CLIMATE CHANGE AND CONFLICT:
IDENTIFYING THE MECHANISMS

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ABSTRACT

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Climate change will lead to massive conflicts, according to claims of such prominent sources as Sir Nicholas Stern and the US National Security Agency - claims repeated by the media. Efforts to tease a specific climate change signal from historical records of civil conflict have proved inconclusive, however: they postulate that farmers will become fighters when resources become critically scarce; but they have been unable to illuminate what specific mechanisms may be involved. Yet the potential for climate change to cause significant civil conflict seems intuitively obvious, and the need for better understanding remains urgent. My research focuses on sub-Saharan Africa, the most conflict-prone region in the world; and it asks what factors make some countries erupt in civil conflict, while others do not. I find that drops in agricultural exports diminish government capacity as tax revenues shrink, leading to an increase in the risk of civil conflict. Thus, government capacity to provide security and services is likely to become weak just at the time when climate change is increasing the need for both. How governments respond will determine the risk of civil conflict, but this research shows that their capacity to respond will, in fact, also be affected. The implications of these conclusions apply beyond sub-Saharan Africa, and begin to move the debate from questions around *if* climate change will cause conflict to more productive discussions of *how* climate change may affect conflict risk.

In Chapter 1, I review the literatures upon which I will be drawing through the rest of this dissertation, including the civil conflict literature, the environmental security literature, and offer a very brief review of some relevant climate change implications. The preponderance of climate change and conflict literature begins by looking at the consequences of climate change: sea level rise, increased droughts, flooding, and extreme events. In reviewing the civil conflict and environmental security literature, a

few conclusions emerge. The most obvious issue is that the environmental security literature is poorly linked to civil conflict literature, or even to social conflict literature, and this has persisted as the focus has shifted to climate change as the main environmental concern. Second, the mechanisms through which climate change might affect conflict risk are not understood. Much of the research has examined questions of if and how climate change itself causes conflict, rather than determining how climate change might affect other relevant risk factors. This chapter provides the foundation for my interest in this topic, as the disconnect between these different literatures highlights the challenges of analyzing spatially and temporally dependent phenomenon, like conflict and climate.

To begin to understand the mechanisms that cause civil conflict, I start by looking at what affects civil conflict, specifically in sub-Saharan Africa. Chapter 2 shows why the usual explanatory variables fail to explain the pervasive conflict on the African continent: previous work has concentrated on factors that emerge as significant at the global level, such as poverty (as measured by GDP). The key question then is: if not opportunity or changes in GDP, what *does* prompt conflict in sub-Saharan Africa? This work focuses on the role of government capacity in determining conflict risk, using measures of government revenue as a proxy for government capacity. The main findings demonstrate that government revenues have a consistently significant effect on conflict onset, and are better able to explain conflict onset in sub-Saharan Africa than measures such as GDP, or oil dependence.

To understand what affects government revenue, and thereby civil conflict, in sub-Saharan Africa, I analyzed the relationship between agriculture and government revenue in sub-Saharan Africa in Chapter 3. Agriculture plays a critical role in sub-Saharan African economies, often accounting for a quarter or more of GDP, and three-quarters of employment. Yet the agricultural sector is often discounted in its importance to government revenues and capacity. In this chapter, I distinguish between export crops and the broader agricultural sector to analyze how agricultural

exports affect government revenue in the region. I argue that while a large agricultural sector may result in lower government revenues, agricultural exports are typically of higher-value, and pass through customs-collection points, and have a positive effect on government revenue. The distinction between agricultural exports and subsistence agriculture is important for understanding how the effects of climate change are likely to impact the agricultural sector directly, and government capacity indirectly.

In Chapter 4, I develop a framework for linking climate change to conflict that requires researchers to be specific about the specific climate change impact of concern, and identify the temporal and spatial implications of those effects. I build on the results of the previous two chapters to demonstrate how this framework could be applied to understand how temperature increases in sub-Saharan Africa may increase the risk of conflict through the effects on agricultural exports and government revenues. I use coffee in Uganda as one simple example of the framework that shows how a changing climate could dramatically affect government capacity. The real strength of this approach is that it emphasizes the mechanisms that link climate to social, economic and political outcomes, highlighting potential opportunities for interventions that will improve resiliency and reduce the vulnerability of those most at risk of negative outcomes as a result of climate change.

Taken as a whole, the results of this dissertation offer a promising new approach for how researchers think about linking climate change and conflict. The emphasis is on the intermediate mechanisms, with careful attention paid to the specific impacts of climate change, and the distinct spatial and temporal implications of those effects. This research has focused on the regional level, and identified a number of areas where closer, sub-regional and sub-national analysis will further clarify what specific mechanisms are at work.

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"Find something you're passionate about and keep tremendously interested in it."
- Julia Child

It is not possible to complete a dissertation unless you are both passionate about, and interested in the topic. Finishing this dissertation also required support and encouragement from a number of people to whom I owe an enormous debt of gratitude.

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Introduction

Over the last several years, climate change has become a focus of concern for more than just environmentalists: security and military analysts have also begun to factor climate change into their threat assessments. The result has been frequent statements in the media and policy papers about the increased risk of global war and civil conflict that climate change will bring. These assertions are made with very little empirical support for a relationship between any environmental factors and civil conflict, however, making it difficult to predict if, where and when a changed climate might lead to civil conflict.

Academic research recently has begun to explore the potential relationship between climate change and civil conflict, with mixed results. Much of this research has focused on teasing out a signal from historical temperature or rainfall data, and linking it to civil conflict. The results have been mixed, and have sparked a number of debates about the appropriate methodology, the correct definition of civil conflict, the distinction between examining conflict onset (the year in which a conflict begins) and conflict incidence (whether or not there is a conflict ongoing in a given year), and the correct climate variable(s) to use. What has been missing from these debates is an investigation into the mechanisms through which climate change may affect civil conflict. The present research begins to address that gap by proposing a framework that encourages research into mechanisms, in addition to effects on economic livelihoods, and provides empirical support for at least one supplementary pathway from climate change to conflict: the effect of agricultural exports on government capacity.

Previous research has asked the question of *if* there is a link between climate factors, such as temperature, and either the onset or incidence of civil conflict; but it has largely ignored the potential mediating mechanisms through which conflict might be affected. This approach makes it empirically difficult to tease out a climate signal,

and also prompts questions about how societies may adapt in the face of a changed climate, versus how they react to any given hot, or dry year. Without understanding what aspects of a society are affected by the consequences of climate change, and how those factors are linked to conflict risk, it is difficult to imagine how a society might prepare for a changing climate in ways that mitigate the risk of conflict. In this dissertation I tackle the question of *how* climate change may affect the risk of civil conflict onset in sub-Saharan Africa in four stand-alone papers that, taken together, trace a causal relationship from climate change to civil conflict.

In the first chapter I review the existing literature on environment and civil conflict, and how that research has evolved as climate change has become the central concern. This review demonstrates that there is a continuing disconnect between the civil conflict research, particularly that which focuses on large-N quantitative analysis, and research that attempts to link environmental factors and conflict. The division between the factors cited in the civil conflict literature and those cited in the environmental conflict literature is stark. Whereas the environmental security research postulates migration as a sure route to civil, and even interstate conflict, it is barely mentioned in the civil conflict literature, which instead focuses on the opportunities for rebels to mobilize against the state. Insofar as the climate change and conflict literature does build on prior work in political science, it has focused exclusively on the effect of climate change on economic livelihoods, and makes the strong assumption that other factors will be affected only indirectly through effects on economic livelihoods.

