox Proportional Hazard Model stratified with environmental conflicts (Ethnic Fixed Effects): Transitions from Armed Violence to other states

	ArmedViolence → *Peace*		Armed Violence → *ArmedViolence*		Armed Violence → *War*	
Low Political Rights Quality	0.175		0.139		-0.313	
	(0.176)		(0.512)		(0.908)	
High Political Rights Quality	-0.021		0.448		0.025	
	(0.226)		(0.607)		(0.824)	
Oil Production (Lag)	-0.261		1.024	**	-1.107	**
	(0.189)		(0.453)		(0.561)	
Autocracy	-0.105		-0.202		0.054	
	(0.180)		(0.578)		(0.558)	
Population Growth (Lag)	-0.069		0.388	**	0.011	
	(0.052)		(0.161)		(0.178)	
Mountainous Terrain	-0.058		-4.078	*	1.255	
	(0.370)		(2.164)		(1.199)	
Oil Gini	0.249		-1.830	**	0.982	
	(0.233)		(0.749)		(0.661)	
Soil Fertility	0.754	***	-1.504	*	-1.686	*
	(0.288)		(0.847)		(0.912)	
Gold Production	-0.084		0.545		-0.245	
	(0.140)		(0.342)		(0.397)	
Diamond Production	0.265	**	-0.040		-0.540	
	(0.114)		(0.310)		(0.399)	
Economic Growth (Lag)	0.459		-1.668		-4.537	*
	(0.361)		(2.052)		(2.661)	
N	558		558		558	

Table 3.32: Cox Proportional Hazard Model stratified with enviromental conflicts (Ethnic Fixed Effects): Transitions from Civil War to other states

	CivilWar → *Peace*		Civil War → *ArmedViolence*		Civil War → *CivilWar*	
Low Political Rights Quality	0.501	**	0.098		-2.169	***
	(0.245)		(0.605)		(0.606)	
High Political Rights Quality	0.239		0.438		-1.464	***
	(0.294)		(0.819)		(0.561)	
Oil Production (Lag)	0.153		1.046		-0.420	
	(0.229)		(0.973)		(0.558)	
Autocracy	-0.071		0.109		-0.311	
	(0.179)		(0.751)		(0.417)	
Population Growth (Lag)	-0.050		-0.046		0.227	
	(0.048)		(0.145)		(0.174)	
Mountainous Terrain	-0.038		-1.443		1.051	
	(0.260)		(1.835)		(0.939)	
Oil Gini	-0.088		-2.663	**	1.026	
	(0.264)		(1.304)		(0.650)	
Soil Fertility	0.596	**	0.255		-2.261	**
	(0.302)		(0.814)		(0.961)	
Gold Production	0.040		-0.100		-0.135	
	(0.142)		(0.403)		(0.366)	
Diamond Production	0.111		0.395		-0.773	**
	(0.122)		(0.398)		(0.358)	
Economic Growth (Lag)	0.430		-2.429		-1.300	
	(0.335)		(2.861)		(2.211)	
N	438		438		438	

Table 3.33: Main Conclusion about Country Level Analysis

	Country Level Analysis
Peace	more population→less peace; more mountains→less peace; more economic growth→more violence
Armed Violence	more mountains → more violence
Civil War	more economic growth → more war

Table 3.34: Main Conclusion about Ethnic Level Analysis

	Ethnic Level Analysis
Peace	more economic growth→more peace or war; more diamond→more peace; more population→less peace; mor
Armed Violence	more oil → more violence; more inequality → more violence
Civil War	more inequality→more war; more fertility→more war; more mountains→more war;more diamond→less war

Table 3.35: Main Conclusion about Transitions

	Non-Ethnic Level Analysis
Peace	more economic growth→more peace; less rights→less peace; more population→more peace
Armed Violence	less rights → more violence.
Civil War	more economic growth→ less war

From this perspective, we have developed a year-level indicator of violence escalation based on 3 levels of violence: 1. peace, peaceful demonstrations and strikes; 2. armed conflict and riots; and 3. civil war. The first two levels are derived from SCAD and ACLED, while the third degree of violence (hence, civil war) is taken from UCDP and ACLED. This construction makes suitable our analysis, since it reports three possible outcomes for its violence status variable.

Moreover, we have linked each degree of violence to a particular root of conflict, which we have divided into: political conflict, religious conflict and environmental conflict. Since ACLED and SCAD provide very detailed information about the typology of conflict, we combine this information with newspapers, historical books, websites and communiqué in order to understand the main reasons of complaint.

By following the econometric procedures of Jung (2009, 2006) and French (2005) we implement 3 methods to construct the Markov probabilities and we develop a country-level analysis, an ethnic-level and a non-ethnic groups-level of analysis: first, we apply a simple counting method, the second method predicts transition probabilities using ordered logit models and, lastly we derive hazard rates from a semi-parametric proportional hazard (Cox) model. 50 African countries and 479 ethnic groups in Africa are covered from 1975 through 2014.

We proceed our analysis, first by estimating transition probabilities between violence states with a simple count method as used in Jung (2006), and Diehr and Patrick (2001). We count the number of transitions from initial states to states one period ahead, also by typology of conflict (environmental conflict, political conflict and religious conflict). We have discovered that when we study at country level we obtain different results from those of ethnic level or non-ethnic groups level. Generally speaking, at country level it seems that countries are more conflict-prone or, at least, trapped into civil war. When we study at micro-macro level, instead, peace is more probable, and even if a community is living an armed conflict, peace shows to be more likely. Moreover, we have seen that the impact of the typology of conflict on violence status should not be overall underestimated.

Since it is also important to understand, which factors may affect the appearance of civil war, in the second method we fit a model to predict the probability of transition as a function of initial violence status, economic growth, population growth, oil, diamond and gold production, quality of political rights, autocracy, soil fertility and a Gini indicator developed by Morelli and Rohner (2015). As before, we run this model on three different dataset: country-level dataset, ethnic-level dataset and non-ethnic groups-level dataset. Results are pretty coherent with the simple counting method. Therefore, peace is more probable than war when a community is living an armed conflict and peace shows to be persistent. In particular, our models tell us that a community living in a territory with a religious (low) conflict, a growing diamond production and a positive economic growth is more likely to remain in peace, while population growth affects negatively peace. When, instead we have an unequal community with many fertile lands, there is more probability to move to war. This can be explained with the inequality issue but also with the land grabbing phenomenon. In a urban context, instead, political and economic variables matter more: if non-ethnic groups can enjoy a positive GDP growth they are more likely to remain peaceful but, if this growth is not used for public purposes and there is an autocratic regime, some grievances may arise and explode into an armed conflict. Autocracy can use governmental forces to repress or control the conflictual mass. Results at country level are coherent with those of the counting model as well: there is a high persistence for each level of violence. In particular, more populated countries with many mountains increase the probability of war (as the economic literature proves). Moreover, economic growth has a crucial role: when we are in peace, an economic growth creates some changes that, if not properly addressed, can rise some violent grievances and if we are in war, economic growth results to be highly related to the persistence of civil war.

Finally, we use methods from survival analysis and we construct hazard rates from the various violence degrees into consecutive violence states.

We find our results very plausible and coherent with previous probabilities: a community living in a mountainous area, with an increase in population density and oil production is more likely to move to war, even in peaceful period. On the contrary, an ethnic group living in a fertile land, with diamond reserves, economic growth and with some religious tensions, are more likely to live in peace.

In every model, we see diamond production, soil fertility and population growth to be related with violence transition.

While diamond production is always associated with a return to peace, in some cases, we have seen that oil is positively related to civil war escalation. We have explained that relationship by linking oil with weapons: oil is used as a primary resource of money to buy weapons, both in the legal market (from government) and in the illegal one. Therefore, if there are some violent turbulences, an increase in oil production may improve the illegal market and so laundering activities.

Soil fertility is always associated with peace as well. We have given an emphasis to this result because it highlights the importance of land in Africa. Of course, fertile lands are important everywhere: fertile lands ensure food security and income at micro and macro level. The link with peace is hence clear. However, in Africa, land is much more important for cultural and historical reasons: many Africans are still related to their ancestral roots, where ethnic groups are historically nomads, farmers, fishermen or shepherds. It is not a matter of tribalism, as Kenyatta said in the first meeting of the Organisation of African Unity (Addis Abeba, 1963). On the contrary, it is a matter of facts that nomads need land for their animals, and farmers need lands for their agriculture. These two needs are sometimes in contrast each other. Of course, there are also several examples of historical equilibrium between different ethnic groups[26]. However, in a continent threatened by desertification and poverty, this need becomes much more complex and crucial. Moreover, fertile land in Africa is drawing international attention also from policy makers.

Finally, we have seen that population growth is a major driver to civil war, which is coherent with the economic literature. However, we have underlined that we should spend more attention on this relationship; first of all, when we talk about population growth, we should not think on population boom (as we can imagine from Asia). We can see from figures 1.2 and 1.3 that Africa is not that much populated, compared to other continents[27]. Projections tell us that because of high levels of fertility[28], Africa will become soon as populated as China (the continent's current population of about one billion is projected to rise to between 3.1 and 5.7 billion with probability 95% by the end of the century) (Raleigh et al., 2010) but nowadays African population is not a problem. Therefore, in Africa population growth does not mean an excessive population density. As we have explained in this chapter, it is rather a problem related to the fact that cities cannot stand population pressure because of lack of services. It is not a coincidence that many governments of developing countries now explicitly discourage strong urban population growth; 77 percent of African countries have implemented policies to reduce migrant flows to large cities (Raleigh et al., 2010). At the same time, it is also true that in some regions, out-migrants from rural areas no longer even aspire to move to towns in their own countries: many rural out-migrants seek to move straight to overseas destinations, mainly in Europe (Smith, 2012).

[26]For instance, in Niger, farmers and shepherds co-live along Niger river. During the flood season fishermen profit of rich water for fishing. When the river get reduces, farmers reach the area where they can find very fertile land and transhumance arrives with breeders and animals for grazing. Niger Delta is thus a perfect place for every type of traditional activity and ethnic groups have found their peaceful equilibrium which is ruling since ever

[27]Only Nigeria and Ethiopia have a density similar to western countries

[28]Bongaarts and Casterline suggest two reasons for the slower fertility decline in Sub-Saharan Africa: first, ideal Africa family size are still high, with a median of 4.6 children per woman. Second, the unmet need for contraception (the difference between the demand for contraception and its use) has remained substantial at about 25%, with no systematic decline over the past 20 years (Gerland et al, 2014)

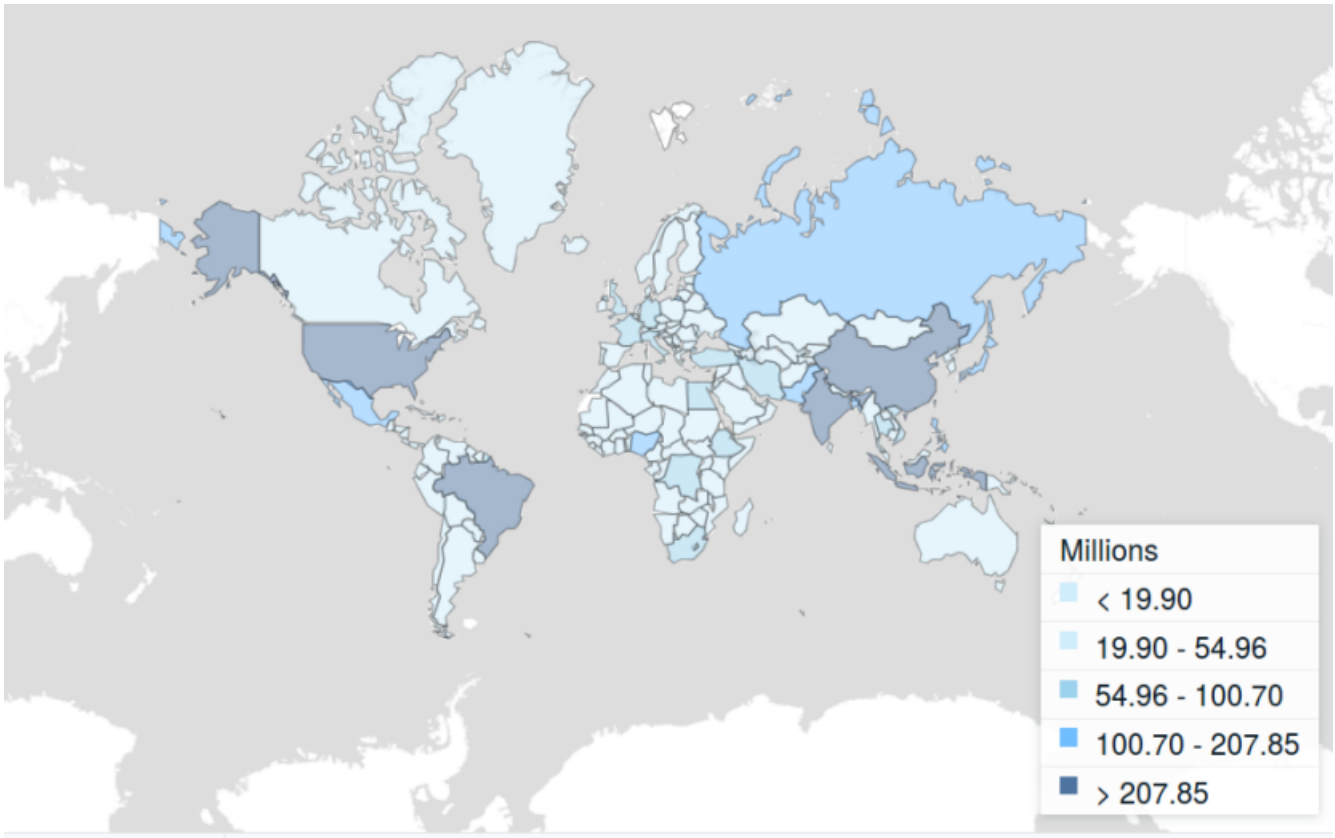


Fig. 3.4: *World Wide Population Growth in 2015. Source: World Bank Indicator 2015*

Moreover, we have to remind that population growth takes into account also migrants from other countries. Migration, in a context of poor development, can arise some social troubles, especially if those migrants come from conflictual territories. Often it is underestimated that during a civil war, graduated people, technicians, experts and professional people escape from the country. This has dramatic consequences not only from an intimate point of view (people are forced to leave their native territories) but also for peace: when a country is impoverished of its best human resources, moral and material reconstruction becomes much more harder.

Brief, population growth is not a problem *per se*. Population becomes a problem in a context of poverty and big cities without services and infrastructures. In fact, when we study at non-ethnic groups level we see that if we are in peace, population growth reduces the likelihood to remain in peace but, if we are in war, population growth helps to reach peace.

Although the economic literature of civil wars puts a lot of emphasis on economic variables, in our study economic growth does not show many significant effects, especially when we focus on ethnic groups. These variables become important when we study at non-ethnic groups or country level. At non-ethnic groups level, political and economic variables matter more: if non-ethnic groups can enjoy a positive GDP growth they are more likely to remain peaceful but, if this growth is not used for public purposes and there is an autocratic regime, some grievances may arise and explode into an armed conflict. Economic growth has a crucial role also when we study at country level. We have seen that economic growth can create some changes that, if not properly addressed, can rise some violent grievances leading not only to civil war, but also to a persistence of civil war.

We focus also on the study of primary reasons of civil war. We have summed up these roots into political, environmental and religious conflicts. However, from our analysis we have found out that only religious conflict has a significant effect on the violence escalation. In particular, religious conflict seems to be peace-prone in every model we have run.