The first step in moving beyond a focus on economic livelihoods as the primary pathway to conflict is to identify additional factors that are important in determining conflict risk. In the second chapter I address a gap in the civil conflict literature: the role of the state in civil conflict. In this paper I focus on sub-Saharan Africa, for two reasons. The first is that this region is the locus of many current conflicts, while many other sub-Saharan African countries have emerged from conflict only recently, and

remain at risk of returning to conflict. The second reason I confine my study to sub-Saharan Africa is its vulnerability to climate change, and particularly to changes in temperature and precipitation that are likely to be felt in the near future, before there is much time for societies to adapt and respond. In this piece I test for the effect of government capacity on civil conflict risk in sub-Saharan Africa, using four distinct measures that capture different aspects of a government's ability to collect revenue. I find that lower levels of revenue collection lead to a higher risk of conflict. This is an important contribution to the civil conflict literature, as few of the other factors that are usually linked to conflict have been found to be significant in sub-Saharan Africa – even poverty, as measured by GDP per capita is not significant. These results suggest that government capacity plays an important role in determining conflict risk, which has been under-examined thus far. They also suggest that it is important to identify regional risk factors, as they may vary from the factors that seem important at the global scale. Understanding regional factors is particularly important when considering the additional risks posed by climate change, which will also vary at regional, national and local levels. Sea-level rise, for instance, will not pose a significant threat for most of sub-Saharan Africa, while it is an existential threat to a country like Bangladesh or the Maldives. Temperature increases, on the other hand, create an imminent threat for a number of countries in sub-Saharan Africa, which rely on crops that are sensitive to changes in temperature, and water availability, to the extent it is linked to temperature.

The potential negative effects of temperature increases, or changes in precipitation patterns on agriculture, and particularly cereal crops, have been explored in depth, and in multiple ways. In the civil conflict and climate literature, it is assumed that these negative effects on cereal and subsistence crops will be translated into conflict risk through their effects on economic livelihoods – depressing farmers' incomes and thereby increasing their incentives to join rebel groups. Yet, in many sub-Saharan African countries, export crops such as coffee and cocoa provide a large portion of rural employment. Decreasing productivity in these crops will have not only a

negative effect on economic livelihoods, but, as I show in this paper, will depress government revenues as well, thereby creating an additional pathway to conflict. I use variation in the total value of agricultural exports to show the effect on government revenue, and find that when agricultural exports are accounted for separately from the agricultural sector as a whole, they exert a strong positive effect on government revenue. Distinguishing between the agricultural sector as a whole, and agricultural exports, including some processed agricultural goods, provides insight into how the agricultural sector relates to the economy in ways beyond simple calculations based on the idea of subsistence farmers.

I build on the previous two empirical chapters in the final chapter, in which I propose expanding the framework for considering how climate change may affect civil conflict, to include the potential effects of specific climate change consequences on multiple pathways to conflict. I illustrate how using this framework could improve research by providing evidence from the empirical work in the dissertation to build a case for a pathway from civil conflict, back through government revenue to agricultural exports. Using Uganda as an example, I argue that the potential effects of climate change on agricultural exports, and coffee in particular, may have a strong negative effect on government capacity that is separate from, and in addition to, any potential economic effects. The negative effect on government revenues wrought by climate change consequences are likely to diminish the capacity of governments to respond to security threats, just as other mechanisms are increasing the risk of security threats. These conclusions argue for a more holistic and considered approach to the idea of climate change and conflict, as multiple pathways will be engaged simultaneously. Focusing on the effect of climate change consequences on economic livelihoods, to the exclusion of other effects, may lead to interventions that do not adequately account for the potential effect on government capacity, at a time when government capacity is likely to become both more needed and more stressed.

Questions about whether climate change will cause conflict have led to massive speculation and strong assertions designed to create a sense of urgency for actions to mitigate the consequences of climate change. The answers to these questions, however, have proven unsatisfactory at best. Understanding how the consequences of climate change relate to the risk of conflict, however, begins to illuminate how factors that increase the risk of conflict are likely to be affected by changes in climate.

Chapter 1: What do we know about climate change and civil conflict?

1.1 Introduction

Understanding the causes of civil conflict is a question that has occupied researchers for years. Recently, the potential for climate change to increase the risk of conflict has prompted a new debate of how environmental factors affect conflict. The nascent research on this proposed relationship is evolving rapidly as new methods are employed and more data are collected, yet the theoretical underpinnings of the research remain weak. The main goal of this paper is to briefly review the civil conflict literature and how the environmental security literature has evolved as climate change has become the central environmental issue. While the civil conflict literature has not been able to conclusively determine the causes of conflict, the environmental security literature is undermined by its lack of engagement with traditional security research.

The preponderance of climate change and conflict literature begins by looking at the consequences of climate change: sea level rise, increased droughts, flooding, and extreme events. The hypotheses most common in the literature are that these effects will lead to conflict directly, through resource scarcity and migration (Homer-Dixon 1994); (Kahl 2006); (Reuveny 2007); (Suhrke 1997) or indirectly, through effects on social, political and economic systems (Miguel et al. 2004); (Hendrix and Glaser 2007); (Hendrix and Salehyan 2010); (Meier et al. 2007). Neo-Malthusian arguments that posit an increase in resource scarcity and migration as a result of environmental degradation and climate change are cited as causal mechanisms in work by Homer-Dixon (Homer-Dixon 1994), and Kahl (Kahl 2006), among others (Kaplan 1994); (Kennedy et al. 1998); (Nordås and Gleditsch 2007). These conclusions have been disputed in the political science and economic literature that relies on large-N quantitative analysis (Fearon and Laitin 1999); (Collier and Hoeffler 1998); (Gleditsch 1998); (Buhaug 2010) – in part because scholars in political science and economics

feel that those looking for a link between conflict and the environment have tended to privilege environmental factors to the exclusion of other explanatory variables, such as economic growth rates or insurgent financing opportunities. Yet despite some notable recent exceptions (Bernauer et al. 2010) (Hendrix and Salehyan 2010); (Miguel et al. 2004), conflict scholars have dismissed the potential relationship between climate change and conflict without considering how climate change might affect the intermediating risk factors that have been identified in the conflict literature.

In reviewing the civil conflict and environmental security literature, a few conclusions emerge. The most obvious issue is that the environmental security literature is poorly linked to civil conflict literature, or even to social conflict literature, and this has persisted as the focus has shifted to climate change as the main environmental concern. Second, the mechanisms through which climate change might affect conflict risk are not understood. Much of the focus has been on the effect that temperature or precipitation changes will have on economic livelihoods, although it is unclear how an effect on livelihoods translates into conflict risk: through making joining a rebellion more enticing for poor farmers; through increasing conflict over the remaining resources; through forcing migration and causing tension in the destination area; or through exacerbating grievances against a government that is poorly equipped to respond? In order to understand the potential for climate change to add to conflict risk it will be important to identify not only *if* there is an effect, but *how* that effect may lead to conflict. This issue is closely related to the third concern with the climate change and conflict literature: while it is generally understood that climate change will act as a multiplier of other extant factors, much of the research has examined questions of if and how climate change itself causes conflict, rather than determining how climate change might affect other relevant risk factors. Finally, both the civil conflict literature and environmental security literature will be well-served by the increased attention to sub-national data and how local issues affect security.

This paper will first review the conflict literature, and how it can contribute to the climate and security debate. I will then outline the history of the environment and security debate, in order to highlight how disconnected it has been from the more traditional conflict research. Next, I discuss the various impacts of climate change, and how they are (or are not) relevant to the debate about security. I conclude with suggestions for improving the environmental security literature.

1.2 What is conflict, and why does it happen?

In order to understand if and how climate change might affect the onset of violent conflict, it is first necessary to examine our understanding of conflict itself. One of the hurdles in the field of conflict research is to understand how various authors define "conflict," and specifically, civil conflict. The need for a precise definition arises from the need to code data and create datasets for quantitative analysis. Two main datasets are used most commonly in quantitative approaches to conflict study: the Correlates of War project (COW) and the Uppsala Conflict Data Program (UCDP), maintained in collaboration with the Peace Research Institute of Oslo (PRIO). The COW definition requires that the national government be an active participant in the conflict; that there are 1,000 battle-deaths per year, on average; that there is effective resistance by both sides; and that the conflict takes place within the national territory (Small and Singer 1982), revised (Sarkees 2000). UCDP/PRIO defines civil war similarly: the state is one of the parties involved; there is an opposition organization; the incompatibility is over control of the government or territory; and there is a minimum of 25 battle-deaths per year, on each side of the conflict (Gleditsch et al. 2002; Harbom and Wallensteen 2007). The obvious difference in these two definitions is the minimum number of battle-deaths required to meet the conflict definition. What is less apparent -- but vital to understanding the relationship between climate and conflict -- is that the difference in battle-death thresholds in the two data sets results in *significant* differences in the dates imputed for the onset of conflict. Sambanis has looked at the multiple definitions that are used, and noted that there is very little overlap in the conflict datasets, particularly with respect to conflict start dates (Sambanis 2004c); and this has dramatic implications for conclusions

drawn about what *causes* civil wars to start. For example, Fearon and Laitin used the COW dataset with the 1,000 battle-death threshold, and defined the year of onset as the first year in which 100 battle-deaths were reached (Fearon and Laitin 1999); Miguel, et.al. used the UCDP/PRIO dataset and the 25 battle-death threshold (Miguel et al. 2004); while Burke, et.al., used the UCDP/PRIO dataset, but defined onset as the first year in which the 1,000 battle-death threshold was reached (Burke 2009). It is not surprising that their results differ!

Nonetheless, this research has consistently shown that there are certain variables that do increase conflict risk, as will be described below. A critical next step will be to understand how these variables relate to the causal mechanisms that affect both environment and conflict.

Economic Causes of Conflict

Among the most consistent findings to emerge from the study of civil conflict is that both a low level of GDP, and a low economic growth rate are significant predictors of conflict risk (Collier and Hoeffler 1998); (Fearon and Laitin 1999); (Blomberg and Hess 2002); (Miguel et al. 2004); (Goldstone et al. 2005); (Sambanis 2004b); (Collier 2006). One common argument to explain this finding is that low levels of GDP and/or slow economic growth indicate a lack of opportunity for legitimate employment, prompting people to take up arms (Miguel et al. 2004); (Collier and Hoeffler 1998); (Collier 2006, 2004). Others use the same variable to proxy for government capacity. Essentially, according to the economic line of reasoning, people are faced with the choice to fight or to farm, and will choose to fight when the expected gains from fighting and looting are sufficiently greater than those that they would receive from working the land. This finding has been remarkably consistent in both cross-national empirical studies (such as those done in Collier and Hoeffler's work, and research by Fearon and Laitin), and in country-specific analysis. Dube and Vargas, for example, found that drops in the price of coffee – the major cash crop in Colombia -- significantly increased the risk of conflict in the most intensive coffee growing areas

(Dube and Vargas 2006). They argue that this is due to decreased opportunity costs of joining a rebellion – echoing arguments made at a more general level by Miguel (Miguel et al. 2004) and Collier and Hoeffler (Collier and Hoeffler 1998).

The lack of economic opportunity becomes especially dangerous, according to some research, when coupled with natural resource wealth. Revenues from natural resources offer an incentive to rebels; and they also provide a potential source of financing for an insurgency (Collier 2004); (Le Billon 2001, 2004); (Ross 2004), (Ross 2005); (Lujala et al. 2005). Oil and diamonds, in particular, have been blamed for increasing civil war risk. Although oil consistently shows up as a significant factor in civil war risk, there is more disagreement about the effect of diamonds (Fearon 2005); (Lujala et al. 2005). Other primary commodities, such as cash crops, timber, or drugs have an even more tenuous link to conflict onset (Ross 2004); (Humphreys 2005), (Humphreys 2007). There are two potential pathways through which natural resources might help create the right opportunity structure for insurgency: one line of reasoning holds that natural resources provide financing for rebel movements (Ross 2004), (Ross 2005); (Collier 1999); while the other focuses on the negative effect that resource dependency has on government capacity (Fearon 2005); (Dunning 2005); (Thies 2010). In both cases, however, the presence or absence of natural resource wealth alone is not sufficient to prompt an insurgency. Rather, it interacts with other factors to create an opportunity structure for conflict.

Critics have argued that proponents of economic causes of conflict privilege economic factors above all others – particularly governance (Peluso and Watts 2001); (Matthew et al. 2003). Such criticism appears justified, because poverty indicators alone do not provide a satisfactory explanation for the onset of conflict. Similarly, the correlation between poverty, inequality and conflict does not explain why conflict emerges in some poor places, but not in others with equally striking inequity in wealth distribution. Nonetheless, economic factors have offered researchers in climate and security a toehold to improve understanding of how climate might interact with

conflict via its effects on the economy. Miguel et al. (Miguel et al. 2004), Burke et al. (Burke 2009), and Bernauer et al. (Bernauer et al. 2010) all rely on the strength of the relationship between economic factors and civil conflict for leverage in examining how climate change might act as a multiplier for civil conflict.

Governance Related Causes of Conflict

The role of good governance in determining conflict risk seems obvious. How to measure good governance, or even to define governance in a way that can be operationalized is much less clear. Broadly speaking, there are three aspects of governance that are examined in the conflict literature: government's repressive capacity; its ability to address the concerns and needs of its citizens; and whether or not it provides an enabling environment for economic growth (Hendrix 2010).

Fearon and Laitin have focused on the repressive capacity of government. They have operationalized this in two ways in two different papers, both under the rubric of understanding the opportunity structure for insurgency. In the first instance, they create an index to measure repressive capacity that includes a measure of armed forces, road coverage, and accessibility of terrain (Fearon and Laitin 1999). Their second paper simply uses GDP as a much cruder measure of government capacity (Fearon and Laitin 2004). In both instances they find that these measures of government capacity are relevant to the opportunity structure for insurgency that determines conflict risk. As one would expect, a drop in government capacity leads to an increased risk of insurgency. The opportunity structure that is critical to the formation of an insurgent group expands if the government leaves a vacuum in some way – in this formulation the inability of the government to repress a nascent insurgency makes the opportunity space larger. The use of GDP as a measure of governance is problematic, however, as it is used elsewhere as an economic indicator (Collier 1999); (Collier 2004); (Sambanis 2004a)). Economic opportunities and governance are intertwined theoretically, and it is thus unsurprising that it is difficult to isolate either factor in a proxy variable. Yet it is unsatisfying to simply substitute

GDP per capita in as a proxy for either economic opportunity or governance, rather than further developing alternatives that could better capture the specific mechanism at work.

The ability of government to address the needs and concerns of its citizens is most often measured through progressive levels of democracy. The emphasis on democracy was fostered by the observation, first made by Immanuel Kant and later statistically tested by Small and Singer (Small and Singer 1976), that democracies do not go to war with each other. How this translates to civil conflict has been less clear: some research shows little relationship between level of democracy and conflict risk (Schwartz and Skinner 2002); other research shows that strong democracies and strong autocracies both experience lower levels of conflict risk; and at the same time, transitional states have been shown to be at a higher level of risk (Mansfield and Snyder 2002); (Goldstone et al. 2005). What aspect of government capacity is captured by the level of democracy remains unclear: holding elections clearly is not an adequate measure of a stable democracy; but other components of governance -- like legitimacy and accountability to citizens -- are more difficult to measure.

Definitions of governance have expanded to include broader measures of state capacity, including the ability of the government to create an enabling environment for investment and economic growth. De Soysa explored this broader approach to governance in her work examining how state consumption, provision of public goods and openness to trade influence conflict risk. She found that openness to trade decreased the risk of conflict (de Soysa and Wagner 2003), but other measures had no discernible relationship with conflict. Thies looked at the ability of government to levy taxes as a measure of state capacity (Thies 2010); but this avenue yielded mixed results.

The difficulty of operationalizing the concept of governance continues to plague researchers who attempt cross- country comparisons. Hendrix made a significant

contribution to this effort in his recent analysis of different measures of state capacity. He examined which aspects are most relevant for the study of civil conflict, and found that bureaucratic quality and tax capacity are in fact critical (Hendrix 2010). The potential significance of government capacity in relation to conflict underscores the importance of further examining how government capacity changes and reacts to varying environmental shocks, as well as to more gradual shifts, in order to understand conflict onset generally, and more particularly with respect to climate change.

Migration's Role in Conflict

The role of migration in civil conflict onset has not been a specific area of research in quantitative political science or economic analyses of civil war; yet migration plays an important role in the debate around climate and conflict. Most of the research on migrants in relation to civil war has been about refugees who are fleeing civil wars, and how they may contribute to conflict contagion (Salehyan and Gleditsch 2006); (Stedman and Tanner (Eds.) 2003), and on how diaspora populations influence the opportunity structures for conflict (Collier 2004).