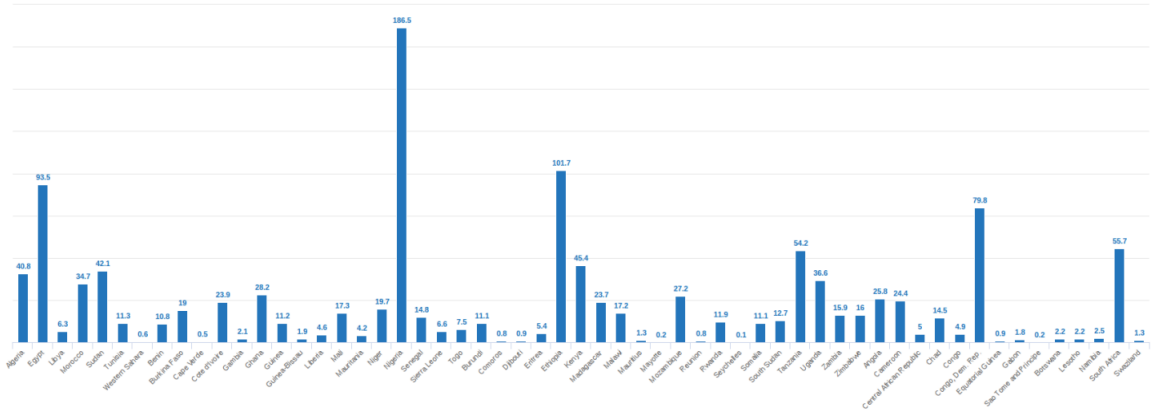


Fig. 3.5: *African Population in 2016. Source: WORLD POPULATION DATA 2016*

3.9 Concluding Remarks

In this thesis we have covered several issues. First of all we have spent a few words on the greed theory developed by Collier and co-authors. We have provided several historical facts and reasoning by suggesting the idea that civil wars are dynamic and complex events which cannot be treated as a simple theft. We have underlined that greedy people, or warlords, are key actors in civil war because usually they are the link among other key actors, such as politics, guns companies, black markets and so on. Therefore, Collier is right but the Greed theory lacks of the attention on ordinary people and their real reasons for joying a fight. We have provided several examples to explain how frustration, inequality, poor public services and unequal redistribution can lead to civil war. We have also showed quantitatively that economic growth and poverty are not the only reasons for conflict onset. In fact, in the second chapter we have showed that MSS's results are not reliable because the rainfall instrument is statistically weak in every specifications, meaning that the estimated negative impact of economic growth on civil war is biased. We have tried to understand the reason of the weakness. First, we have hypothesised a problem in the coding rule of the definition. Therefore, we have tried to change the threshold by choosing different numbers of battle-death, but the rainfall instrument remains weak in every attempt. Finally, we have hypothesised that the bias might be caused by the the model. In fact, the dependent variable is a dichotomous variable assuming 1 when the threshold is reached, and 0 otherwise. When we show a descriptive statistics of the civil war variable we see that the zeros are much more frequent than the one. Therefore, the IV2SLS might be not appropriate, rather we have suggested to use a Zero Inflated Poisson Model (ZIP) as in the work of Dunne and Tian (2015). We find that estimates result to be less biased with the ZIP and the impact of economic growth on civil war is reduced because other determinants become important. Namely, oil exports, population growth and mountainous terrain result to be significantly related to the likelihood of civil war.

In parallel, we have found out that in the IV2SLS and in the ZIP estimates are very sensible to the battle-death threshold because a very small change in the threshold affects severely estimates. This result makes clear that battle-death threshold is an arbitrary indicator of civil war.

Finally, in the last chapter we have suggested a proactive critique of the definition of civil war. We have developed a new civil war indicator which is not based on the battle-death threshold, rather tries to catch the dynamic process of conflicts. We have combined information taken from several quantitative and qualitative sources in order to develop an indicator ranging from 1 (peace) , 2 (armed conflict) to 3 (civil war). We have applied this indicator to a three-stages and levels analysis, to see whether our intuitions and estimates are coherent. In particular, we have estimated Markov transition probabilities with 3 different statistical models, from the simplest to

the more accurate. Moreover, we have used three different dataset, in order to see the behaviour of different actors. Namely, we have estimated the transition probabilities at country level, ethnic level and non-ethnic level. Non-ethnic groups are defined as a group of people which are not tied by ethnic roots, rather by social reasons, such as group of students, group of workers and so on. The results we obtain in this chapter are interesting. In fact, at country level, estimates are in line with the economic literature: hence, economic growth increases the likelihood of civil war. Interestingly, when we study transition probabilities at non-ethnic level, we find opposing results: economic growth reduces the likelihood to have war. On the contrary, at ethnic level, several variables affect the likelihood of civil war. In particular, inequality in terms of natural resources, mountainous terrain and fertile lands increase the likelihood to transit to war.

The overall conclusions we get from this study are that (i) we should elaborate a new definition of civil war, able to catch the dynamic process of civil war; and that (ii) civil wars are linked to poverty but we should pay attention on non-economic variables, such as inequality in terms of natural resources, mountainous terrain, population growth and fertile lands because they can foster frustration and research of revenge which is, in turn, exploited by warlords. The third chapter, in particular, shows us that we should study at country level in order to see the general picture of a country. In parallel, we need to study in a less aggregate level because every country has different and independent conflictual or peaceful conditions. Therefore, a country might have a civil war in a certain region for a particular reason but in the opposite region, there might be other reasons pushing people to protest in a peaceful way. When we develop a country level analysis, we risk to mix these different context and our conclusions might lead to wrong public policies.

3.10 Appendix A

3.10.1 Country Level Analysis

Generally speaking, Table 3.4 shows a pretty high tendency to peace, although civil war has almost the same probability to remain in war than to move to peace. This latter probability confirms economic literature: if a country is in civil war, it can be trapped into civil war or it can reach peace. It is much more rare to gradually reach peace. Similarly, if a country is peaceful, it is unlikely to experience a war (only 19% probability). This result becomes impressive in the case of political conflict, where the likelihood to remain in war is 76% and the likelihood to remain in peace is 88%. Religious conflicts, instead, show a completely different scenario: if a country is in peace, it has a 63% probability to experience an armed conflict, which however, does not break out in a war but remains in a low-profile conflict. If, instead, a country is living a civil war for religious purposes, it is trapped into that war, which is a result in line with our current history (where religious conflicts are quite widespread in Africa, as well as in the Middle East).

Table 3.36: Count of Overall Transition Probabilitiess at Country Level

Violence Degree	Peace	Armed Violence	Civil War	N
Peace	60.25	20.38	19.38	800
Armed Violence	48.48	33.33	18.18	330
Civil War	43.32	14.99	41.69	367
N.Osservations	801	328	368	1497

As it is clear from tables 3.5 to 3.7, each typology of conflict is pretty persistent. This is in line with the economic literature. For instance, we have already seen in the first chapter (pg. 19) of this dissertation that turbulent countries suffer from the so-called Conflict Trap. Hence, once a country is in war it faces serious difficulty to get out because of several obstacles.

Table 3.37: Count of Transition Probabilitiess at Country Level: Political Conflict

Violence Degree	Peace	Armed Violence	Civil War	N
Peace	88.15	10.90	0.95	945
Armed Violence	13.84	82.60	3.56	730
Civil War	8.33	15.97	75.69	144
N.Osservations	946	729	144	1819

Table 3.38: Count of Transition Probabilitiess at Country Level: Religious Conflict

Violence Degree	Peace	Armed Violence	Civil War	N
Peace	18.75	62.50	18.75	16
Armed Violence	9.33	88.08	2.59	193
Civil War	10.53	8.77	80.70	57
N.Osservations	27	185	54	266

Table 3.39: Count of Transition Probabilitiess at Country Level: Environmental Conflict

Violence Degree	Peace	Armed Violence	Civil War	N
Peace	60.00	40.00	0.00	45
Armed Violence	13.73	81.05	5.23	153
Civil War	6.45	9.68	83.87	62
N.Osservations	20.00	56.92	23.08	260

3.10.2 Ethnic Level Analysis

The following tables present a summary of transitions at ethnic level.

Generally speaking, the transition probabilities do not differ that much from country-level analysis. In fact, as in the previous case, there is an overall tendency to peace even at ethnic level (a little bit more evident in the ethnic level case): if a ethnic group is in peace, it has the same probability (around 16%) to go to armed protests or to civil war. But, if a community is in a violent phase, it is more likely to turn back to peace (almost 50% probability) than to start a war.

One interesting result is what happens when a community is living a civil war. In this case, 34% of communities do not transit and 49% of communities have a transition to peace.

Table 3.40: Overall Count of Transition Probabilities at Ethnic Level

Violence Degree	Peace	Armed Violence	Civil War
Peace	67.47	15.72	16.81
Armed Violence	50.53	30.85	18.62
Civil War	49.67	16.59	33.75
Total	60.64	18.74	20.62

Differences appear when we study in details the different roots of conflict. For example, the case of religious conflict is striking. At country level, we have a tendency to violence. Here, at ethnic level, the tendency is toward peace. If an ethnic group is experiencing an armed conflict, it is much more likely to move to peace and remain in peace, than to go to war. At the same time, if an ethnic group has a civil war, it has a 36% probability to remain in war and a 52% to go to peace.

Same situation for the environmental and political case. Excepts for the first line, in which it seems that when an ethnic group or a country is in peace, both have a very high probability

Table 3.41: Count of Transition Probabilities at Ethnic Level: Religious Conflicts

Violence Degree	Peace	Armed Violence	Civil War
Peace	72.53	11.48	16.00
Armed Violence	69.39	10.88	19.73
Civil War	60.89	14.22	24.89
N.Osservations	915	155	234

Table 3.42: Count of Transition Probabilities at Ethnic Level: Environmental Conflicts

Violence Degree	Peace	Armed Violence	Civil War
Peace	66.96	13.64	19.40
Armed Violence	64.93	20.85	14.22
Civil War	52.41	12.05	35.54
N.Osservations	915	207	323

to remain in peace, the other transitions differ a lot. Again, ethnic group are more likely to experience peace, with a small probability of persistence of violence.

Table 3.43: Count of Transition Probabilities at Ethnic Level: Political Conflicts

Violence Degree	Peace	Armed Violence	Civil War
Peace	68.11	15.09	16.80
Armed Violence	48.76	32.80	18.45
Civil War	46.98	15.20	37.81
N.Osservations	2219	680	800

3.10.3 Non-ethnic Level Analysis

When we count transition probabilities at non-ethnic level (i.e. taking into account organized group not belonging to a specific ethnic group), we observe an overall small tendency to peace, which is more evident in the environmental case (from war there is a 62.50% probability to move to peace). However, the persistence of war is always between 22% and 31%. Clearly, these probabilities are much more smaller compared to the case of country analysis, but at the same time they are more closer to the case of ethnic analysis. Therefore, again, we observe from this first stage of analysis an evident difference in results between a macro analysis and a macro-micro analysis.

As we can see from Table 3.12, the overall transition probabilities are similar to the ethnic case.

Table 3.44: Overall Count of Transition Probabilities (non-ethnic)

Violence Degree	Peace	Armed Violence	Civil War
Peace	58.30	25.11	16.59
Armed Violence	40.94	37.80	21.26
Civil War	45.10	23.53	31.37
Total	50.44	28.32	21.24

Only the case of religious conflicts differ from the ethnic case. In fact, here it seems that non-ethnic groups in peace are equally likely to remain in peace or start to reclaim religious concerns with violence. At the same time, once the armed conflict starts, it is more likely to

Table 3.45: Count of Transition Probabilities: Environmental Conflicts (non-ethnic)

Violence Degree	Peace	Armed Violence	Civil War
Peace	50.00	38.89	11.1
Armed Violence	57.14	14.29	28.57
Civil War	62.50	12.50	25.00
N.Osservations	18	8	6

Table 3.46: Count of Transition Probabilities: Political Conflicts (non-ethnic)

Violence Degree	Peace	Armed Violence	Civil War
Peace	56.00	26.00	18.00
Armed Violence	41.88	35.04	23.08
Civil War	45.10	23.53	31.37
N.Osservations	207	117	95

occur peace than war and even when a war breaks out, there is a much more bigger probability to reach peace than remain in war.

Table 3.47: Count of Transition Probabilities: Religious Conflicts (non-ethnic)

Violence Degree	Peace	Armed Violence	Civil War
Peace	40.00	40.00	20.00
Armed Violence	57.14	14.29	28.57
Civil War	55.56	22.22	22.22
N.Osservations	13	7	6

From this first-step analysis, we infer that when we study in details what specific group do in their territories, we see a bigger tendency to peace than to war. On the contrary, at country level war is more likely to occur.

3.11 Appendix B

Table 3.48: Transition Probabilities, Ordered Logit (Ethnic Fixed Effects) - Marginal Effects

	Ologit1		Ologit2		Ologit3	
1						
Political Rights Quality	-0.016		-0.085	**	-0.063	
	(0.020)		(0.043)		(0.041)	
Oil Production (Lag)	0.009		-0.010		-0.015	
	(0.036)		(0.051)		(0.077)	
Autocracy	-0.003		-0.031		0.060	
	(0.026)		(0.056)		(0.057)	
Population Growth (Lag)	-0.014		-0.049	*	-0.132	***
	(0.014)		(0.028)		(0.027)	
Religious Conflict	0.056	**	0.261	***	0.249	***
	(0.026)		(0.048)		(0.047)	
Environmental Conflict	0.022		0.051		0.059	
	(0.026)		(0.055)		(0.049)	
Political Conflict	0.021		-0.114	**	-0.168	***

Table 3.48: (Continues in Next Page)

Table 3.48: (Continues from Previous Page)

	(0.021)		(0.046)		(0.047)	
Mountainous Terrain	0.091		-0.319		-0.366	
	(0.091)		(0.209)		(0.225)	
Oil Gini	0.015		0.078		0.253	**
	(0.052)		(0.093)		(0.111)	
Soil Fertility	0.055		0.088		0.713	***
	(0.066)		(0.150)		(0.151)	
Africa Region (Est)	0.019		0.116	*	0.194	***
	(0.033)		(0.063)		(0.065)	
Africa Region (Center)	0.052		-0.047		-0.075	
	(0.037)		(0.096)		(0.069)	
Gold Production	-0.023		0.114	**	-0.067	
	(0.022)		(0.045)		(0.043)	
Diamond Production	0.063	**	0.114	**	0.201	***
	(0.026)		(0.052)		(0.044)	
Economic Growth (Lag)	0.239	**	0.081		0.496	*
	(0.113)		(0.206)		(0.271)	
Time Span	0.072	***	-0.003		-0.064	***
2						
Political Rights Quality	0.007		0.044	*	0.015	
	(0.008)		(0.023)		(0.010)	
Oil Production (Lag)	-0.004		0.005		0.004	
	(0.015)		(0.026)		(0.018)	
Autocracy	0.001		0.016		-0.016	
	(0.011)		(0.029)		(0.015)	
Population Growth (Lag)	0.006		0.025	*	0.032	***
	(0.006)		(0.015)		(0.007)	
Religious Conflict	-0.024	**	-0.156	***	-0.077	***
	(0.011)		(0.034)		(0.017)	
Environmental Conflict	-0.009		-0.027		-0.015	
	(0.011)		(0.031)		(0.014)	
Political Conflict	-0.009		0.059	**	0.040	***
	(0.009)		(0.025)		(0.012)	
Mountainous Terrain	-0.038		0.165		0.090	
	(0.039)		(0.109)		(0.055)	
Oil Gini	-0.006		-0.040		-0.062	**
	(0.022)		(0.049)		(0.028)	
Soil Fertility	-0.023		-0.046		-0.174	***
	(0.028)		(0.078)		(0.041)	
Africa Region (Est)	-0.008		-0.061	*	-0.051	***
	(0.014)		(0.034)		(0.019)	
Africa Region (Center)	-0.023		0.024		0.016	
	(0.016)		(0.046)		(0.013)	
Gold Production	0.010		-0.056	**	0.017	
	(0.010)		(0.022)		(0.012)	
Diamond Production	-0.027	**	-0.060	**	-0.055	***
	(0.011)		(0.028)		(0.014)	
Economic Growth (Lag)	-0.101	**	-0.042		-0.121	*
	(0.048)		(0.107)		(0.067)	

Table 3.48: (Continues in Next Page)

Table 3.48: (Continues from Previous Page)