In some research, migration across national boundaries plays an implicit role in conflict risk, as new migration into an area may affect the ethnic balance, add stress to an already tense area, or increase competition over scarce livelihood options (Cederman and Girardin 2007). Migration is not addressed specifically in this line of research, although it clearly could have a multiplier effect – similar to the knock-on effect that it is claimed climate change will have (CNA 2007); (Smith and Vivekananda 2007). How population movements within a country might affect the risk of conflict is less well understood. Yet it is precisely such internal migration that will become increasingly relevant if people move -- as they have done historically, and are expected to do in the future -- in response to stress brought on by the impacts of climate change.

Fearon and Laitin more explicitly address how migration may act as a tipping factor in their *Sons of the Soil* framework (Fearon and Laitin 2010). In this analysis they highlight the disruptive role that migration can play when migrants move into an area that historically has been held by a different ethnic group that still retains relative strength in the region. This theory has been particularly relevant in Asia, where land has been scarce for many decades or even centuries. Given a changing climate, this mechanism may become more relevant elsewhere, as arable land becomes increasingly scarce, and ethnic groups must compete for scarce resources. The available arable land per capita in Africa is already declining, and the trend seems set to continue (Bank). The declining availability of land may exacerbate tensions in Africa, where ethnic groups do not coincide with national borders, and new migrants may allow oppressed minority groups to secure adequate support to mount an opposition. Migration between developing countries has not been examined as deeply as migration from developing to developed countries. This oversight already has implications for understanding current migration flows; and it will only become more critical if migration increases in response to climate change.

1.3 Environment and Conflict – history of the debate

The proposed link between environment and security is not a new one. Environmentalists and activists have often posited a link in order to draw attention to the urgency of environmental degradation. Yet, this debate has largely taken place at the periphery of academic research into the causes of civil conflict. In part, this is because the arguments made in favor of a link between environment and security seldom include the variables that conflict scholars have shown to be relevant with the result that conflict scholars tend to be dismissive of claims linking environmental factors to conflict. Now that climate change has moved to the forefront of discussions of environmental dangers, it has prompted a new line of research into the relationship with conflict. While a more detailed approach is developing, much of the research demonstrates that there is a poor understanding of the specific effects of climate change -- including their spatial distribution and time-scale -- and how those might relate to conflict risk. The failure to understand the impact of climate change on

factors known to increase the probability of conflict has, in turn, perpetuated the gap between more traditional conflict scholars and environmental security research. In addition, there is a maddening pattern in which each article cites the same group of articles, resulting in "proof by repeated assertion," with very few studies using robust tools of analysis – either quantitative or qualitative. Although this may be due in part to the lack of high quality, detailed data, scholars rarely cite this as a challenge to their research.

Thomas Homer-Dixon was one of the first to examine how environmental factors might affect violent conflict (Homer-Dixon 1994, 1991). His argument was that as resources become increasingly scarce, people would either fight over them, or would migrate across national boundaries, causing conflict in their destination countries. This research spawned a host of reactions, with some criticizing the definition of conflict used and the methodology (Gleditsch 1998), and others more rigorously testing the hypothesis and finding that, on the contrary, resource abundance was a better indicator of conflict risk than resource scarcity (Collier and Hoeffler 1998), (Collier 1999); (Fearon and Laitin 1999); (Hauge and Ellingsen 1998). Peluso and Watts (Peluso and Watts 2001) also criticized Homer-Dixon's approach in their book *Violent Environments,* for privileging resource scarcity as a cause of conflict above other initial environmental conditions, such as abundance and distribution. And yet, attempts to trace a direct line from environmental factors to conflict have been largely unsuccessful once other political and economic factors are included, leaving researchers in this field stymied (Salehyan 2008). The lack of a clear link from environmental causes to conflict has forced a shift in the research towards trying to understand the indirect consequences of environmental factors that might lead to conflict. Nevertheless, the starting point has remained the effects of environmental change, rather than understanding how conflict risk factors are affected by the environment, and how those might change under different climate scenarios.

Chief among the indirect factors cited in the environmental security literature are migration, and the increase in tensions wrought by competition over scarce resources that may be further exacerbated by in-migration.

Migration and Environmental Security:

The argument that environmentally-induced migration causes conflict which was first put forth by Homer Dixon (Homer-Dixon 1991), (Homer-Dixon 1994), actually posits two causal relationships: 1) that environmental scarcity triggers migration; and 2) that migration, in turn, causes conflict.

A number of scholars since Homer-Dixon have tried to understand exactly how natural resource limitations contribute to migration flows. Using evidence from China, Stranks finds that land degradation may lead to population displacement (Stranks 1997), although he is cautious about drawing the next link to conflict. And once again, attempts to link environmental factors to migration depend heavily on how those factors are defined (Suhrke 1997). The relationship becomes even more indirect as environmental factors are teased apart from economic relationships that affect migration. Henry, et.al. (Henry et al. 2003) model how environmental factors influence migration in Burkina Faso, focusing on agricultural factors. They find only a weak relationship between poor agricultural conditions and migration – a relationship that is very sensitive to exactly how the variables are defined, and the empirical relationship that is tested. Looking at rural-urban migration specifically, Barrios was able to find a significant link in sub-Saharan Africa between climate factors and an increase in urbanization (Barrios et al. 2006), although it is unclear if there truly is a causal relationship or if the two variables are just trending together.

The difficulty in finding a relationship between environmental factors and migration has prompted others to look at extreme cases of "environmental refugees" who they argue are more representative of the future under certain climate change scenarios. Even in close, case-study analyses of these extreme events, such as the famines in

Ethiopia and Sudan, economic and political factors trump any potential signal from environmental causes (Berhanu and White 2000); (Castles 2002); (Corbett 1988; De Waal 1989); (Ezra and Kiros 2001). There remains an on-going debate about whether or not there is, or should be, a separate categorization and treatment of environmental refugees, as distinct from normal migration flows induced by economic or social factors (Salehyan 2008); (Vlachos 1997).

Despite very limited evidence that environmental factors cause migration, there is significant research that *assumes* migration to be environmentally induced, and proceeds directly to the question of how this environmental migration leads to conflict (Mohammed 1997); (Lee 1997); (Scheffran 2008). A vital aspect of this argument, which is simply repeated in much of the literature, is the assumption that the human response to environmental factors will be rapid and almost simultaneous: migrants will move en masse, at the same time, to a new place where they will be regarded as threatening to the host country. Smith offers an alternative to this view, in which environmental migrants move more gradually, eventually reaching a tipping point for conflict in the destination country as a result of multiple contributing factors: added social and economic burdens; threats to cultural identity; political threats to the host state; and the potential for migration inflows to hide terrorists in their midst (Smith 2007). These authors rely on hypothetical scenarios, however, and are unable to offer convincing examples or empirical support as to where any type of migration has led to conflict, much less cases of environmentally-induced migration.

The government is largely absent as an actor in the above arguments. In a response to critiques (Gleditsch 1998); (Peluso and Watts 2001) of Homer-Dixon's work, Suhrke introduces governance, and the relationship between migrants and host population in her study based on evidence from Bangladesh (Suhrke 1997). While her conclusions are drawn from anecdotal evidence, her work offers insight into the types of conflict that might result from migration: between states as famine victims move from one country to another; in urban areas as new migrants arrive; and as a result of political

tensions brought on by intensified competition for relief assistance. Notably, none of these causes of conflict is found in the civil conflict literature.

Reuveny is regularly cited in the nonacademic literature, such as the CNA, CSIS, and International Alert reports, as demonstrating that migration will lead to conflict (Reuveny 2007). Reuveny uses a loose definition of environmentally induced migration, and finds that conflict resulted in 19 of 38 instances of environmentally induced migration. Both he and Barnett emphasize the roles that government and governmental response to migration play in determining whether or not migration will heighten existing tensions and lead to conflict (Reuveny 2007; Barnett and Adger 2007). Neither, however, offers a satisfactory explanation of the conditions under which climate change will prompt migration, nor why migration seems to lead to conflict in some cases, but not others.

Many of these articles rely on case studies, and some warrant the usual criticism of selecting on the dependent variable. Even more problematic however, is the dominant role that is assigned to migration, despite the numerous other factors that are at play. Existing political and economic conditions are cited as mitigating or exacerbating variables, but it is never made explicit how these factors might interact, or whether these other factors might in fact be more important in determining outcomes. It is assumed that not only will there be rapid changes in natural systems, but that these will permeate through political, social and economic systems at the same speed or faster than has happened in the past (Barnett and Adger 2007). The agency of the actors involved – the migrants, the host nationals, the host government, or the international community – is unacknowledged, making them all simply reactive to any large-scale changes.

Migration scholars, like civil conflict scholars, have accumulated a large body of knowledge about the drivers of population movements, but that evidence has been largely sidelined in the above discussions. Economic factors play a dominant role in

explaining *why* people move (Harris and Todaro 1970); (Massey 1988), (Massey 1999); (Lall et al. 2006), while social networks, geographic obstacles, and cost concerns can offer significant insights into *where* individuals go (Menjívar 1999); (Bauer et al. 2000). To understand more clearly how migration might affect conflict onset, however, much more detailed analysis will be required, in addition to identifying locations that might be particularly vulnerable to an influx of migrants.

Scarce Resources and Economic Factors in Environmental Security:

Competition over scarce resources represents another potential path to conflict in the context of climate change. One part of this argument is linked to the migration argument: new migrants are assumed to increase competition for the same, or dwindling, pool of resources in the host country. That argument has already been covered, as it is effectively subsumed into the discussion about migration. The other part of the argument focuses on increasing conflict over depleted resources among the people who stay.

Hauge and Ellingson set out explicitly to test the hypothesis that conflict would result from competition over scarce resources, using a systematic and quantitative approach (Hauge and Ellingsen 1998). They found that economic factors were paramount in conflict onset, trumping any environmental effect, although they emphasized that environmental factors could be behind variations in economic indicators – a link that researchers have been slow to examine further. Their results cast into doubt the idea that the environment alone could be the dominant catalyst for conflict. Subsequently, research shifted towards exploring the link between the environment and the economy, and the effect that economic decline could have on other social factors, such as unemployment (Mohammed 1997); (Stranks 1997); (Miguel et al. 2004).

More recent research has been able to take on the question of how climate variability, natural resource impacts, and conflict are related. The introduction of new tools such as geographic information systems (GIS), has allowed scholars to use sub-national

data on violent incidents and climatic variables, such as rainfall and vegetation, to investigate how natural resource availability or scarcity might be related to violence. Using various models of specification, a promising line of research has emerged that links the availability of fresh water to conflict, demonstrating that declines in rainfall (or increases in temperature) critical to agriculture in sub-Saharan Africa, have significant effects on conflict onset (Miguel et al. 2004; Hendrix and Glaser 2007; Raleigh and Urdal 2007); (Burke 2009). This work represents an exciting new avenue for exploration, as it capitalizes on sub-national data, and more explicitly relates to the existing literature on conflict.

There is strong potential for this kind of research to illuminate specific relationships between environmental factors and conflict risk, although it has so far been unable to tease out what mechanisms are at work. These papers assume that rainfall, or temperature, affects the opportunity cost for potential fighters, because the returns to agriculture diminish in years of poor rainfall. Yet there may be other potential mechanisms confounding this effect, or alternative explanations that are not explored: A drop in economic productivity, for example, may reduce tax revenues, reducing government capacity; demands for assistance by the population may increase; or preferential treatment of one group over another may contribute to heightened tensions. Bernauer, et.al., (Bernauer et al. 2010) offer an exception to this approach, focusing on the resulting economic effects from increased temperatures, and explicitly including the political system in which changes are occurring. These researchers find that the level of democracy is important in determining the vulnerability of countries to risks induced by the economic impacts of climate change. Their focus on democracy as the most relevant aspect of governance is somewhat problematic, however; and they also fail to consider how government structures and capacity may change in response to climate variability.

Other research has exploited sub-national data on climatic variables, paired with local data on violent incidents -- as opposed to the narrower definition of civil conflict

summarized above. This approach too has found mixed evidence, even using the more relaxed definition of conflict. Meier looks at the frequency and intensity of pastoral raids in the Horn of Africa as a function of vegetation availability (Meier et al. 2007). He finds a weak relationship between increased scarcity and a higher number of violent raids; but he is unable to discern any relationship between scarcity and the intensity of violence, as measured by human and livestock deaths. In a similar approach, Hendrix and Salehyan look at the effect of hydro-meteorological disasters (floods and droughts) on various forms of violence that fall short of civil conflict, such as riots, demonstrations and communal conflict (Hendrix and Salehyan 2010). They also find mixed effects, although their research tentatively concludes that wet years correspond to increased incidents of violent political conflict, contradicting the studies mentioned previously, which conclude that drier years tend to prompt more conflict as agricultural production declines.

Dube makes an important contribution to this debate by examining detailed data on violent incidents in Colombia to see how changes in agricultural productivity impact violence (Dube and Vargas 2006). She explicitly tests whether or not a change in opportunity cost leads to more violence when the price of coffee drops. She is able to do this by comparing the effects of price changes of coffee, and then comparing these effects to price shocks in the oil sector. This has enabled her to identify what types of violence are involved. Because different types of violence are linked to distinct groups of perpetrators, she is able to demonstrate convincingly that there is an opportunity-cost rationale at work for those employed in the agricultural sector, who are more likely to join the rebels in times of agricultural stress. In the oil sector, the picture is more complicated: violence in this sector goes up in parallel with price increases, as paramilitaries run by wealthy landowners try to capture the rents from this lucrative sector. But there is no increase in violence by rebels, thus demonstrating that the violence perpetrated by paramilitaries is more closely linked to political and economic motivations. This work is a significant contribution as it manages to isolate the mechanisms at work by identifying the specific actors, as well as their motivations

for engaging in violence at particular times. While Dube's research is not explicitly attempting to test the role of environment in conflict, it demonstrates the value of focusing on sub-national levels.

A critical element still missing from the above literature, with the exception of Bernauer's work, is the role of government. Barnett emphasizes how the state's response to scarcity influences the likelihood that conflict will result (Barnett 2003; Barnett and Adger 2007). Barnett privileges the role of the state above other factors, such as economic hardship, as a determinant of conflict. He argues that states that already suffer from a poor perception of their legitimacy, or from low levels of capacity to meet citizens' needs, will be especially vulnerable to conflict as a result of environmental factors. The ability of the government to provide economic opportunities, and to provide a social safety net is critical to bolstering its legitimacy. Where the government does not have this capacity, there will be an increased risk of conflict, even without more climate stress, according to Barnett's argument. He calls for an improved understanding of how the government and its institutions will be affected, as critical to improved understanding of the myriad indirect effects that environmental changes may have.

Skepticism on Environmental Security:

The paucity of robust evidence supporting the link between climate change and conflict has led to skepticism among some conflict scholars, who doubt that there is any relationship at all between environment and conflict. They question how reasonable it is to extrapolate future climate effects without also allowing for adaptation or changes in political and economic structures. This debate is neatly summarized by Salehyan, who highlights the disparity between the cautious academic research, and the deterministic conclusions posited in the media (Salehyan 2008). He faults the academic research for not taking into account the role that governments and other agencies play in regulating resources and shaping the incentives of different actors who might engage in violence. Others are doubtful based on a perceived lack

of empirical evidence – a dispute that often hinges on methodological differences in approach between the natural and social sciences, and differing definitions of conflict (Burke 2009); (Buhaug 2010).

In an earlier criticism, McDonald argued that conflict will not result from environmental stresses unless there are other factors already in play (McDonald and Gaulin 2002). This is similar to conclusions drawn in the work discussed above; however McDonald believes that adaptation will mitigate the potential adverse effects of climate change, reducing the potential risk. This optimistic read on the likely effects of climate change is not grounded in evidence; and it does nothing to further understanding of how climate, the environment and human systems are likely to interact under conditions of increasing stress. Matthew et.al., emphasize the potential of the state itself to adapt its capacity, in order to avoid being overwhelmed by the effects of climate change (Matthew et al. 2003). One important contribution that emerges from this debate is the emphasis placed on the time frame for both the impacts and adaptation. Although they do not explore this conclusion in depth, they note that there may be negative effects of particular adaptation choices, such as trade balances and migration, on neighboring states.