Time Span	-0.030	***	0.002		0.016	***
	(0.004)		(0.004)		(0.003)	
3						
Political Rights Quality	0.009		0.041	**	0.047	
	(0.011)		(0.020)		(0.031)	
Oil Production (Lag)	-0.005		0.005		0.011	
	(0.020)		(0.025)		(0.059)	
Autocracy	0.002		0.015		-0.045	
	(0.015)		(0.028)		(0.041)	
Population Growth (Lag)	0.008		0.023	*	0.100	***
	(0.008)		(0.013)		(0.021)	
Religious Conflict	-0.032	**	-0.105	***	-0.172	***
	(0.014)		(0.017)		(0.031)	
Environmental Conflict	-0.012		-0.023		-0.043	
	(0.015)		(0.025)		(0.035)	
Political Conflict	-0.012		0.055	**	0.129	***
	(0.012)		(0.022)		(0.036)	
Mountainous Terrain	-0.052		0.154		0.276	
	(0.053)		(0.101)		(0.171)	
Oil Gini	-0.008		-0.037		-0.191	**
	(0.030)		(0.045)		(0.084)	
Soil Fertility	-0.032		-0.042		-0.539	***
	(0.038)		(0.072)		(0.116)	
Africa Region (Est)	-0.011		-0.054	*	-0.143	***
	(0.019)		(0.029)		(0.047)	
Africa Region (Center)	-0.030		0.024		0.059	
	(0.021)		(0.050)		(0.056)	
Gold Production	0.013		-0.058	**	0.050	
	(0.013)		(0.024)		(0.031)	
Diamond Production	-0.036	**	-0.053	**	-0.147	***
	(0.015)		(0.024)		(0.031)	
Economic Growth (Lag)	-0.139	**	-0.039		-0.375	*
	(0.065)		(0.100)		(0.205)	
Time Span	-0.042	***	0.002		0.048	***
	(0.004)		(0.003)		(0.008)	
N	3152		975		999	

Table 3.49: Reduced Form: Transition Probabilities at Citizens Level, Ordered Logit - Marginal Effects

	Peace		Armed Conflict		War
1					
Political Rights Quality	0.074		0.257		0.039
	(0.296)		(0.326)		(0.173)
Oil Production (Lag)	-0.189		-0.061		-0.013
	(0.257)		(0.213)		(0.156)
Autocracy	0.195		0.654	***	-0.088
	(0.167)		(0.146)		(0.229)
Population Growth (Lag)	-0.218	*	-0.057		-0.008

Table 3.49: (Continues in Next Page)

Table 3.49: (Continues from Previous Page)

	(0.113)		(0.136)		(0.061)
Mountainous Terrain	0.016		0.504		-0.331
	(0.539)		(0.933)		(0.288)
Oil Gini	0.172		-0.056		0.003
	(0.321)		(0.330)		(0.216)
Soil Fertility	0.220		0.180		0.381
	(0.345)		(0.749)		(0.460)
Africa Region (Est)	-0.098		0.286		0.157
	(0.302)		(0.323)		(0.181)
Africa Region (Center)	-0.322	*	-0.127		0.081
	(0.176)		(0.184)		(0.148)
Diamond Production	-0.072		0.039		0.135
	(0.168)		(0.177)		(0.125)
Economic Growth (Lag)	1.974	***	1.857	***	0.226
	(0.525)		(0.697)		(1.387)
Time Span	0.026		-0.007		-0.068
	(0.042)		(0.058)		(0.049)
Religious Conflict			-0.238		
			(0.170)		
2					
Political Rights Quality	-0.035		-0.087		0.000
	(0.144)		(0.141)		(0.003)
Oil Production (Lag)	0.069		0.017		-0.000
	(0.074)		(0.039)		(0.004)
Autocracy	-0.104		-0.406	***	-0.007
	(0.104)		(0.129)		(0.039)
Population Growth (Lag)	0.102		0.019		-0.000
	(0.075)		(0.052)		(0.001)
Mountainous Terrain	-0.007		-0.170		-0.004
	(0.252)		(0.331)		(0.024)
Oil Gini	-0.081		0.019		0.000
	(0.160)		(0.108)		(0.002)
Soil Fertility	-0.103		-0.061		0.004
	(0.172)		(0.265)		(0.030)
Africa Region (Est)	0.043		-0.140		-0.010
	(0.118)		(0.206)		(0.027)
Africa Region (Center)	0.088	*	0.026		-0.003
	(0.053)		(0.034)		(0.013)
Diamond Production	0.033		-0.013		0.000
	(0.075)		(0.064)		(0.010)
Economic Growth (Lag)	-0.924	**	-0.628		0.002
	(0.453)		(0.493)		(0.024)
Time Span	-0.012		0.002		-0.001
	(0.019)		(0.019)		(0.005)
Religious Conflict			-0.045		
			(0.140)		
3					
Political Rights Quality	-0.039		-0.170		-0.039
	(0.153)		(0.197)		(0.175)

Table 3.49: (Continues in Next Page)

Table 3.49: (Continues from Previous Page)

Oil Production (Lag)	0.120		0.044		0.013
	(0.190)		(0.176)		(0.160)
Autocracy	-0.090		-0.248	***	0.095
	(0.070)		(0.060)		(0.267)
Population Growth (Lag)	0.116	**	0.038		0.009
	(0.048)		(0.086)		(0.061)
Mountainous Terrain	-0.008		-0.334		0.335
	(0.286)		(0.623)		(0.283)
Oil Gini	-0.092		0.037		-0.003
	(0.164)		(0.222)		(0.218)
Soil Fertility	-0.117		-0.119		-0.386
	(0.178)		(0.487)		(0.470)
Africa Region (Est)	0.055		-0.147		-0.147
	(0.184)		(0.127)		(0.157)
Africa Region (Center)	0.234		0.101		-0.078
	(0.149)		(0.168)		(0.136)
Diamond Production	0.039		-0.026		-0.135
	(0.095)		(0.113)		(0.126)
Economic Growth (Lag)	-1.050	***	-1.230	***	-0.228
	(0.261)		(0.463)		(1.405)
Time Span	-0.014		0.004		0.068
	(0.024)		(0.039)		(0.050)
Religious Conflict			0.284		
			(0.299)		
N	117		63		67

Table 3.50: Cox Proportional Hazard Model with Time Varying Covariates: General transitions toward Peace

	Peace to Peace		Other to Peace	
main				
Low Political Rights Quality	-0.299		0.004	
	(0.223)		(0.214)	
High Political Rights Quality	-0.948	**	-0.244	
	(0.450)		(0.423)	
Public Spending	0.040	**		
	(0.016)			
Oil Production (Lag)	-0.214		0.229	
	(0.455)		(0.381)	
Autocracy	0.360		1.007	***
	(0.388)		(0.367)	
Population Growth (Lag)	0.347	*	0.487	***
	(0.191)		(0.163)	
Religious Conflict	0.449		0.323	
	(0.373)		(0.294)	
Environmental Conflict	-0.389		0.322	
	(0.417)		(0.323)	

Table 3.50: (Continues in Next Page)

Table 3.50: (Continues from Previous Page)

Political Conflict	-0.426		-0.660	**
	(0.346)		(0.259)	
Mountainous Terrain	0.027		-0.843	
	(1.512)		(0.819)	
Oil Gini	-0.646		-0.785	
	(0.669)		(0.603)	
Soil Fertility	-1.196		-0.547	
	(0.978)		(0.858)	
Africa Region (Est)	-0.340		-0.124	
	(0.487)		(0.387)	
Africa Region (Center)	1.155	**	1.239	**
	(0.584)		(0.555)	
Gold Production	-0.358		-0.100	
	(0.375)		(0.286)	
Diamond Production	-1.014	**	-0.630	
	(0.441)		(0.407)	
Economic Growth (Lag)	2.658		0.943	
	(2.260)		(1.092)	
tvc				
Political Rights Quality	0.072	*	0.032	
	(0.039)		(0.036)	
Public Spending	-0.012	***		
	(0.004)			
Oil Production (Lag)	0.021		-0.051	
	(0.055)		(0.051)	
Autocracy	-0.099		-0.189	***
	(0.064)		(0.061)	
Population Growth (Lag)	-0.088	***	-0.103	***
	(0.031)		(0.026)	
Religious Conflict	-0.010		0.012	
	(0.074)		(0.057)	
Environmental Conflict	0.088		-0.052	
	(0.076)		(0.058)	
Political Conflict	0.048		0.117	***
	(0.063)		(0.043)	
Mountainous Terrain	-0.000		0.068	
	(0.243)		(0.131)	
Oil Gini	0.121		0.142	
	(0.121)		(0.103)	
Soil Fertility	0.352	**	0.205	
	(0.176)		(0.147)	
Africa Region (Est)	0.061		0.008	
	(0.075)		(0.053)	
Africa Region (Center)	-0.234	**	-0.256	**
	(0.109)		(0.101)	
Gold Production	0.072		0.016	
	(0.070)		(0.049)	
Diamond Production	0.259	***	0.151	**
	(0.079)		(0.069)	

Table 3.50: (Continues in Next Page)

Table 3.50: (Continues from Previous Page)

Economic Growth (Lag)	-0.128	-0.039
	(0.316)	(0.155)
N	489	604

Table 3.51: Cox Proportional Hazard Model with Time Varying Covariates: General transitions toward Armed Violence

	1		2	
main				
Low Political Rights Quality	0.099		0.314	
	(1.271)		(1.294)	
High Political Rights Quality	0.626		0.447	
	(2.502)		(2.276)	
Public Spending	-0.046			
	(0.073)			
Oil Production (Lag)	-0.243		-0.600	
	(1.563)		(1.199)	
Autocracy	-0.271		-1.142	
	(1.933)		(1.784)	
Population Growth (Lag)	-2.345	**	-2.383	***
	(1.119)		(0.782)	
Religious Conflict	-1.127		0.216	
	(3.134)		(1.228)	
Environmental Conflict	0.527		2.609	
	(2.302)		(1.678)	
Political Conflict	-1.176		1.724	
	(1.675)		(1.177)	
Mountainous Terrain	-21.990		3.432	
	(20.128)		(11.812)	
Oil Gini	-2.710		1.179	
	(3.945)		(2.429)	
Soil Fertility	9.005		2.535	
	(5.810)		(3.697)	
Africa Region (Est)	4.946	*	1.056	
	(2.721)		(1.818)	
Africa Region (Center)	2.138		-2.626	
	(3.717)		(2.904)	
Gold Production	4.609	**	1.559	
	(2.129)		(1.192)	
Diamond Production	1.601		0.561	
	(2.434)		(1.355)	
Economic Growth (Lag)	-7.530		-11.939	**
	(8.039)		(5.590)	
tvc				
Political Rights Quality	-0.007		-0.020	
	(0.225)		(0.193)	
Public Spending	0.017			
	(0.012)			

Table 3.51: (Continues in Next Page)

Table 3.51: (Continues from Previous Page)

Oil Production (Lag)	0.062		0.162	
	(0.194)		(0.155)	
Autocracy	0.179		0.279	
	(0.345)		(0.299)	
Population Growth (Lag)	0.565	***	0.470	***
	(0.206)		(0.139)	
Religious Conflict	-0.328		-0.426	*
	(0.528)		(0.223)	
Environmental Conflict	-0.034		-0.570	*
	(0.432)		(0.341)	
Political Conflict	0.205		-0.311	
	(0.326)		(0.193)	
Mountainous Terrain	0.050		-1.994	
	(3.455)		(1.584)	
Oil Gini	0.150		-0.399	
	(0.759)		(0.447)	
Soil Fertility	-1.374		-0.140	
	(1.095)		(0.662)	
Africa Region (Est)	-0.430		0.127	
	(0.489)		(0.254)	
Africa Region (Center)	0.118		0.728	
	(0.761)		(0.561)	
Gold Production	-0.788	**	-0.203	
	(0.371)		(0.216)	
Diamond Production	-0.430		-0.140	
	(0.490)		(0.241)	
Economic Growth (Lag)	0.051		1.184	
	(0.999)		(0.776)	
N	489		604	

Table 3.52: Cox Proportional Hazard Model with Time-Varying Covariates: General Transitions toward War

	I		II	
main				
Low Political Rights Quality	1.099		0.045	
	(1.037)		(0.792)	
High Political Rights Quality	4.642	***	1.882	
	(1.748)		(1.262)	
Public Spending	0.027			
	(0.040)			
Oil Production (Lag)	3.637	**	0.174	
	(1.735)		(1.063)	
Autocracy	0.154		-2.352	*
	(1.618)		(1.217)	
Population Growth (Lag)	-0.432		-0.526	
	(0.514)		(0.619)	

Table 3.52: (Continues in Next Page)

Table 3.52: (Continues from Previous Page)

Religious Conflict	-4.779	***	-1.349	
	(1.799)		(1.757)	
Environmental Conflict	-1.337		-4.642	***
	(1.229)		(1.725)	
Political Conflict	2.494	**	1.757	*
	(1.052)		(0.989)	
Mountainous Terrain	1.638		4.834	
	(3.995)		(5.260)	
Oil Gini	1.246		-0.592	
	(2.242)		(2.221)	
Soil Fertility	0.895		-3.540	
	(2.953)		(3.675)	
Africa Region (Est)	-1.613		-0.615	
	(1.533)		(1.404)	
Africa Region (Center)	-5.478	**	-2.779	
	(2.173)		(2.470)	
Gold Production	-1.488	*	-0.912	
	(0.848)		(0.792)	
Diamond Production	1.178		2.305	**
	(1.299)		(1.091)	
Economic Growth (Lag)	12.657		18.534	***
	(7.753)		(6.242)	
tvc				
Political Rights Quality	-0.518	***	-0.317	***
	(0.139)		(0.100)	
Public Spending	0.013	*		
	(0.008)			
Oil Production (Lag)	-0.980	***	-0.236	*
	(0.341)		(0.140)	
Autocracy	-0.034		0.285	*
	(0.238)		(0.154)	
Population Growth (Lag)	0.211	**	0.188	
	(0.085)		(0.129)	
Religious Conflict	0.512	*	0.039	
	(0.286)		(0.338)	
Environmental Conflict	0.112		0.669	**
	(0.191)		(0.277)	
Political Conflict	-0.409	**	-0.343	**
	(0.190)		(0.172)	
Mountainous Terrain	0.927		-0.083	
	(0.676)		(0.922)	
Oil Gini	0.017		0.135	
	(0.371)		(0.346)	
Soil Fertility	-1.328	**	-0.038	
	(0.542)		(0.735)	
Africa Region (Est)	0.254		0.057	
	(0.232)		(0.218)	
Africa Region (Center)	1.157	***	0.749	
	(0.352)		(0.502)	

Table 3.52: (Continues in Next Page)

Table 3.52: (Continues from Previous Page)

Gold Production	0.271	**	0.205	
	(0.138)		(0.148)	
Diamond Production	-0.546	**	-0.638	***
	(0.220)		(0.207)	
Economic Growth (Lag)	-2.955	**	-3.891	***
	(1.165)		(0.960)	
N	489		604	

Table 3.53: Cox Proportional Hazard Model (Ethnic Fixed Effects): Transitions from Peace to other states

	$Peace \rightarrow Peace$		Peace $\rightarrow ArmedViolence$		Peace $\rightarrow CivilWar$	
Low Political Rights Quality	0.314		0.186		-1.225	**
	(0.193)		(0.503)		(0.617)	
High Political Rights Quality	0.106		0.414		-0.842	
	(0.234)		(0.703)		(0.658)	
Oil Production (Lag)	-0.237		1.018	***	-0.366	
	(0.164)		(0.381)		(0.538)	
Autocracy	-0.138		0.163		0.389	
	(0.153)		(0.549)		(0.569)	
Population Growth (Lag)	-0.091		0.236		0.295	
	(0.057)		(0.218)		(0.197)	
Religious Conflict	0.336	***	-1.838	**	-0.608	
	(0.116)		(0.770)		(0.565)	
Environmental Conflict	0.137		-0.551		-0.461	
	(0.112)		(0.605)		(0.467)	
Political Conflict	-0.090		-0.081		0.201	
	(0.106)		(0.376)		(0.330)	
Mountainous Terrain	-0.299		-6.415		1.716	
	(0.294)		(5.624)		(1.374)	
Oil Gini	0.252		-1.239		-0.272	
	(0.242)		(1.040)		(0.949)	
Soil Fertility	0.679	**	-0.411		-0.775	
	(0.309)		(0.835)		(1.195)	
Africa Region (Est)	-0.012		0.809		0.201	
	(0.135)		(0.761)		(0.480)	
Africa Region (Center)	-0.058		-0.152		1.101	
	(0.180)		(1.101)		(0.810)	
Gold Production	0.016		0.387		-0.360	
	(0.131)		(0.400)		(0.373)	
Diamond Production	0.297	**	0.027		-0.902	*
	(0.141)		(0.342)		(0.468)	
Economic Growth (Lag)	0.691	*	-2.104		-5.118	*
	(0.389)		(1.780)		(2.947)	
N	604		604		604	

Fig. 3.6: *Goodness of Fit for General Transitions*

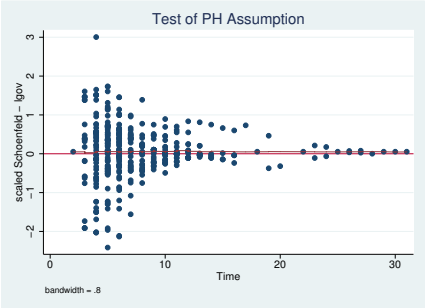


Fig. 3.7: *Test of PH Assumption for Economic Growth (Lag)*

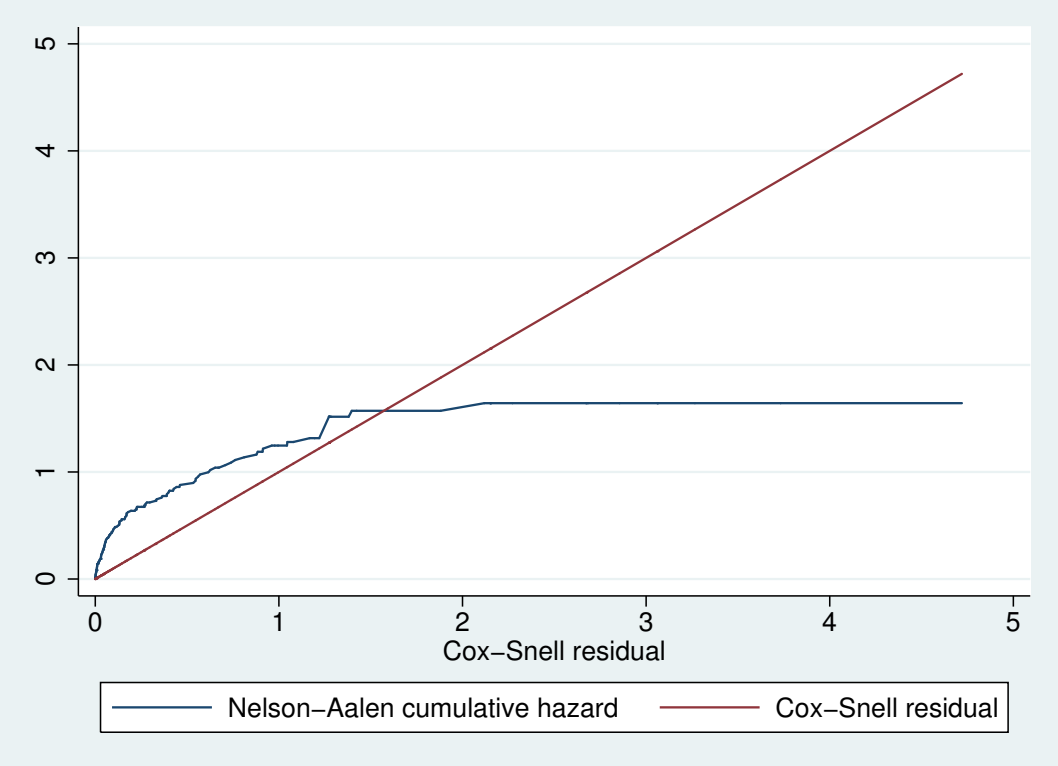


Fig. 3.8: *Goodness of Fit for General Transitions - Armed Violence*

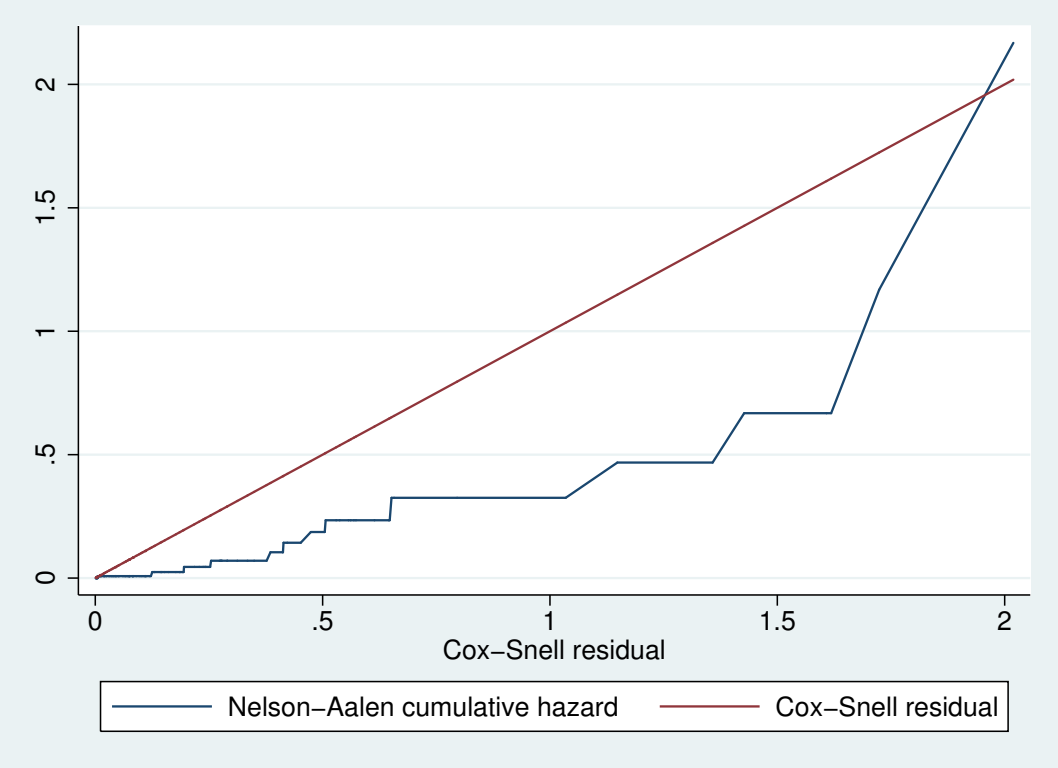


Fig. 3.9: *Goodness of Fit for General Transitions - War*

Table 3.54: Cox Proportional Hazard Model with tvc: Transitions from Peace to other states

	Peace → *Peace*		Peace → *ArmedViolence*		Peace → *CivilWar*	
main						
Low Political Rights Quality	-0.017		-0.893		-0.289	
	(0.220)		(0.938)		(0.717)	
High Political Rights Quality	-0.303		-1.714		1.164	
	(0.430)		(1.667)		(1.189)	
Oil Production (Lag)	0.421		-1.175		-0.275	
	(0.338)		(1.230)		(1.015)	
Autocracy	0.754	**	-1.882		-2.277	*
	(0.380)		(1.402)		(1.166)	
Population Growth (Lag)	0.414	***	-2.371	***	-0.209	
	(0.143)		(0.700)		(0.498)	
Religious Conflict	0.408	*	-0.143		-1.315	
	(0.246)		(1.139)		(1.363)	
Environmental Conflict	0.264		2.078		-3.983	***
	(0.273)		(1.360)		(1.376)	
Political Conflict	-0.648	***	1.538		1.378	
	(0.228)		(0.941)		(0.873)	
Mountainous Terrain	-0.402		1.105		5.713	
	(0.702)		(10.288)		(4.107)	
Oil Gini	-0.915	*	2.602		-1.123	
	(0.539)		(1.981)		(1.838)	
Soil Fertility	-0.218		2.003		-3.568	

Table 3.54: (Continues in Next Page)

Table 3.54: (Continues from Previous Page)

	(0.736)		(3.680)		(2.744)	
Africa Region (Est)	-0.274		2.093		-0.891	
	(0.355)		(1.777)		(1.140)	
Africa Region (Center)	1.077	**	-2.463		-1.771	
	(0.472)		(2.525)		(1.797)	
Gold Production	-0.100		1.696		-0.916	
	(0.252)		(1.040)		(0.677)	
Diamond Production	-0.475		0.091		1.489	
	(0.351)		(1.127)		(0.920)	
Economic Growth (Lag)	1.336		-12.853	***	15.574	***
	(0.989)		(4.383)		(5.124)	
tvc						
Political Rights Quality	0.044		0.204		-0.294	**
	(0.046)		(0.160)		(0.117)	
Oil Production (Lag)	-0.095	**	0.313		-0.171	
	(0.047)		(0.201)		(0.159)	
Autocracy	-0.179	**	0.468	*	0.380	*
	(0.081)		(0.256)		(0.198)	
Population Growth (Lag)	-0.108	***	0.591	***	0.148	
	(0.027)		(0.147)		(0.118)	
Religious Conflict	0.001		-0.444	*	0.035	
	(0.058)		(0.237)		(0.304)	
Environmental Conflict	-0.050		-0.588	*	0.682	***
	(0.059)		(0.347)		(0.248)	
Political Conflict	0.131	***	-0.318	*	-0.349	**
	(0.043)		(0.189)		(0.176)	
Mountainous Terrain	0.024		-2.202		-0.293	
	(0.131)		(1.564)		(0.832)	
Oil Gini	0.184	*	-0.801	*	0.268	
	(0.106)		(0.424)		(0.328)	
Soil Fertility	0.182		0.001		-0.067	
	(0.149)		(0.818)		(0.620)	
Africa Region (Est)	0.026		-0.021		0.139	
	(0.055)		(0.334)		(0.203)	
Africa Region (Center)	-0.274	***	0.919		0.722	*
	(0.103)		(0.578)		(0.436)	
Gold Production	0.020		-0.275		0.257	*
	(0.051)		(0.222)		(0.149)	
Diamond Production	0.151	**	-0.075		-0.583	***
	(0.072)		(0.242)		(0.206)	
Economic Growth (Lag)	-0.126		1.800	***	-4.014	***
	(0.164)		(0.656)		(0.877)	
N	604		604		604	

Table 3.55: Cox Proportional Hazard Model with Time Varying Covariates: from Armed Violence

	$Violence \rightarrow Peace$	Violence $\rightarrow Violence$	Violence $\rightarrow CivilWar$
main			

Table 3.55: (Continues in Next Page)

Table 3.55: (Continues from Previous Page)

Low Political Rights Quality	0.172		-0.769		0.543	
	(0.198)		(1.157)		(0.746)	
High Political Rights Quality	0.096		-1.206		1.802	
	(0.389)		(1.969)		(1.152)	
Oil Production (Lag)	0.049		0.066		0.031	
	(0.352)		(0.982)		(1.007)	
Autocracy	0.841	***	-0.512		-1.653	
	(0.323)		(1.255)		(1.262)	
Population Growth (Lag)	0.257	*	-0.843		-0.287	
	(0.141)		(0.533)		(0.483)	
Religious Conflict	0.572	**	-0.941		-1.474	
	(0.235)		(1.183)		(1.324)	
Environmental Conflict	0.285		-0.308		-4.582	***
	(0.311)		(1.289)		(1.631)	
Political Conflict	-0.628	**	1.575	*	1.350	*
	(0.246)		(0.905)		(0.722)	
Mountainous Terrain	-1.269		-0.520		6.284	
	(0.782)		(10.273)		(4.508)	
Oil Gini	-0.199		-0.618		-2.554	
	(0.558)		(1.709)		(2.110)	
Soil Fertility	0.112		0.733		-3.816	*
	(0.751)		(2.552)		(2.218)	
Africa Region (Est)	-0.009		0.222		-0.641	
	(0.349)		(1.706)		(1.097)	
Africa Region (Center)	0.708		-0.766		-0.492	
	(0.494)		(2.215)		(1.909)	
Gold Production	0.016		0.986		-1.120	
	(0.291)		(0.883)		(0.766)	
Diamond Production	-0.359		0.507		2.295	**
	(0.348)		(1.004)		(1.161)	
Economic Growth (Lag)	0.918		-10.999	**	16.626	***
	(1.602)		(5.402)		(4.843)	
tvc						
Political Rights Quality	-0.009		0.164		-0.311	*
	(0.036)		(0.235)		(0.183)	
Oil Production (Lag)	-0.049		0.117		-0.333	**
	(0.057)		(0.150)		(0.154)	
Autocracy	-0.203	***	0.283		0.168	
	(0.063)		(0.278)		(0.179)	
Population Growth (Lag)	-0.072	***	0.248	**	0.116	
	(0.026)		(0.114)		(0.128)	
Religious Conflict	-0.056		-0.255		0.127	
	(0.054)		(0.245)		(0.264)	
Environmental Conflict	-0.044		-0.033		0.815	***
	(0.066)		(0.306)		(0.277)	
Political Conflict	0.140	***	-0.371	**	-0.414	**
	(0.051)		(0.173)		(0.177)	
Mountainous Terrain	0.211		-1.527		-0.402	
	(0.159)		(1.740)		(0.845)	

Table 3.55: (Continues in Next Page)

Table 3.55: (Continues from Previous Page)

Oil Gini	0.066		-0.103	0.650	*
	(0.113)		(0.460)	(0.387)	
Soil Fertility	0.112		-0.060	0.206	
	(0.150)		(0.627)	(0.677)	
Africa Region (Est)	-0.034		0.305	0.145	
	(0.053)		(0.298)	(0.233)	
Africa Region (Center)	-0.185	*	0.332	0.434	
	(0.108)		(0.608)	(0.478)	
Gold Production	-0.021		-0.121	0.344	*
	(0.066)		(0.235)	(0.182)	
Diamond Production	0.136	*	-0.103	-0.914	***
	(0.070)		(0.229)	(0.337)	
Economic Growth (Lag)	-0.078		1.313	-4.413	***
	(0.296)		(0.984)	(0.840)	
N	558		558	558	