There have been some attempts to tease out the role of intermediate variables such as resource scarcity, migration, economic stress, and governance. Skeptics have countered by emphasizing the dominant role of economic and governance factors, among others, for explaining conflict onset – even in the absence of environmental issues. What is missing from this skeptical literature, however, is a more nuanced assessment of how different climate effects would have varying impacts both in terms of timing and geographical distribution. While the think-tank reports discuss each region in turn, and highlight the climatic fallout that is likely to affect each, they do not address the different time-scales over which these effects will occur. Sea level rise is presented as a concurrent threat with increased incidence of drought and famine.

Teasing apart the differential effects over time and space is an area where academic research has the potential to make a very substantive contribution to this debate.

1.4 Climate change impacts and security risks

The review of conflict research in Section I shows how environmental causes have largely been ignored by conflict scholars, while Section II has shown that environmental literature, with its sense of urgency about impending environmental disaster, has failed to connect to the findings of conflict scholarship. Yet dire predictions of catastrophic impacts of climate change on conflict persist. To move research on climate change and conflict forward, the two approaches need to be better integrated. Towards that end, this section examines the specific impacts climate change may have, and how these impacts in turn affect the probability of conflict, taking into consideration the disparate spatial and temporal aspects. Climate change is sure to have a number of negative effects, but not all of those effects will affect conflict outcomes – although they are certainly undesirable for other reasons. One example of this is the potential for climate change to lead to an increased disease burden on the economy. As seen with the HIV/AIDS epidemic, production may go down, but people continue to work, albeit at a lower capacity. It seems unlikely that this type of economic impact would lead to more conflict – people have not lost their livelihood options, they are just less able to take advantage of them -- and less able to take advantage of these opportunities in ways that make them less prone to violence.

Scientists can now model a range of possible climate change effects with some confidence; but the consequential impacts on human systems are not as easily identified. Disaggregating climate change into its component parts, therefore, so that timing and geographic dispersion can be unpacked is a critical next step in tackling this complex issue. Recent research on climate and security interactions has begun to do this, looking at specific problems in specific countries, or regions. The impact of changes in monsoon patterns in India, (Kumar and Sankar 2010); desertification in northern Nigeria (Ikuomola 2010); and scarcity and communal violence in Kenya (Theisen et al. 2010) are examples of current work in this area that attempt to go more

deeply than cross-national aggregations allow. Using sub-national data to identify potential links between environmental factors and conflict, they have made very positive contributions to the literature.

The following table lays out some of the effects that have been most frequently discussed in the climate change literature. A rough time frame for each of these impacts is also indicated, along with notes on the potential geographic dispersion.

Table 1.1 Climate Change Effects and Implications

Climate Change	Impact	Time Scale	Note	Implications
Mean Temp	+0.64-0.69 C	Imminent	Compared to 1980-1999, with relatively little uncertainty between models. There is variation between regions, and models show that temperatures will increase more over land – possible as much as 2x the global average temperature	Extremely important for agriculture, particularly in regions, such as sub-Saharan Africa where crops exhibit sensitivity to changes in temperature (Burke et al. 2008)
	+1.3-1.8 C	Mid-century	The choice of models becomes more significant as the time scale expands, but about a third of the warming comes from changes that are already in the system – ie. some part of these increases will occur regardless of any mitigation efforts.	Uncertainties become greater as the time frame is pushed out, and the feedbacks become more complex, making predictions more difficult. The implications for agriculture become even more critical, however, as temperature increases of this scale could dramatically affect productivity.
Temperature Extremes	More frequent, more intense, longer heat waves very likely. Minimum daily temperatures will increase faster than maximum temperatures	Imminent		Higher minimum daily temperatures is likely to have a significant impact on agricultural productivity, with some crops being particularly affected (Lobell et al. 2008)

Climate Change	Impact	Time Scale	Note	Implications
Mean Precipitation	Effects vary widely according to region, with models diverging in agreement in particular regions, such as sub-Saharan Africa	Imminent/Mid-Century	Precipitation generally will increase in monsoon regions, and decrease in the subtropics, and increase at high latitudes	Effects on agriculture and infrastructure will vary, as precipitation patterns change across regions.
Precipitation Extremes	Intensity of precipitation events projected to increase – including events with dramatically more precipitation and events with longer dry periods between precipitation (ie. droughts)	Imminent		Additional rainfall could overwhelm some areas that do not have adequate water storage capacity, while less rainfall could lead to drought in other areas
Snow and Ice Cover (Glacial Melt)	Snow cover and sea ice decrease	End of Century	These changes will contribute to sea level rise, and affect water availability in regions that depend on glacial melt for seasonal	In regions that depend on glacial melt for agricultural production, there may be a short-term benefit as water increases, but the long term effects are uncertain as this
Sea Level	0.18m – 0.59m	End of Century	There is a very wide range in these predictions depending on the emissions scenario, and how feedbacks are accounted for.	There is substantial geographic variation, with smaller than average effects in the Southern Ocean, and pronounced effects in the Southern Atlantic and Indian Oceans. Low lying delta regions and small islands states are under the most threat from this climate change effect.

Information in this table extracted from IPCC Working Group 1, Chapter 10 (Meehl et al. 2007), unless otherwise indicated.

Note: Imminent indicates that the models assessed by the IPCC begin showing changes by 2030. Mid-century indicates that the models show change by 2040-2060, while End of Century reflects changes that emerge in 2080-2100. All of these changes are indicated by the IPCC as likely (> 66% probability) or highly likely (> 90% probability).

Outlining the factors known to affect conflict(Fearon and Laitin 2010) risk is essential to extracting which impacts are relevant from a security perspective.

Still missing, however is an overarching framework for understanding when – and with what rapidity – these climate effects might occur, how they might affect security more generally, and what priorities should be set for considering them. To illustrate this point, consider the effect of changes in rainfall and temperature that may cause a drought in a given country. Beyond the potential human and economic costs, a drought could have direct impacts both on the demands on the government, and on its capacity to respond, particularly if there are successive years of drought. Increasing numbers of citizens would need access to some sort of social safety net in order to survive. At the same time, the drop in agricultural production may lower government revenues, leaving it with fewer resources to respond. This is a treacherous cycle that could overwhelm a government just when it is least able to respond. A lack of response could reduce the perceived legitimacy of the government and thereby provide fodder for insurgents. The government may also come to be seen as simply irrelevant, leading groups to form on their own to provide protection, and capture whatever resources they are able to secure by force. This is in addition to the effect that a drop in agricultural production could have on the economy, and the "fight or farm" mechanisms discussed above. Most important, such scenarios underscore the importance of understanding the causes of conflict, and the specific ways in which climate change is likely to impinge on factors known to contribute to conflict risk.

1.5 Conclusion

The interaction between economic, migration, and governance effects will influence whether or not conflict results from climate change. The historical debate about environment and conflict has influenced current debates about the effects of climate change on conflict risk. A misguided preoccupation with the dramatic effects of climate change has led some to reach stark conclusions about how climate change will inevitably lead to climate wars. But it is hard to find empirical support for such a scenario; and the risk is that this type of approach leads to esoteric arguments about

methodology rather than furthering our understanding about how climate change may, indeed, affect conflict.

Conflict literature has ignored environmental contributing factors for the most part; and the climate-and-conflict literature has had at best a tenuous link to the more traditional civil conflict literature. In order to integrate these areas of research, more work needs to be done in identifying and evaluating potential causal pathways to conflict. Current quantitative research has focused on identifying what variables are significant without adequate attention paid either to the actual mechanism captured by the variable (e.g. using GDP to proxy for government capacity and economic outcomes), or to the factors that cause those variables to actually change. Recent research is improving on this, but is still in its nascent stages, and will require still more integration of methods, and disciplines as social scientists strive to incorporate information from natural systems. Understanding the process of conflict, and the systemic and proximate changes that lead to conflict will improve the ability of researchers to link climate change research to conflict studies. This is especially true as climate change impacts are thought to act as threat 'multipliers' – understanding which threats are being multiplied, how, and by how much will help researchers isolate the potential effect of climate change, and policy-makers design appropriate interventions, without falling back on dire predictions that remove any agency from either individuals or states.