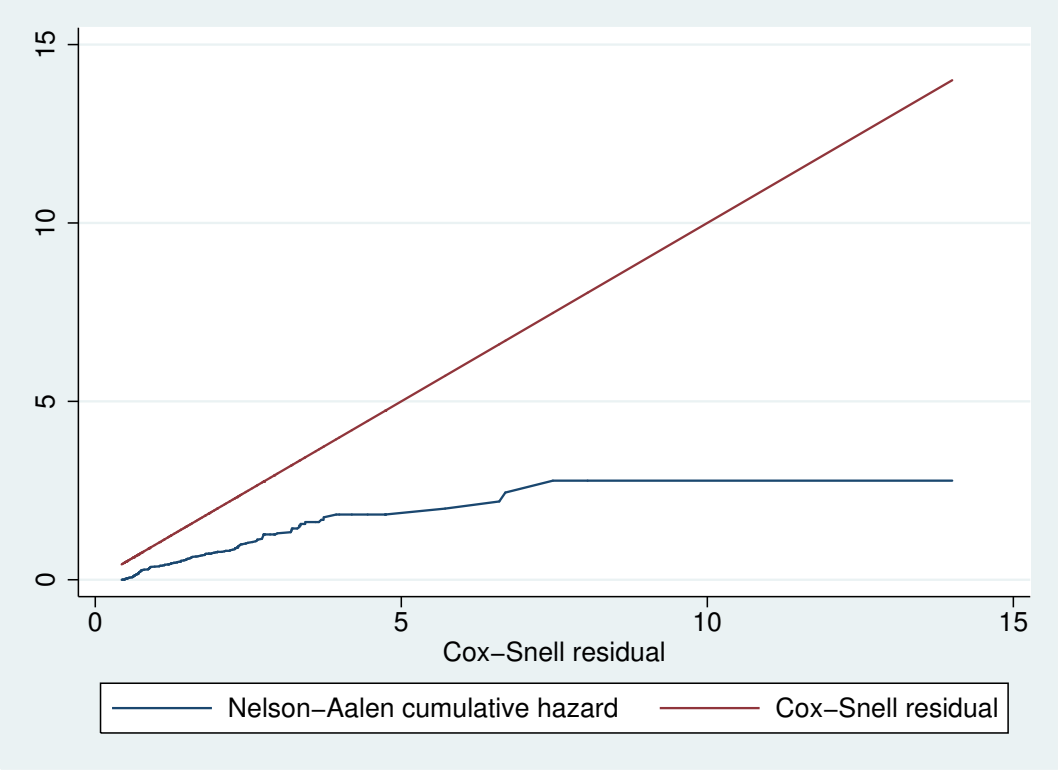


Fig. 3.10: *Goodness of Fit: Persistence of Peace*

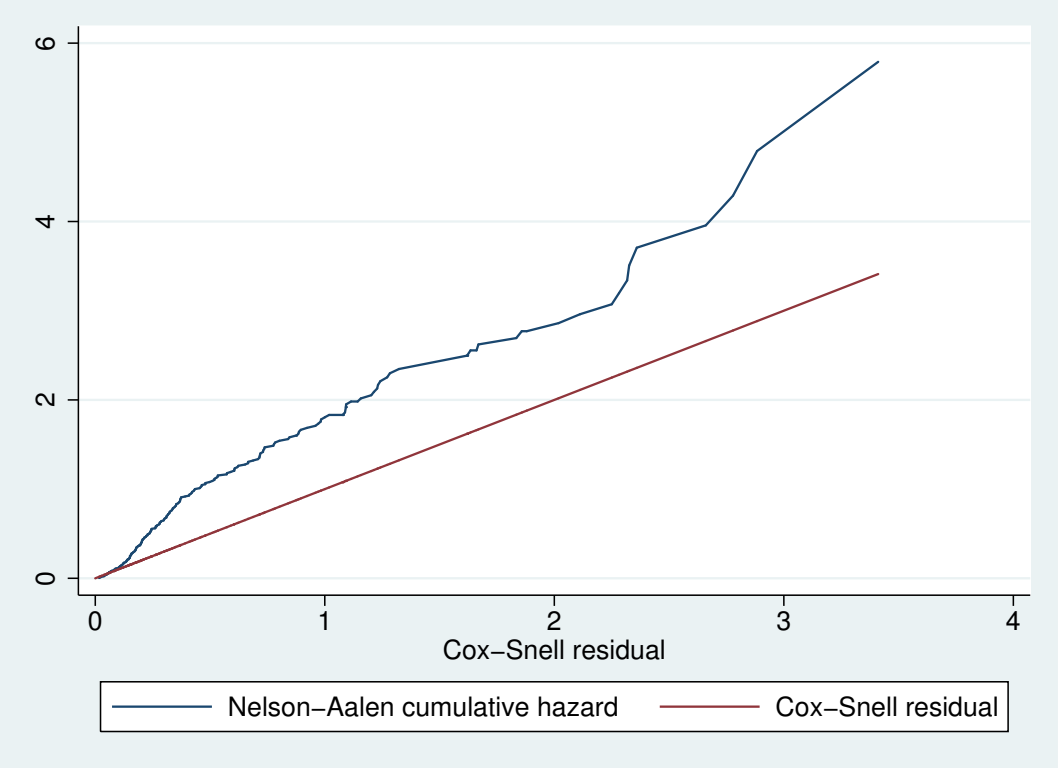


Fig. 3.11: *Goodness of Fit: Transition from Peace to Armed Violence*

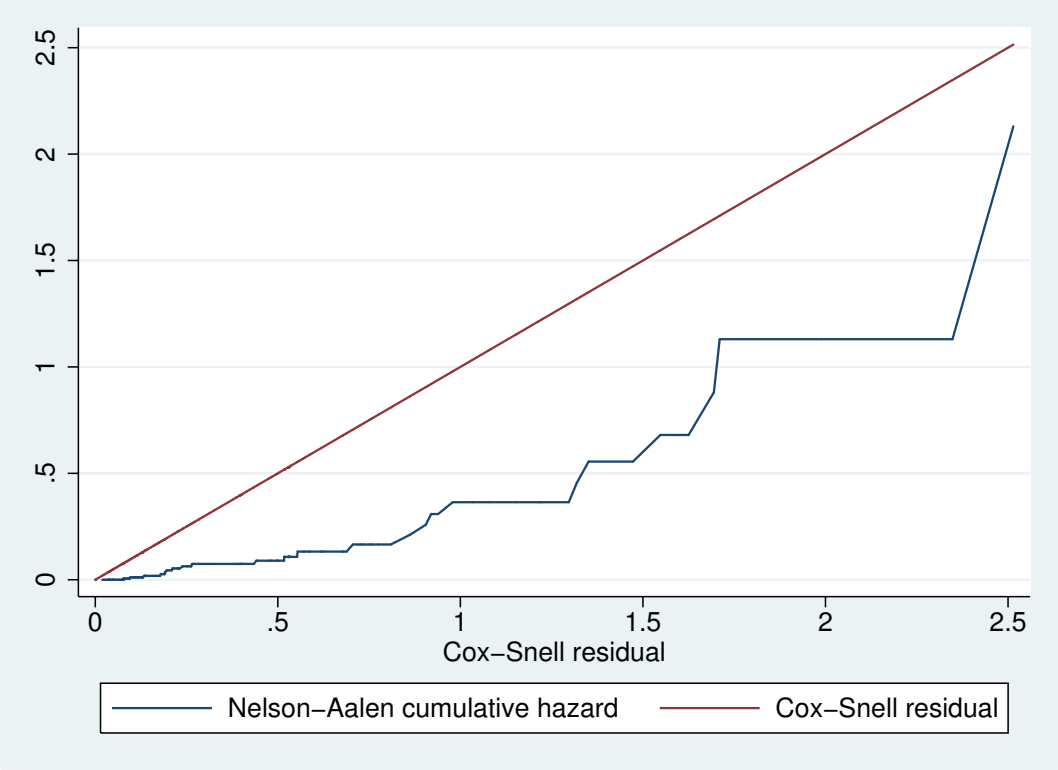


Fig. 3.12: *Goodness of Fit: Transition from Peace to War*

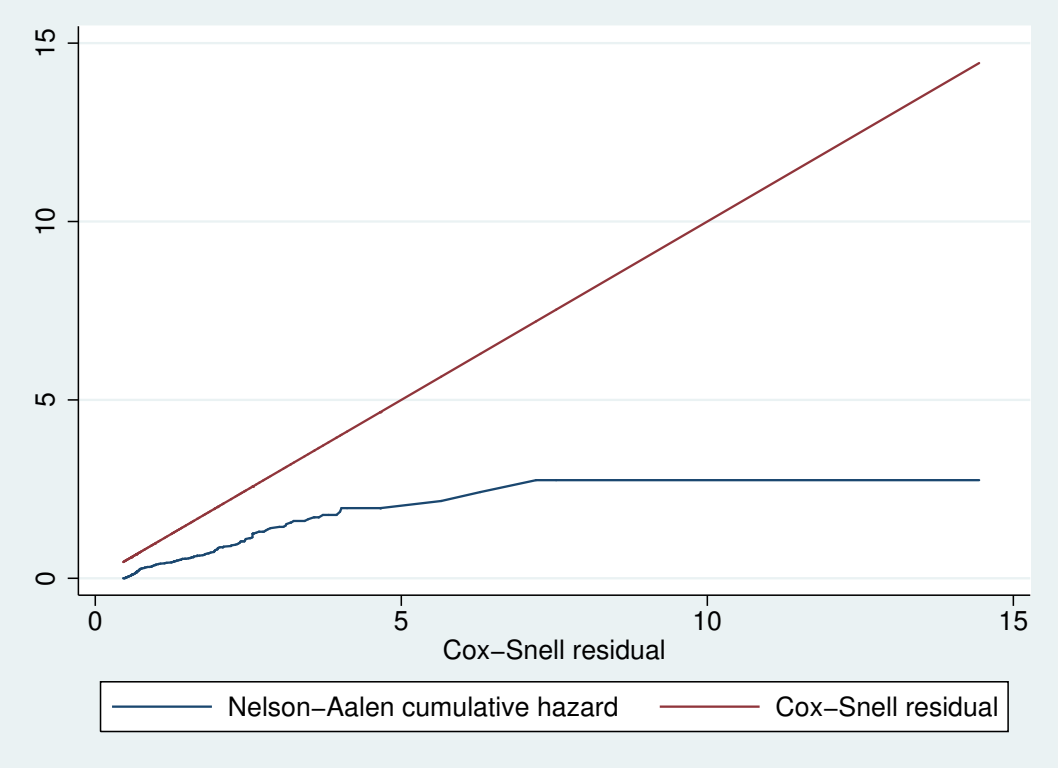


Fig. 3.13

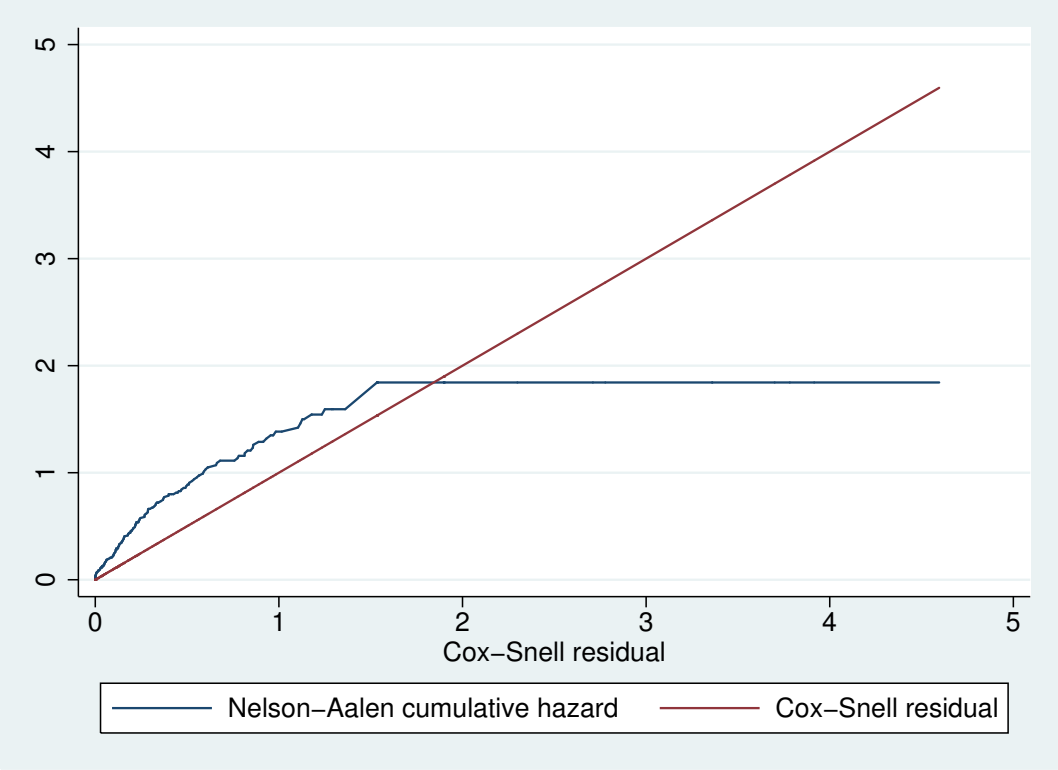


Fig. 3.14: *Goodness of Fit: Persistence of Armed Conflict*

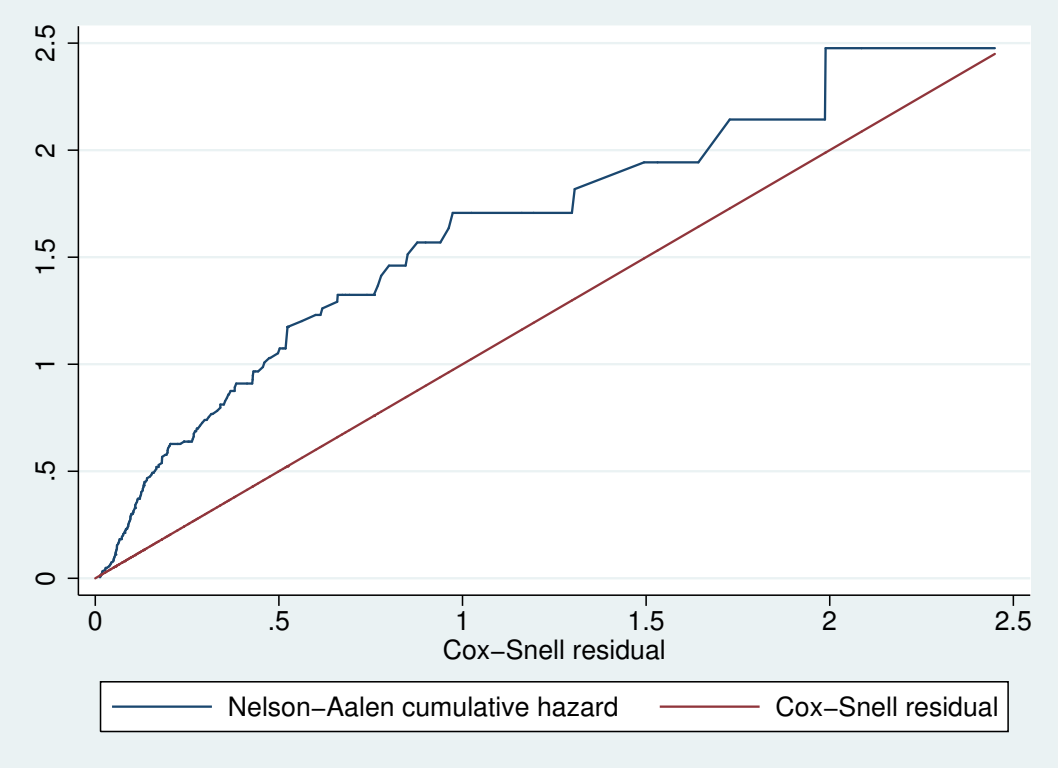


Fig. 3.15: *Goodness of Fit: Transition from Armed Conflict to Civil War*

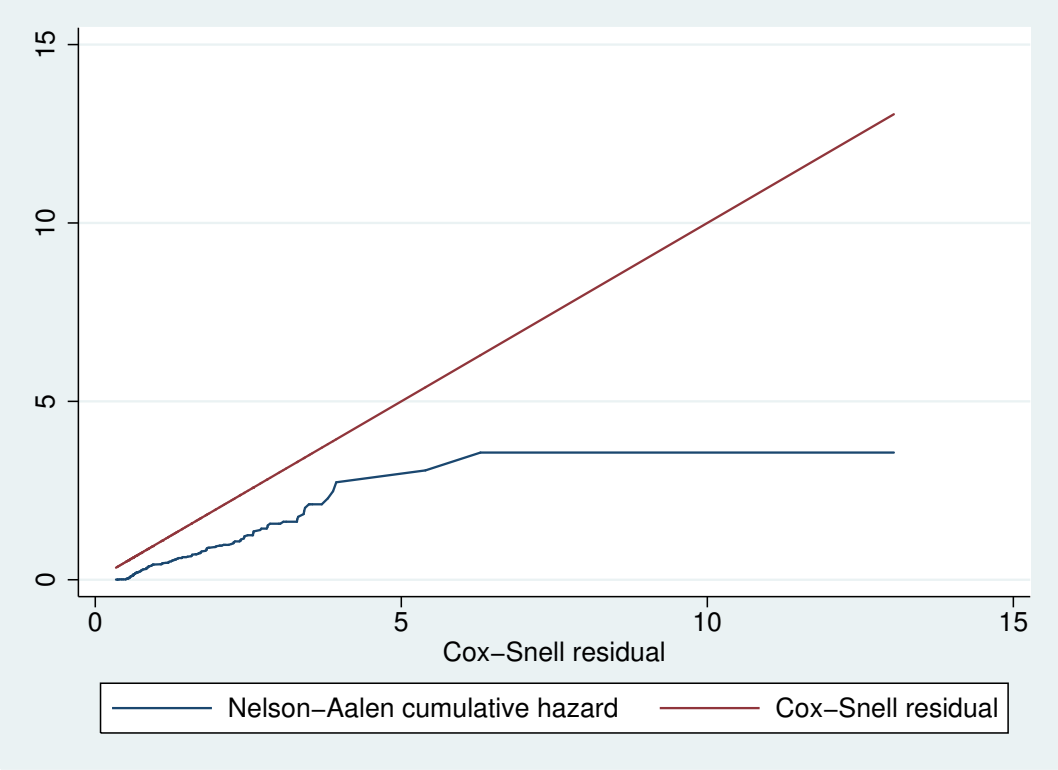


Fig. 3.16: *Plot of Goodness of Fit: From Civil War to Peace*

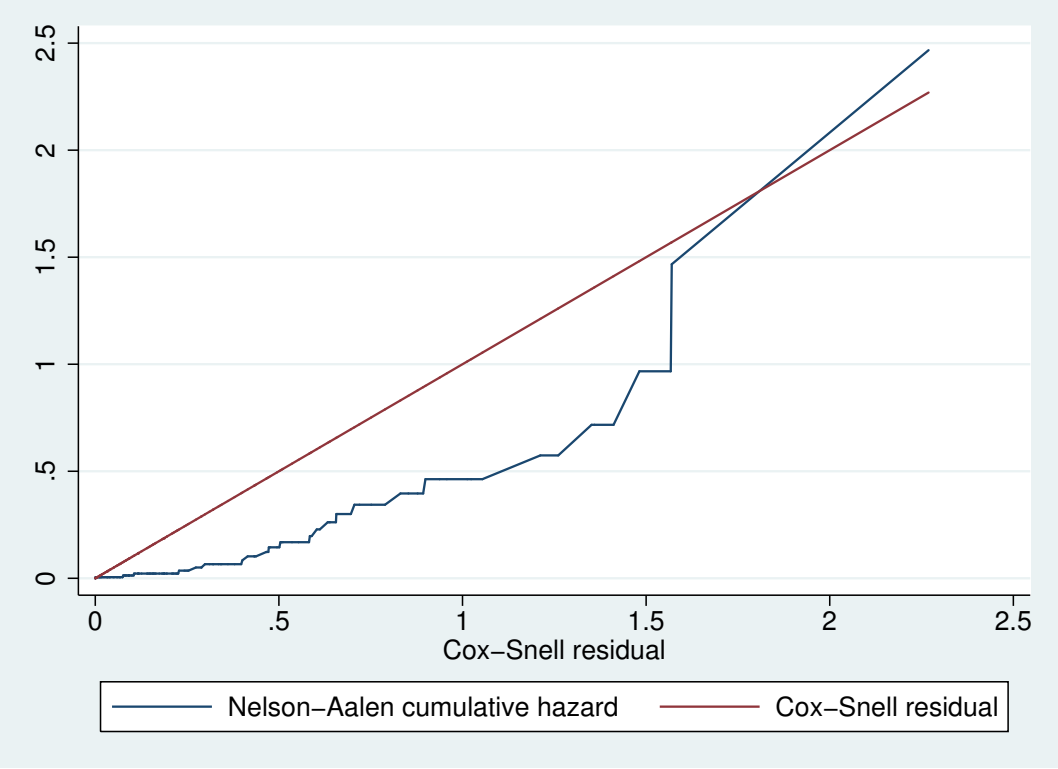


Fig. 3.17: *Plot of Goodness of Fit: From Civil War to Armed Violence*

Table 3.56: Cox Proportional Hazard Model (Ethnic Fixed Effects): Transitions from Peace to other states

	$Peace \rightarrow Peace$		Peace $\rightarrow ArmedViolence$		Peace $\rightarrow CivilWar$	
Low Political Rights Quality	0.314		0.186		-1.225	**
	(0.193)		(0.503)		(0.617)	
High Political Rights Quality	0.106		0.414		-0.842	
	(0.234)		(0.703)		(0.658)	
Oil Production (Lag)	-0.237		1.018	***	-0.366	
	(0.164)		(0.381)		(0.538)	
Autocracy	-0.138		0.163		0.389	
	(0.153)		(0.549)		(0.569)	
Population Growth (Lag)	-0.091		0.236		0.295	
	(0.057)		(0.218)		(0.197)	
Religious Conflict	0.336	***	-1.838	**	-0.608	
	(0.116)		(0.770)		(0.565)	
Environmental Conflict	0.137		-0.551		-0.461	
	(0.112)		(0.605)		(0.467)	
Political Conflict	-0.090		-0.081		0.201	
	(0.106)		(0.376)		(0.330)	
Mountainous Terrain	-0.299		-6.415		1.716	
	(0.294)		(5.624)		(1.374)	
Oil Gini	0.252		-1.239		-0.272	
	(0.242)		(1.040)		(0.949)	
Soil Fertility	0.679	**	-0.411		-0.775	
	(0.309)		(0.835)		(1.195)	
Africa Region (Est)	-0.012		0.809		0.201	
	(0.135)		(0.761)		(0.480)	
Africa Region (Center)	-0.058		-0.152		1.101	
	(0.180)		(1.101)		(0.810)	
Gold Production	0.016		0.387		-0.360	
	(0.131)		(0.400)		(0.373)	
Diamond Production	0.297	**	0.027		-0.902	*
	(0.141)		(0.342)		(0.468)	
Economic Growth (Lag)	0.691	*	-2.104		-5.118	*
	(0.389)		(1.780)		(2.947)	
N	604		604		604	

Table 3.57: Cox Proportional Hazard Model (Ethnic Fixed Effects): Transitions from Armed Violence to other states

	$Peace \rightarrow Peace$		Peace $\rightarrow ArmedViolence$		Peace $\rightarrow CivilWar$	
Low Political Rights Quality	0.093		0.182		-0.045	
	(0.169)		(0.489)		(0.991)	
High Political Rights Quality	-0.143		0.509		0.307	
	(0.218)		(0.654)		(0.916)	
Oil Production (Lag)	-0.240		1.011	**	-0.788	
	(0.186)		(0.397)		(0.584)	
Autocracy	-0.187		0.382		0.378	
	(0.166)		(0.553)		(0.503)	
Population Growth (Lag)	-0.046		0.221		0.038	
	(0.054)		(0.228)		(0.221)	
Religious Conflict	0.339	***	-1.806	**	-0.783	
	(0.130)		(0.743)		(0.624)	
Environmental Conflict	0.072		-0.494		-0.049	
	(0.128)		(0.586)		(0.521)	
Political Conflict	-0.082		-0.156		0.137	
	(0.110)		(0.397)		(0.384)	
Mountainous Terrain	-0.311		-6.617		2.169	
	(0.465)		(6.012)		(1.730)	
Oil Gini	0.241		-1.261		0.107	
	(0.246)		(1.120)		(0.990)	
Soil Fertility	0.616	**	-0.804		-0.724	
	(0.297)		(0.833)		(1.299)	
Africa Region (Est)	-0.095		0.914		0.313	
	(0.137)		(0.779)		(0.593)	
Africa Region (Center)	-0.015		-0.383		0.689	
	(0.183)		(1.161)		(0.797)	
Gold Production	0.011		0.482		-0.238	
	(0.139)		(0.404)		(0.408)	
Diamond Production	0.305	**	0.123		-0.863	*
	(0.138)		(0.344)		(0.468)	
Economic Growth (Lag)	0.580		-2.381		-5.429	*
	(0.399)		(2.159)		(3.007)	
N	558		558		558	

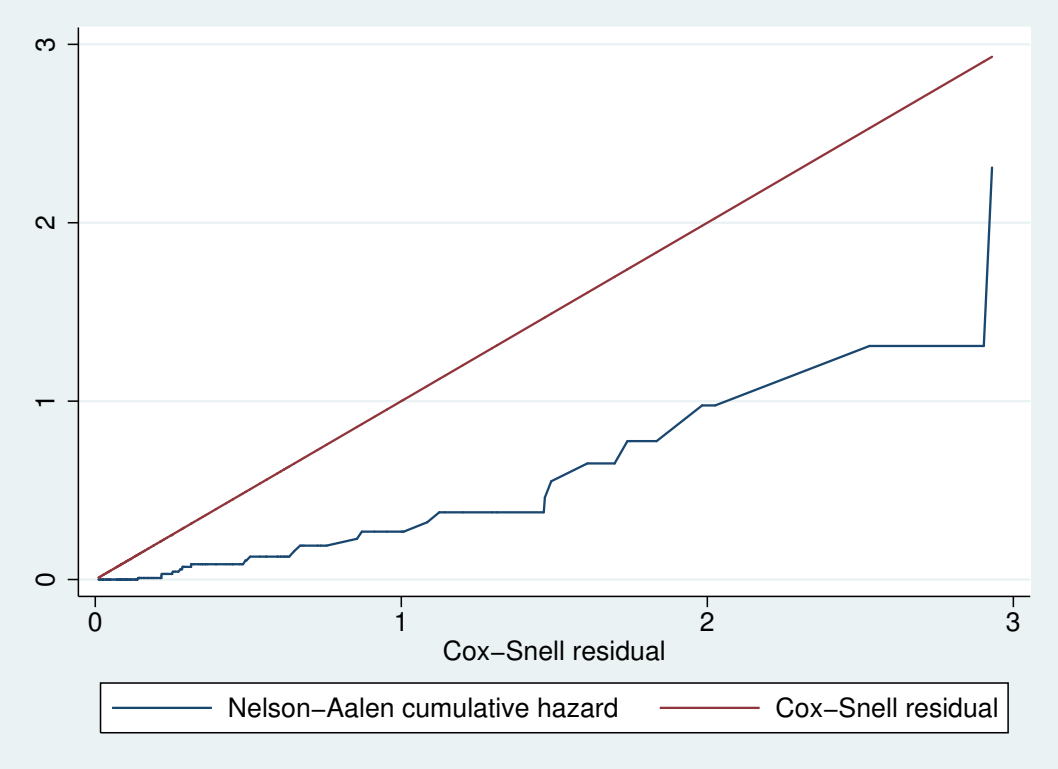


Fig. 3.18: *Plot of Goodness of Fit: Persistence of Civil War*

Bibliography

Achebe, C. (1988). *A Man of the People*, volume 31. Heinemann.

Achen, C. H. (1986). *The statistical analysis of quasi-experiments*. Univ of California Press.

Addison, T. (2005). *Agricultural development for peace*, volume 7.

Adler, R. F., Huffman, G. J., Chang, A., Ferraro, R., Xie, P.-P., Janowiak, J., Rudolf, B., Schneider, U., Curtis, S., Bolvin, D., et al. (2003). The version-2 global precipitation climatology project (gpcp) monthly precipitation analysis (1979-present). *Journal of hydrometeorology*, 4(6):1147–1167.

Agresti, A. (1999). Modelling ordered categorical data: recent advances and future challenges. *Statistics in medicine*, 18(17-18):2191–2207.

Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S., and Wacziarg, R. (2003). Fractionalization. *Journal of Economic growth*, 8(2):155–194.

Allison, P. D. (1984). *Event history analysis: Regression for longitudinal event data*. Number 46. Sage.

Andersen, P. K., Hansen, L. S., and Keiding, N. (1991). Non-and semi-parametric estimation of transition probabilities from censored observation of a non-homogeneous markov process. *Scandinavian Journal of Statistics*, pages 153–167.

Anderton, C. H. and Carter, J. R. *A Survey of Peace Economics*, volume 2.

Atran, S. (2015a). Isis is a revolution. *Aeon (15 December, 2015). https://aeon. co/essays/why-isis-has-the-potential-to-be-a-world-altering-revolution.*

Atran, S. (2015b). Seminar about terrorism at the "ecole normale superieure de cachan", paris 2015.

Atran, S. (2016). The devoted actor: unconditional commitment and intractable conflict across cultures. *Current Anthropology*, 57(S13):S000–S000.

Ayoob, M. (1995). *The third world security predicament: State making, regional conflict, and the international system*. L. Rienner Publishers.

Azam, J.-P. The redistributive state and conflicts in africa.

Azam, J.-P. (1996). How to pay for the peace? a theoretical framework with references to african countries. *Journal of Peace Research*.

Azam, J.-P. and Mesnard, A. (2003). Civil war and the social contract. *Public Choice*, 115(3-4):455–475.

Bagozzi, B. E. (2015). Forecasting civil conflict with zero-inflated count models. *Civil Wars*, 17(1):1–24.

Bagozzi, B. E., Hill, D. W., Moore, W. H., and Mukherjee, B. (2015). Modeling two types of peace the zero-inflated ordered probit (ziop) model in conflict research. *Journal of Conflict Resolution*, 59(4):728–752.

Balcells, L. and Justino, P. (2014). Bridging micro and macro approaches on civil wars and political violence issues, challenges, and the way forward. *Journal of Conflict Resolution*, 58(8):1343–1359.

Balch-Lindsay, D. and Enterline, A. J. (2000). Killing time: The world politics of civil war duration, 1820–1992. *International Studies Quarterly*, 44(4):615–642.

Balch-Lindsay, D., Enterline, A. J., and Joyce, K. A. (2008). Third-party intervention and the civil war process. *Journal of Peace Research*, 45(3):345–363.

Ballentine, K. (2003). *The political economy of armed conflict: Beyond greed and grievance*. Lynne Rienner Publishers.

Ballentine, K. and Nitzschke, H. (2003). Beyond greed and grievance: Policy lessons from studies in the political economy of armed conflict. *Security and Development: Investing in Peace and Prosperity*, page 164.

Bangura, A. K. and McCandless, E. (2007). Peace research for africa: Critical essays on methodology. *Published by the University for Peace, Africa Programme, Addisababa Ethiopia*.

Barrows, W. L. (1976). Ethnic diversity and political instability in black africa. *Comparative Political Studies*, 9(2):139.

Bates, R. H. et al. (1999). *Ethnicity, capital formation, and conflict*, volume 12. Weatherhead Center for International Affairs, Harvard University.

Bazenguissa-Ganga, R. (1999). The spread of political violence in congo-brazzaville. *African Affairs*, 98(390):37–54.

Bazzi, S. and Clemens, M. A. (2013). Blunt instruments: avoiding common pitfalls in identifying the causes of economic growth. *American Economic Journal: Macroeconomics*, 5(2):152–186.

Beck, T., Clarke, G., Groff, A., Keefer, P., and Walsh, P. (2001). New tools in comparative political economy: The database of political institutions. *the world bank economic review*, 15(1):165–176.

Benoit, K. (1996). Democracies really are more pacific (in general) reexamining regime type and war involvement. *Journal of Conflict Resolution*, 40(4):636–657.

Bensted, R. (2011). A critique of paul collier's 'greed and grievance'thesis of civil war. *African Security Review*, 20(3):84–90.

Berdal, M. (2003). How" new" are" new wars"? global economic change and the study of civil war. *Global Governance*, 9(4):477–502.

Berdal, M. and Malone, D. M. (2000). *GREED GRIEVANCE. Economic Agendas in Civil Wars.*

Berman, E. (2011). *Radical, religious, and violent: the new economics of terrorism.* MIT press.

Blattman, C. and Miguel, E. (2010). Civil war. *Journal of Economic Literature.*

Bleaney, M. and Dimico, A. (2011). How different are the correlates of onset and continuation of civil wars? *Journal of Peace Research*, 48(2):145–155.

Bridgman, B. (2008). Why are ethnically divided countries poor? *Journal of Macroeconomics*, 30(1):1–18.

Brinkerhoff, D. W. (2005). Rebuilding governance in failed states and post-conflict societies: core concepts and cross-cutting themes. *Public administration and development*, 25(1):3–14.

Brunnschweiler, C. N. and Bulte, E. H. (2009). Natural resources and violent conflict: resource abundance, dependence, and the onset of civil wars. *Oxford Economic Papers*, 61(4):651–674.

Buhaug, H. and Gates, S. (2002). The geography of civil war. *Journal of Peace Research*, 39(4).

Burt Alison, Hughes Barry, M. G. (2014). Eradicating poverty in fragile states: prospects of reaching the "high-hanging" fruit by 2030. *World Bank Policy Research Working Paper No. 7002.*

Calipel, S., Azam, J.-P., and Berthélemy, J.-C. (1996). Risque politique et croissance en afrique. *Revue économique*, (3):819–829.

Call, C. T. (2012). *Why peace fails: the causes and prevention of civil war recurrence.* Georgetown University Press.

Cameron, A. C. and Trivedi, P. K. (2005). *Microeconometrics: methods and applications.* Cambridge university press.

Carr-Hill, R. (2014). Measuring development progress in africa: the denominator problem. *Canadian Journal of Development Studies.*

Casasnovas, G. L. and Nicodemo, C. (2012). Transition probabilities and duration analysis among disability states: Some evidence from spanish data. *Barcelona GSE WP*, (643).

Caselli, F., Morelli, M., and Rohner, D. (2013). The geography of inter-state resource wars. Technical report, National Bureau of Economic Research.

Cederman, L.-E. and Girardin, L. (2007). Beyond fractionalization: Mapping ethnicity onto nationalist insurgencies. *American Political science review*, 101(01):173–185.