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Chapter 2: Government Capacity and Civil Conflict in sub-Saharan Africa

2.1 Introduction

Understanding the causes of conflict and the conditions that make civil war more likely concerns policy-makers and scholars alike. Sub-Saharan Africa has been the locus of much of this concern: 31 of its 46 countries have experienced conflict between 1960 and 1999, with thousands dying, and hundreds of thousands displaced (Ross 2004b). Factors that seem to influence conflict at the global level, such as economic shocks, generally are not associated with higher levels of conflict in sub-Saharan Africa, however ((Miguel et al. 2004; Hendrix and Salehyan 2010); and this lack of correlation has confounded efforts to get a handle on conflict risk in this region. The widespread poverty on the continent cannot explain why some countries fall into conflict, but not others. That one of the most preferred explanatory factors does not explain conflict risk in one of the regions most prone to civil wars demonstrates the challenges that ensue from moving cross-national research from the global to the regional level. This paper demonstrates how factors that may not appear significant at the global level, do in fact play a determining role when examined at the regional level.

This research focuses on governance, which has been inadequately addressed in conflict research to-date. Yet as this research demonstrates, governance plays a strong role in conflict onset sub-Saharan Africa. It seems intuitively obvious that governments without adequate resources either to meet the needs of their people, or to counter threats from within and without would be "fragile," ("World Development Report 2011: Conflict, Security and Development" 2011); but the empirical relationship between governance and conflict risk is poorly understood. Most conflict

research has focused on stability (usually based on the Polity IV index)[1] as an indicator of good governance more generally (Fearon and Laitin 2003) (Thies 2010) (Doyle and Sambanis 2000). Stability reflects only one aspect of capacity, however; and it ignores the long history of research emphasizing the role of revenue extraction in state-building (Tilly 1975) (Levi 1981), which captures the role of the state, and its rulers in a more dynamic way than stability can. The resources available to the state shape the opportunities faced by rebels, and influence the likelihood of their success in mounting and sustaining a rebellion against the state. Using government revenue to measure state capacity thus provides a handle for incorporating the state into civil conflict research in a way that allows for more variation, even within stable governments, than previous measures of democracy have done.

This research shows how specific factors may emerge at the regional level that do not appear significant when analysis is conducted at the global level. It also makes a critical distinction between variables that are static, but create the structure of conditions favorable to conflict, and those that vary year-to-year, and can thus explain conflict onset. Poverty levels, which vary widely at the global level, show only slight variation in sub-Saharan Africa – either between countries, or over time – and thus more closely resemble static factors, like mountainous terrain in sub-Saharan Africa than they do elsewhere. Poverty therefore may contribute to a structure that favors conflict risk in sub-Saharan Africa; but it should not be surprising that it is cannot explain what triggers conflict onset in the region. Government capacity, and government revenue in particular, show substantial variation across the continent and over time, and thus offer better insight into why conflict breaks out in some cases, but not others.

[1] POLITY IV – The Polity index assesses the levels of authority and democracy of political regimes by scaling country performance on a number of indicators that are used both individually, and in aggregate. Political regimes are ranked along a scale from fully autocratic to fully democratic.

These findings provide some empirical support for the intuitive sense that states should and do play a strong role in creating the conditions for peace, or for war. This research on sub-Saharan Africa, in contrast to that at the global level, suggests that the role of the state has been significantly under-appreciated in favor of economic factors, such as poverty, which have been pervasive and persistent – yet unsatisfactory -- explanations for conflict in sub-Saharan Africa. . The role of government revenue in conflict risk implies that state-building is at least as important as economic development for lowering conflict risk in sub-Saharan Africa.

While this conclusion has clear implications for understanding conflict in sub-Saharan Africa, it also suggests that closer attention needs to be paid to specific regional, and country level conditions. Beyond the role that democracy can play in creating peace, it suggests that a more robust approach to building government capacity is required to understand how to reduce the risk of conflict.

The next section introduces a brief overview of the literature on conflict onset, how it applies to sub-Saharan Africa, and the theoretical support for focusing on government capacity, before introducing the data and the model. I then discuss the results and their implications for understanding and even preventing conflict, as well as priorities for future research.

2.2 Review of Conflict Literature

Sambanis (Sambanis 2004) and Blattman (Blattman and Miguel 2009) both provide excellent reviews of the cross-national empirical literature on civil conflict, so only the key elements of this literature are reviewed here. Using large-N quantitative analyses, research in political science and economics has shown support for a number of factors that are consistently related to conflict, both theoretically and empirically. Low levels of GDP per capita and low growth rates make it easier to recruit fighters who have poor alternatives (Collier and Hoeffler 1998); (Fearon and Laitin 1999); (Miguel et al. 2004). The presence of oil or other high-value resources is thought to provide a potential source of financing to rebels, or to motivate the rebellion to capture the

lucrative revenue (Humphreys 2005; Humphreys 2007); (Ross 2004a);(Ross 2005); (Le Billon 2001); (Le Billon 2004). Scholars have also examined how conflict is affected by mountainous terrain (Fearon and Laitin 1999), ethnic and religious fractionalization (Fearon and Laitin 1999), and regime type (Goldstone et al. 2005); (Hendrix 2010), with somewhat mixed results.

Economic factors, such as GDP per capita and growth rates, show the most consistent relationship with conflict incidence and onset. The effect of the economy on conflict risk is thought to operate through one of two main ways. First, low levels of GDP per capita, and/or slow economic growth indicate that farming or other economic activities are not adequately profitable, making recruitment easier for rebel groups (Humphreys 2008); (Miguel et al. 2004); (Collier and Hoeffler 1998); (Fearon and Laitin 1999). Basically, individuals see the use of force as an easier way to make a living than other economic options. Second, low GDP per capita indicates that the government lacks effective repressive capacity, and is therefore unable to nip potential insurgencies in the bud (Fearon and Laitin 2003). This argument is problematic, however, as it ignores the multiple other avenues through which GDP may affect conflict onset, beyond its impact on government capacity.[2]

The role of primary commodities has also drawn attention. Oil and diamonds have dominated this area of the literature (Humphreys 2005); (Fearon 2005); (Lujala et al. 2005), with less weight given to other commodities such as timber and illegal crops, such as drugs (Ross 2004b); (Ross 2005); (Le Billon 2001); (Le Billon 2004). These valuable commodities create favorable conditions for conflict by providing a potential source of financing, and motivation to seize or retain power -- both for the rebels and the government. Rebels are viewed as predatory in this instance, and the government is considered the "prize" (Thies 2010). Fearon (Fearon 2005) also suggests that the income from such commodities diminishes the government's interest in capacity

[2] Another potential factor that has been considered extensively in the literature are measures of income inequality, rather than mean income levels. Despite multiple attempts to include this variable in different ways, it does not emerge as significant (Fearon 2010).

building, by allowing the regime to extract wealth without strengthening its institutions or promoting accountability to its people.[3] Yet, the resource endowment of a country is largely fixed (although new discoveries of oil are occasionally made), and thus the presence or absence of oil does not offer much insight into why a country experiences conflict in a given year, although it may provide some rationale for how conflicts are financed over time.

If and how mountainous terrain may play a role in creating conditions favorable to insurgency is more debated. While Fearon and Laitin found this measure to be significant (Fearon and Laitin 1999); (Miguel et al. 2004), the relationship between mountainous terrain and conflict onset has not been consistent (Sambanis 2004). Obviously, the measurement of mountainous terrain does not vary from year-to-year, however; so while it may provide some indication of how easily an insurgency can hide from government forces, it is unclear how it can predict changes from peace to conflict.