Cederman, L.-E., Wimmer, A., and Min, B. (2010). Why do ethnic groups rebel? new data and analysis. *World Politics*, 62(01):87–119.

Charness, G. and Rabin, M. (2002). Understanding social preferences with simple tests. *Quarterly journal of Economics*, pages 817–869.

Christian, K. (2015). Colonial military participation in europe (africa). *ternational Encyclopedia of the First World War.*

Ciccone, A. (2011). Economic shocks and civil conflict: A comment. *American Economic Journal: Applied Economics*, 3(4):215–227.

Cincotta, R. P., Engelman, R., and Anastasion, D. (2003). The security demographic: Population and civil conflict after the cold war. Technical report, DTIC Document.

Coghlan, B., Brennan, R. J., Ngoy, P., Dofara, D., Otto, B., Clements, M., and Stewart, T. (2006). Mortality in the democratic republic of congo: a nationwide survey. *The Lancet*, 367(9504):44–51.

Collier, P. (1998). The political economy of ethnicity. *Working Paper Oxford Economic Press*.

Collier, P. (1999). Doing well out of war. In *conference on economic agendas in civil wars, London*, volume 26, page 27.

Collier, P. (2000). Rebellion as a quasi-criminal activity. *Journal of Conflict Resolution*.

Collier, P. (2006a). Economic causes of civil conflict and their implications for policy. Oxford Economic Papers.

Collier, P. (2006b). Is aid oil? an analysis of whether africa can absorb more aid. *World development*, 34(9):1482–1497.

Collier, P. (2007). The bottom billion. *Oxford University Press*.

Collier, P. and Dominic, R. (2008). Democracy, development and conflict. *Journal of the European Economic Association*.

Collier, P. and Hoeffler, A. (1998). On economic causes of civil war. *Oxford economic papers*, 50(4):563–573.

Collier, P. and Hoeffler, A. (2004). Greed and grievance in civil war. *Oxford economic papers*, 56(4):563–595.

Collier, P. and Rohner, D. (2008). Democracy, development, and conflict. *Journal of the European Economic Association*, 6(2-3):531–540.

Cotet, A. M. and Tsui, K. K. (2013). Oil and conflict: What does the cross country evidence really show? *American Economic Journal: Macroeconomics*, 5(1):49–80.

Cox, D. R. (1972). mregression models and life tables (with discussion). *n Journal of the Royal Statistical Society, Series B*, 34(2).

Cragg, J. G. and Donald, S. G. (1993). Testing identifiability and specification in instrumental variable models. *Econometric Theory*, 9(02):222–240.

Cramer, C. (2002). Homo economicus goes to war: methodological individualism, rational choice and the political economy of war. *World development*, 30(11):1845–1864.

Cramer, C. (2006). *Civil War Is Not a Stupid Thing. Accounting for Violence in Developing Countries*.

Cramer, C. (2007). Violence in developing countries: War. *Memory, Progress*.

Cramer, C. (2011). Unemployment and participation in violence.

Cramer, C. and P., R. (2011). Violence and war in agrarian perspective. *Journal of Agrarian Change*.

Cunningham, K. G. and Weidmann, N. B. (2010). Shared space: Ethnic groups, state accommodation, and localized conflict1. *International Studies Quarterly*, 54(4):1035–1054.

d'Agostino, G., Dunne, J. P., and Pieroni, L. (2013). Military expenditure, endogeneity and economic growth.

Darwin, C. (1871). *The descent of man, and selection in relation to sex.*

Davenport, C., Armstrong, D., and Lichbach, M. (2005). Conflict escalation and the origins of civil war. In *annual meeting of the Midwest Political Science Association, Chicago, Illinois, USA*.

De Quervain, D. J., Fischbacher, U., Treyer, V., Schellhammer, M., et al. (2004). The neural basis of altruistic punishment. *Science*, 305(5688):1254.

Deriu, M., Tosolini, A., and Barbieri, D. (2005). *Dizionario critico delle nuove guerre*. Emi.

Devarajan, S. (2013a). Africa's statistical tragedy. *Review of Income and Wealth*, 59(S1):S9–S15.

Devarajan, S. (2013b). Africa's statistical tragedy. *Review of Income and Wealth, International Association for Research in Income and Wealth*.

Donatella, S. (2010). *Decolonizzazione e sviluppo economico. Dalla Cassa per la circolazionemonetaria della Somalia alla Banca nazionale somala: il ruolo della Banca d'Italia (1947-1960)*.

Donatella, S. (2012). *The Reasons for Underdevelopment. The Case of Decolonisation in Somaliland*.

Duffield, M. (1994). Complex emergencies and the crisis of developmentalism. *IDS bulletin*, 25(4):37–45.

Duffield, M. (1998). Post-modern conflict: Warlords, post-adjustment states and private protection. *Civil Wars*, 1(1):65–102.

Duffield, M. (2001). *Global Governance and the New Wars: The Merging of Development and Security*. Zed Books.

Duffield, M. (2002). War as a network enterprise: the new security terrain and its implications. *Cultural Values*, 6(1-2):153–165.

Dunne, J. P. (2006). After the slaughter: reconstructing Mozambique and Rwanda. *Economics of Peace Security Journal*.

Dunne, J. P. et al. (2006). After the slaughter: reconstructing mozambique and rwanda. *The Economics of Peace and Security Journal*, 1(2):39–46.

Dunne, J.-P. and Tian, N. (2006). The determinants of civil war and excess zeros. *Economics and Peace Security Journal*.

Dunne, J. P. and Tian, N. (2013). Military expenditure, economic growth and heterogeneity. *Defence and Peace Economics*.

Dunne, J. P. and Tian, N. (2015a). Conflict, Economic Growth and Spillover Effects in Africa Conflict. *Economics of Peace Security Journal*.

Dunne, J. P. and Tian, N. (2015b). Military expenditure, economic growth and heterogeneity. *Defence and Peace Economics*, 26(1):15–31.

d'Agostino, G., Dunne, J. P., and Pieroni, L. (2016). How much does military spending affect growth? causal estimates from the world's non-rich countries.

Elbadawi, I., Hegre, H., and Milante, G. J. (2008). The aftermath of civil war. *Journal of Peace Research*, 45(4):451–459.

Elbadawi, I. and Sambanis, N. (2002). How much war will we see? explaining the prevalence of civil war. *Journal of conflict resolution*, 46(3):307–334.

Ellingsen, T. (2000). Colorful community or ethnic witches' brew? multiethnicity and domestic conflict during and after the cold war. *Journal of Conflict Resolution*, 44(2):228–249.

Esteban, J. and Ray, D. (1999). Conflict and distribution. *Journal of Economic Theory*, 87(2):379–415.

Esteban, J.-M. and Ray, D. (1994). On the measurement of polarization. *Econometrica: Journal of the Econometric Society*, pages 819–851.

Fan, J. (1993). Local linear regression smoothers and their minimax efficiencies. *The Annals of Statistics*, pages 196–216.

Fan, J. and Gijbels, I. (1992). Variable bandwidth and local linear regression smoothers. *The Annals of Statistics*, pages 2008–2036.

Fan, J. and Gijbels, I. (1996). *Local polynomial modelling and its applications: monographs on statistics and applied probability 66*, volume 66. CRC Press.

Fearon, J. (2010). Governance and civil war onset. *World Devepolment Report*.

Fearon, J. D. and Laitin, D. D. (1996). Explaining interethnic cooperation. *American political science review*, 90(04):715–735.

Fearon, J. D. and Laitin, D. D. (1999). Weak states, rough terrain, and large-scale ethnic violence since 1945. pages 2–5.

Fearon, J. D. and Laitin, D. D. (2003). Ethnicity, insurgency, and civil war. *American political science review*.

Fearon, J. D. and Laitin, D. D. (2013). How persistent is armed conflict?

Fehr, E. and Schmidt, K. M. (1999). A theory of fairness, competition, and cooperation. *Quarterly journal of Economics*, pages 817–868.

Fiori, M. (2015). Il business delle specie rare che finanzia il terrorismo. *Limes 12/2015*.

Fortuna, G. (2015). E pluribus, multi: il caleidoscopio dei musulmani in nigeria. *Limes 12/2015*.

Frances Stewart, Holdstock Douglas, J. A. (2002). Root causes of violent conflict in developing countries. *British Medical Journal*.

French, E. (2005). The effects of health, wealth, and wages on labour supply and retirement behaviour. *The Review of Economic Studies*, 72(2):395–427.

Gallissot, R. (2001). Identità-identificazione. *Gallissot R., Kilani M., Rivera AM, L'imbroglio etnico in*, 14.

Galtung, J. (1996). *Peace by peaceful means: Peace and conflict, development and civilization*, volume 14. Sage.

Galtung, J. (2010). Peace studies and conflict resolution: the need for transdisciplinarity. *Transcultural Psychiatry*.

Garcia-Montalvo, J. and Reynal-Querol, M. (2004). Ethnic polarization, potential conflict, and civil wars. *Potential Conflict, and Civil Wars (July 2004)*.

Garfinkel, M. R. and Skaperdas, S. (2000). Conflict without misperceptions or incomplete information: how the future matters. *Journal of Conflict Resolution*.

Garfinkel, M. R. and Skaperdas, S. (2007). Economics of conflict: An overview. *Handbook of defense economics*, 2:649–709.

GATES, S., HEGRE, H., GISSINGER, R., and GLEDITSCH, N. P. (1997). Timing the changes in political structures: A new polity database.

Gates, S., Hegre, H., Jones, M. P., and Strand, H. (2006). Institutional inconsistency and political instability: Polity duration, 1800–2000. *American Journal of Political Science*, 50(4):893–908.

Gates, S., Hegre, H., Nygård, H. M., and Strand, H. (2010). Consequences of civil conflict. *Washington (District of Columbia): World Bank*.

Gleditsch, K. S. (2002). Expanded trade and gdp data. *Journal of Conflict Resolution*, 46(5):712–724.

Gleditsch, N. P., Hegre, H., and Strand, H. (2009). Democracy and civil war. *Handbook of War Studies III: The Intrastate Dimension*, pages 155–92.

Gleditsch, N. P., Wallensteen, P., Eriksson, M., Sollenberg, M., and Strand, H. (2002). Armed conflict 1946-2001: A new dataset. *Journal of peace research*, 39(5):615–637.

Goldstone, J. A., Bates, R. H., Epstein, D. L., Gurr, T. R., Lustik, M. B., Marshall, M. G., Ulfelder, J., and Woodward, M. (2010). A global model for forecasting political instability. *American Journal of Political Science*, 54(1):190–208.

Grenier, Y. (1996a). From causes to causers: the etiology of salvadoran internal war revisited. *The Journal of Conflict Studies*.

Grenier, Y. (1996b). From causes to causers: The etiology of salvadoran internal war revisited1. *Journal of conflict studies*, 16(2).

Grootaert, C. (1998). *Child labor in Cote d'Ivoire: incidence and determinants*, volume 1905. World Bank Publications.

Grossman, H. I. (1999). Kleptocracy and revolutions. *Oxford Economic Papers*, 51(2):267–283.

Gugliotta, A. (2008). *Nigeria, risorse di chi? Petrolio e gas nel Delta del Niger*.

Gurr, T. R. (1999). Minorities at risk dataset. *College Park, MD: Center for International Development and Conflict Management*.

Gurr, T. R. (2000a). Peoples versus states: Ethnopolitical conflict and accommodation at the end of the 20th century. *Institute of Peace Press*.

Gurr, T. R. (2000b). *Peoples versus states: Minorities at risk in the new century*. US Institute of Peace Press.

Haavelmo, T. (1954). *A Study in the Theory of Economic Evolution*.

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica: Journal of the Econometric Society*, pages 1251–1271.

Hegre, H. (2001). Toward a democratic civil peace? democracy, political change, and civil war, 1816–1992. In *American Political Science Association*, volume 95, pages 33–48. Cambridge Univ Press.

Hegre, H. (2003a). Democracy development conflict. *World Bank/PRIO*.

Hegre, H. (2003b). Disentangling democracy and development as determinants of armed conflict.

Hegre, H. (2004a). Disentangling democracy and development as determinants of armed conflict. *International Peace Research Institute Oslo (PRIO)*.

Hegre, H. (2004b). The duration and termination of civil war. *Journal of Peace Research*, 41(3):243–252.

Hegre, H., Buhaug, H., Calvin, K. V., Nordkvelle, J., Waldhoff, S. T., and Gilmore, E. (2016). Forecasting civil conflict along the shared socioeconomic pathways. *Environmental Research Letters*, 11(5):054002.

Hegre, H., Strand, H., Gates, S., and Nygard, H. M. (2011). The conflict trap. In *APSA 2011 Annual Meeting Paper*.

Henderson, E. A. (2000). When states implode: The correlates of africa's civil wars, 1950–92. *Studies in Comparative International Development*, 35(2):28–47.

Henderson, E. A. and Singer, J. D. (2000). Civil war in the post-colonial world, 1946-92. *Journal of Peace Research*.

Henderson, J. V., Shalizi, Z., and Venables, A. J. (2001). Geography and development. *Journal of Economic Geography*, 1(1):81–105.

Herbst, J. (2000a). Economic incentives, natural resources and conflict in africa. *Journal of African Economies*, 9(3):270–294.

Herbst, J. (2000b). *States and Power in Africa: Comparative Lessons in Authority and Control*.

Herrera, Y. M. and Kapur, D. (2007). Improving data quality: actors, incentives, and capabilities. *Political Analysis*, 15(4):365–386.

Hirshleifer, J. (1988). The analytics of continuing conflict. *Synthese*.

Hirshleifer, J. (1989). Conflict and rent-seeking success functions: Ratio vs. difference models of relative success. *Public Choice*.

Hirshleifer, J. (1991a). The paradox of power. *Economics Politics*.

Hirshleifer, J. (1991b). The technology of conflict as an economic activity. *The American Economic Review*, 81(2):130–134.

Hirshleifer, J. (1995a). Anarchy and its breakdown. *Journal of Political Economy*.

Hirshleifer, J. (1995b). Theorizing about conflict. *Handbook of defense economics*, 1:165–189.

Hirshleifer, J. (2001). *The dark side of the force: Economic foundations of conflict theory*. Cambridge University Press.

Hislope, R. (1998). Ethnic conflict and the" generosity moment". *Journal of Democracy*, 9(1):140–153.

Hobbes, T. (1651). *Leviathan.*

Holsti, K. J. and Holsti, K. (1996). *The state, war, and the state of war.* Cambridge Univ Press.

Hsiang, S. M., Burke, M., and Miguel, E. (2013). Quantifying the influence of climate on human conflict. *Science*, 341(6151).

Humphreys, M. (2005). Natural resources, conflict, and conflict resolution uncovering the mechanisms. *Journal of conflict resolution*, 49(4):508–537.

Håvard Hegre, G. O. and Raleigh, C. (2009). Poverty and Civil War Events. *Journal of Conflict Resolution.*

Håvard Hegre, Tanja Ellingsen, S. G. and Gleditsch, N. P. (2001). Toward a democratic civil peace? democracy, political change, and civil war, 1816-1992. *The American Political Science Review.*

Iannaccone, L. R. and Berman, E. (2006). Religious extremism: The good, the bad, and the deadly. *Public Choice*, 128(1-2):109–129.

Jeff, G. and Skocpol, T. (1989). Explaining revolutions in the contemporary.

Jerven, M. (2013a). Comparability of gdp estimates in sub-saharan africa: The effect of revisions in sources and methods since structural adjustment. *Review of Income and Wealth, International Association for Research in Income and Wealth.*

Jerven, M. (2013b). *Poor numbers: how we are misled by African development statistics and what to do about it.* Cornell University Press.

Jerven, M. and Johnston, D. (2015). Statistical tragedy in africa? evaluating the data base for african economic development. *The Journal of Development Studies*, 51(2):111–115.

Jonsson, J. (2007). *The overwhelming minority: traditional leadership and ethnic conflict in Ghana's northern region.* Centre for Research on Inequality, Human Security and Ethnicity Oxford.

Jung, J. (2006). Estimating markov transition probabilities between health states in the hrs dataset.

KALYVAS, S. (2006). The logic of violence in civil war. *International Affairs*, 82(6):1167–68.

Kalyvas, S. N. (2008). 16 promises and pitfalls of an emerging research program: the microdynamics of civil war. *Order, conflict, and violence*, 397.

Kalyvas, S. N., Shapiro, I., and Masoud, T. E. (2008). *Order, conflict, and violence.* Cambridge University Press Cambridge.

Kang, S. and Meernik, J. (2005). Civil war destruction and the prospects for economic growth. *Journal of Politics*, 67(1):88–109.

Karl, R., Sobek, D., et al. (2004). The dynamics of civil war duration and outcome. *Journal of Peace Research*, 41(3):303–320.

Keen, D. (2001a). Disqualifying grievance? a response to the collier/hoeffler model as an explanation for civil war. *Presented to CODEP Conference, School of Oriental and African Studies, London, June 18– 20.*

Keen, D. (2001b). *The political economy of war*. Oxford University Press.

Keen, D. (2008). Civil war is not a stupid thing: Accounting for violence in developing countries: Christopher cramer.

Keen, D. (2012). Greed and grievance in civil war. *International Affairs*, 88(4):757–777.

Kleibergen, F. and Paap, R. (2006). Generalized reduced rank tests using the singular value decomposition. *Journal of econometrics*, 133(1):97–126.

Kuran, T. (1989a). Sparks and prairie fires: A theory of unanticipated political revolution. *Public choice*, 61(1):41–74.

Kuran, T. (1989b). Sparks and prairie fires: A theory of unanticipated political revolution. *Springer*.

Lambert, D. (1992). Zero-inflated poisson regression, with an application to defects in manufacturing. *Technometrics*, 34(1):1–14.

le Pichon, T., on Drugs, U. N. O., Crime, Ctr, V. I., and Austria (2008). Drug trafficking as a security threat in west africa. *Vienna: United Nations Office on Drugs and Crime*.

Lejeune, M. and Sarda, P. (1992). Smooth estimators of distribution and density functions. *Computational Statistics & Data Analysis*, 14(4):457–471.

Liang, K.-Y., Zeger, S. L., and Qaqish, B. (1992). Multivariate regression analyses for categorical data. *Journal of the Royal Statistical Society. Series B (Methodological)*, pages 3–40.

Little, K. (2013). *Urbanization as a social process: an essay on movement and change in contemporary Africa*. Routledge.

Long, J. (1997). *Regression Models for Categorical and Limited Dependent Variables*. Advanced Quantitative Techniques in the Social Sciences. SAGE Publications.

Luard, N. (1989). *Gondar*.

Lucima, O. (2002). Protracted conflict, elusive peace: Initiatives to end the violence in northern uganda (london: Conciliation resources, 2002, 100pp.).

Lujala, P., Gleditsch, N. P., and Gilmore, E. (2005). A diamond curse? civil war and a lootable resource. *Journal of Conflict Resolution*, 49(4):538–562.

Masto, R. (2011). *Buongiorno Africa: tra capitali cinesi e nuova società civile*. Bruno Mondadori.

Mathoulin-Pelissier, S., Gourgou-Bourgade, S., Bonnetain, F., and Kramar, A. (2008). Survival end point reporting in randomized cancer clinical trials: a review of major journals. *Journal of Clinical Oncology*, 26(22):3721–3726.

McBride, M. and Richardson, G. (2012a). Religion, conflict, and cooperation. *The Oxford Handbook of the Economics of Peace and Conflict*, page 110.

McBride, M. and Richardson, G. (2012b). Stopping suicide attacks: optimal strategies and unintended consequences. *Defence and Peace Economics*, 23(5):413–429.

McCandless, E. and Karbo, T. (2015). *PEACE, CONFLICT, AND DEVELOPMENT IN AFRICA: A READER*.

Menocal, A. R. (2010). State building for peace. *a new paradigm for international engagement in post-conflict fragile states.*

Miguel, E. and Satyanath, S. (2011). Re-examining economic shocks and civil conflict. *American Economic Journal: Applied Economics*, 3(4):228–232.

Miguel, E., Satyanath, S., and Sergenti, E. (2004). Economic shocks and civil conflict: An instrumental variables approach. *Journal of political Economy*, 112(4):725–753.

Milliken, J. and Krause, K. (2002). State failure, state collapse, and state reconstruction: concepts, lessons and strategies. *Development and change*, 33(5):753–774.

Mira, A. N. (1964). Atlas of the peoples of the world. *Moscow: Glavnoe Upravlenie Geodezii i Kartografii.*

Montalvo, J. G. and Reynal-Querol, M. (2005). Ethnic diversity and economic development. *Journal of Development economics*, 76(2):293–323.

Morelli, M. and Rohner, D. (2015). Resource concentration and civil wars. *Journal of Development Economics*, 117:32–47.

Mousseau, M., Hegre, H., and O'neal, J. R. (2003). How the wealth of nations conditions the liberal peace. *European Journal of International Relations*, 9(2):277–314.

Mukherjee, B. E. B. . D. W. H. . W. H. M. . B. (2015). Modeling two types of peace: The zero-inflated ordered probit (ziop) model in conflict research. *Journal of Conflict Resolution.*

Nachtergaele, F., van Velthuizen, H., Verelst, L., Batjes, N., Dijkshoorn, K., van Engelen, V., Fischer, G., Jones, A., Montanarella, L., Petri, M., et al. (2008). Harmonized world soil database. *Food and Agriculture Organization of the United Nations.*

Nathan, L. (2008). The causes of civil war: the false logic of collier and hoeffler. *South African Review of Sociology*, 39(2):262–275.

Ngaruko, F. and Nkurunziza, J. D. (2000). An economic interpretation of conflict in burundi. *Journal of African economies*, 9(3):370–409.

Nkurunziza, J. D. (2008). Civil war and post-conflict reconstruction in africa. In *United Nations Conference on Trade and Development, Geneva.*

Nkurunziza, J. D. and Ngaruko, F. (2005).

North, D. C. (1990). *Institutions, institutional change and economic performance.* Cambridge university press.

North, D. C. (1993). Toward a theory of institutional change. *Political economy: Institutions, competition, and representation*, 31(4):61–69.

North, D. C., Wallis, J. J., and Weingast, B. R. (2009). *Violence and social orders: a conceptual framework for interpreting recorded human history.* Cambridge University Press.

Ohlson, T. (2008). Understanding Causes of War and Peace. *Eurean Journal International Relations.*

Olson, M. (1982). *The rise and decline of nations: Economic growth, stagflation, and economic rigidities.* Yale University Press, New Haven and London.

Olsson, O. and Fors, H. C. (2004). Congo: The prize of predation. *Journal of Peace Research*, 41(3):321–336.

ORGANISATION, N. A. T. (2003). Urban operations in the year 2020.

Outlook, A. E. (2012). Promoting youth employment. *a publication of AfDB*.

Page, P. (2002). Final report of the panel of experts on the illegal exploitation of natural resources and other forms of wealth of the democratic republic of the congo. *Change*, 1(11):4.

Pagliani, G. (2004). *Il mestiere della guerra: dai mercenari ai manager della sicurezza*, volume 65. FrancoAngeli.

Palumbo, M. G. (1999). Uncertain medical expenses and precautionary saving near the end of the life cycle. *The Review of Economic Studies*, 66(2):395–421.

Paxson, C. H. (1992). Using weather variability to estimate the response of savings to transitory income in thailand. *The American Economic Review*, pages 15–33.

Peace, R. M. (1999). *Surface Tension: Place/poverty/policy: from" poverty" to" social Exclusion": Implications of Discursive Shifts in European Union Poverty Policy, 1975-1999*.

Pepino, D. (2009). Delta in rivolta, suggerimenti da una "insurrezione asimmetrica". *Centro di documentazione Porfido, Torino*.

Pettersson, T. and Wallensteen, P. (2015). Armed conflicts, 1946-2014. *Journal of Peace Research*.

Raknerud, A. and Hegre, H. (1997). The hazard of war: Reassessing the evidence for the democratic peace. *Journal of Peace Research*, 34(4):385–404.

Raleigh, C. and Hegre, H. (2005). Introducing acled: An armed conflict location and event dataset (selection of acled maps). paper presented to the conference on disaggregating the study of civil war and transnational violence, university of california institute of global conflict and cooperation, san diego, ca.

Raleigh, C. and Jordan, L. (2010). Climate change and migration: emerging patterns in the developing world. *Social dimensions of climate change*, page 103.

Ramsey, J. B. (1969). Tests for specification errors in classical linear least-squares regression analysis. *Journal of the Royal Statistical Society. Series B (Methodological)*, pages 350–371.

Rao, C., Bradshaw, D., and Mathers, C. D. (2004). Improving death registration and statistics in developing countries: Lessons from sub-saharan africa. *Southern African Journal of Demography*, pages 81–99.

Reynal-Querol, M. (2002). Ethnicity, political systems, and civil wars. *Journal of Conflict Resolution*, 46(1):29–54.

Richar Cincotta, R. E. and Anastasion, D. (2003). *The security demographic: Population and civil conflict after the Cold War*.

Richardson, L. F. (1960). {Statistics of Deadly Quarrels}.

Ross, M. (2003). Oil, drugs, and diamonds: How do natural resources vary in their impact on civil war. *The political economy of armed conflict: Beyond greed and grievance*, pages 47–67.

Ross, M. (2006). A closer look at oil, diamonds, and civil war. *Annual Review of Political Science*.

Ross, M. L. (2004). What do we know about natural resources and civil war? *Journal of peace research*, 41(3):337–356.

Rotberg, R. I. (2002). The new nature of nation-state failure. *Washington Quarterly*, 25(3):83–96.

Rothenberg, T. J. (1984). Approximating the distributions of econometric estimators and test statistics. *Handbook of econometrics*, 2:881–935.

Salehyan, I. (2014). Climate change and conflict: making sense of disparate findings.

Sambanis, N. (2002). A review of recent advances and future directions in the quantitative literature on civil war. *Defence and Peace Economics*.

Sambanis, N. (2004a). Poverty and the organization of political violence. 2004(1):165–211.

Sambanis, N. (2004b). What is civil war? conceptual and empirical complexities of an operational definition. *Journal of conflict resolution*, 48(6):814–858.

Sawyer, A. (2004a). Social capital, survival strategies and their implications for post-conflict governance in liberia. *Unpublished paper*.

Sawyer, A. (2004b). Violent conflicts and governance challenges in west africa: the case of the mano river basin area. *The Journal of Modern African Studies*, 42(03):437–463.

Sawyer, M. and Arestis, P. (2005). Aggregate demand, conflict and capacity in the inflationary process. *Cambridge Journal of Economics*.

Sawyer, R. D., Sawyer, M., et al. (2005). *The essential art of war*. Basic Books.

Schedler, A. and Mudde, C. (2010). Data usage in quantitative comparative politics. *Political Research Quarterly*, 63(2):417–433.

Schlichte, K. (1994). Is ethnicity a cause of war? *Peace Review*, 6(1):59–65.

Sen, A. et al. (1999). Commodities and capabilities. *OUP Catalogue*.

Sheikh, H., Gómez, Á., and Atran, S. (2016). Empirical evidence for the devoted actor model. *Current Anthropology*, 57(S13):S000–S000.

Singer, J. D. (1979). *The Correlates of War, Vol. I, Research Origins and Rationale*.

Singer, J. D. and Associates (1979). *Explaining War: Selected Papers from the Correlates of War Project*.

Skaperdas, S. (2006). Bargaining versus fighting. *Defence and Peace Economics*, 17(6):657–676.

Skocpol, T. (1979). *States and social revolutions: A comparative analysis of France, Russia and China*. Cambridge University Press.

Small, M. and Singer, J. D. (1979). Conflict in the international system, 1816-1977: Historical trends and policy futures. *Explaining War: Selected Papers from the Correlates of War Project*.

Spalding, N. (2000). A cultural explanation of collapse into civil war: Escalation of tension in nigeria. *Culture & Psychology*, 6(1):51–87.

STAIGER, D. and STOCK, J. (1997). Instrumental variables regression with weak instruments. *Econometrica*, 65(3):557–586.

Stedman, S. J. (1996). Conflict and conciliation in sub-saharan africa. *CSIA STUDIES IN INTERNATIONAL SECURITY*, pages 235–266.

Stewart, F. (2002). Horizontal inequalities as a source of conflict. *From Reaction to Prevention: Opportunities for the UN System*, pages 105–136.

Stewart, F. (2004). Development and security. *Conflict, Security & Development*, 4(3):261–288.

Stock, J. H. and Yogo, M. (2005). Testing for weak instruments in linear iv regression. *Identification and inference for econometric models: Essays in honor of Thomas Rothenberg*.

Strangio, D. (2010). *Decolonizzazione e sviluppo economico: dalla Cassa per la circolazione monetaria della Somalia alla Banca nazionale somala: il ruolo della Banca d'Italia, 1947-1960*. FrancoAngeli.

Strangio, D. (2012). Analysis of the economic system of somalia. In *The Reasons for Underdevelopment*, pages 39–74. Springer.

Suhrke, A., Villanger, E., and Woodward, S. L. (2005). Economic aid to post-conflict countries: a methodological critique of collier and hoeffler: Analysis. *Conflict, Security & Development*, 5(3):329–361.

Therborn, G. (2004). *African families in a global context*. Number 131. Nordic Africa Institute.

Thürer, D. (1999). The "failed state" and international law. *Revue Internationale de la Croix-Rouge/International Review of the Red Cross*, 81(836):731–761.

Tony Addison, G. M. a. M. (2005). Aid to africa: an unfinished agenda. *Journal of International Development*.

••

Touadi, J.-L. (2015). Le guerre invisibili del congo. *Limes 12/2015*.

Treier, S. and Jackman, S. (2008). Democracy as a latent variable. *American Journal of Political Science*, 52(1):201–217.

Tukey, J. W. (1949). One degree of freedom for non-additivity. *Biometrics*, 5(3):232–242.

UNICEF et al. (2008). Strengthening birth registration in africa: opportunities and partnerships. *PDF). www. unicef. org/esaro/Technical_ paper_ low_ res_ . pdf*.

Valsecchi, G. C. N.-P. and Calchi Novati, G. (2005). Africa, la storia ritrovata: dalle prime forme politiche alle indipendenze nazionali. *Roma, Carocci editore*.

Van Reybrouck, D. (2012). *Congo, une histoire*. Éditions Actes Sud.

Verbeek, M. (2004). *A guide to modern econometrics*. John Wiley & Sons.

Verwimp, P., Justino, P., and Brück, T. (2009). The analysis of conflict: A micro-level perspective. *Journal of Peace Research*, 46(3):307–314.

Vogt, M., Bormann, N.-C., Rüegger, S., Cederman, L.-E., Hunziker, P., and Girardin, L. (2015). Integrating data on ethnicity, geography, and conflict: The ethnic power relations data set family. *Journal of Conflict Resolution*, 59(7):1327–1342.

Von Bortkiewicz, L. (1898). *Das Gesetz der kleinen Zahlen*. BG Teubner.

Von Clausewitz, C. and Graham, J. J. (1873). *On war*, volume 1. London, N. Trübner & Company.

Vuong, Q. H. (1989). Likelihood ratio tests for model selection and non-nested hypotheses. *Econometrica: Journal of the Econometric Society*, pages 307–333.

Weinstein, J. M. (2005). Resources and the information problem in rebel recruitment. *Journal of Conflict Resolution*, 49(4):598–624.

Wezeman, P. D. and Wezeman, S. T. (2015). *Trends In international arms transfers, 2014*. SIPRI.

Wilkinson, D. O. (1980). *Deadly quarrels: Lewis F. Richardson and the statistical study of war*. Univ of California Press.

Wood, E. J. (2006). The ethical challenges of field research in conflict zones. *Qualitative Sociology*, 29(3):373–386.

Woods, D. (2014). The use, abuse and omertà on the "noise" in the data: African democratisation, development and growth. *Canadian Journal of Development Studies / Revue canadienne d'études du développement*, 35(1):120–135.

Wooldridge Jeffrey, M. (2002). Econometric analysis of cross section and panel data. *Cambridge, MA: Massachusetts Institute of Technology*.

Wucherpfennig, J., Weidmann, N. B., Girardin, L., Cederman, L.-E., and Wimmer, A. (2011). Politically relevant ethnic groups across space and time: Introducing the geoepr dataset. *Conflict Management and Peace Science*, 28(5):423–437.