The final factor that often is significantly related to civil conflict is regime type (Goldstone et al. 2005); (Collier and Hoeffler 2002). Regime type is often approximated from the Polity IV score described earlier, which -- although problematic for many reasons (Treier and Jackman 2008) -- provides a consistent assessment of democracy across countries. From these analyses: strong democracies appear able to accommodate demands from their populations; and strong autocracies reflect an ability to suppress potential insurgencies, while transitional governments can do neither adequately, and therefore are most at risk of falling into conflict (Fearon and Laitin 2004). It is hard to determine if the imputed vulnerabilities come from the increased desire of people to rebel under democracy, or thethe government's inability to repress them. Regime type thus captures only a small part of government capacity

[3] This is effectively a compounded Dutch disease problem. "Dutch disease" occurs when high revenue from natural resources causes currency appreciation, which in turn makes the country's manufacturing industry uncompetitive in comparison to other countries. In the case of many sub-Saharan African nations, the revenues from natural resources have both cut off the development of manufacturing, and the development of capable governments.

(Hendrix 2010), and other aspects may, in fact, be more relevant to conflict risk. Besley and Persson have looked beyond measures of democracy to consider how investments in government capacity may be determined, in part, by the perception of conflict risk (Besley and Persson 2008); but they do not examine the reverse effect: how government capacity, or lack thereof, might contribute to conflict risk (Besley and Persson 2008).

What happens in Africa?

The factors discussed above give some general insight into the causes of conflict at the global level, but they are unable to provide robust explanations at the regional level. This breakdown is particularly stark in sub-Sahara Africa – a continent that has long been, and continues to be plagued by conflicts. Of the 87 countries that experienced conflict in the sample period (1960-1999), 31 of them were in sub-Saharan Africa, and yet *none* of the theoretical causes of conflict from previous global-level analyses finds empirical support when the analysis is confined to a specific region. To understand conflict, and conflict onset at the regional level, sub-Saharan Africa offers a good test region as it has been so conflict prone. These insights can then be applied to other regions and used to re-examine the factors that have been linked to conflict at the global level. The rest of this section will review the work that does address sub-Saharan Africa, and the gaps that persist.

Relatively few studies focus specifically on sub-Saharan Africa. Two that do find that factors that have explanatory power at the global level do not have any statistically significant relationship to either conflict onset or incidence. Miguel, et.al. (Miguel et al. 2004), for example, used panel data to examine the relationship between rainfall and conflict onset in sub-Saharan Africa, and found that the only variable that emerged as significant from the first phase of their analysis was the mountainous terrain measure proposed by Fearon and Laitin. Notably, GDP per capita was not significant – despite GDP playing a central role in their proposed causal mechanism, whereby reduced economic opportunities make fighting a more attractive alternative –

the "fight or farm" theory. In the second phase of their analysis, the estimate of economic growth that they calculated based on the relationship between rainfall and GDP did emerge as significant. These estimates, however, may be noisy for a number of reasons, complicating the interpretation of these results (Jensen and Gleditsch 2009). Finally, the focus on conflict incidence, rather than conflict onset, makes it difficult to separate out the effect of economic shocks that are distinct from conflict that was on-going in the previous years.

Hendrix and Salehyan (Hendrix and Salehyan 2010) conducted research using civil unrest as a more general measure than civil conflict, using a panel dataset of all African countries from 1990-2009. They also found that none of the usual factors were good indicators of conflict risk in the region. Despite these somewhat surprising results, they did not pursue this inconsistency, focusing instead on the effect of rainfall on social conflict. Hendrix and Saleyhan's conclusions are less reliant on the pivotal role of GDP, however, as they are more agnostic about how rainfall might affect conflict – in part because they found *more* civil unrest in wetter years. This finding counters the theory, put forth by Miguel, et.al., that dry years create economic hardships that lower the opportunity cost of joining a rebellion; but Hendrix and Salehyan do not offer any strong counter-argument as to why wet years might cause more conflict. Bruckner and Ciccone have taken up Miguel et. al.'s work, focusing on the effect of commodity prices on civil conflict in sub-Saharan Africa (Brückner and Ciccone 2007), (Brückner and Ciccone 2010). Their analysis led them to conclude that economic growth is unrelated to conflict risk, but that economic growth, in conjunction with institutional factors is relevant. They focused on the institution of democracy, which they found to lower the risk of conflict in the face of economic shocks. In this work, the concept of governance was expanded beyond the institution of democracy to include a more fundamental definition of government capacity, based on revenue.

Sub-Saharan Africa thus continues to puzzle conflict scholars and development economists alike: what is it about the continent that has suppressed development and encouraged conflict? There are a number of theories about why countries in sub-Saharan Africa face special challenges: many countries are land-locked, increasing the transaction costs of joining the global economy (Collier and Gunning 1999); the climate and soils are adverse, limiting agricultural development and productivity growth (Breman et al. 2001); ethnic diversity, particularly when coupled with poor governance, is detrimental to economic growth as in-group favoritism does not reward merit (Collier and Gunning 1999); over-reliance on primary commodities makes African economies particularly vulnerable to external forces (Deaton 1999); and countries in sub-Saharan Africa tend to have more neighbors, increasing the spillover effect if a neighbor falls into conflict (Collier 2007).

Some of these explanations have to do with geography, and some rely on the colonial legacy that determined the borders of these countries. Others are less easy to explain – why, for instance, is sub-Saharan Africa still so dependent on primary commodities, and lacking in a productive industrial or service sector? It is not satisfying to ascribe these outcomes to some sort of "Africa effect" as there is no realistic policy response to that. While sub-Saharan Africa has experienced more conflict than other regions, there is still no good explanation for why it should not only be more at risk, structurally, but then actually experience more trigger events. The fact that there are multiple theoretical mechanisms through which GDP per capita may be operating suggests that the prevalence of conflict may be reflecting multiple pathways through which GDP may affect conflict: it may be significant in different places for different reasons. Thus, sub-Saharan Africa offers an opportunity to examine more closely the conclusions from global analyses, and to explore alternative factors and how they interact, in order to gain more insight into the mechanisms at work on the regional level.

Despite the lack of empirical evidence, explanations of conflict risk in sub-Saharan

Africa related to poverty, poor governance, resource dependency and ethnicity still resonate. The divergence between intuitive explanations and empirical evidence highlights a broader issue in the conflict literature: factors such as ethnicity are measured in static terms, when in fact they matter in dynamic ways. . The amount of insight into the risk of conflict starting in a given year, versus a general level of risk that is constant over time, is limited by how much these variables change over time, and how well they are linked to specific theoretical mechanisms (Brown 1996). Many of the variables studied delineate risk factors that favor insurgency; but they do little to identify trigger mechanisms that might cause a conflict to actually begin, as they do not change year-to-year. This is perhaps one reason why GDP per capita is consistently significant for conflict onset at the global level – it is one of the few variables that does change from year-to-year. In sub-Saharan Africa, however, most countries are poor, so there is scant variation between countries, and even over time, that would help explain why and when particular countries fall into conflict. It may be that economic shocks hit the poor disproportionately, prompting them to take up arms; but inequality has not emerged as a significant factor in conflict onset or conflict incidence, making this argument problematic.

An alternative explanation for why poor economic performance may lead to conflict onset is that the government revenue base is weakened at precisely the same time that there is a low opportunity cost for citizens to join a rebellion (Collier and Hoeffler 2002). Conventional explanations offer little analysis of government's role as an actor in the conflict, however, despite the fact that poor economic performance may reduce the government's capacity to repress, as much as it increases the insurgents' incentive to rebel and ability to recruit fighters. This possibility is explored in more detail below. I find that it offers a dynamic and compelling explanation of how economic health affects conflict risk through alternative causal pathways, beyond just the economic opportunity cost of fighting. While the analysis focuses on sub-Saharan Africa, moreover, it has significant implications for understanding the causes of conflict more generally.

2.3 Government Capacity

The state has been at the forefront of explanations of social revolutions (Goodwin 2001), yet in the transition from qualitative analysis of cases to quantitative analysis of civil conflict at a larger scale, the role of the state has been largely ignored. This section reviews the limited role accorded to the state in quantitative research, and provides support for incorporating revenue measures as proxies for state capacity.

The definitions of civil conflict used by the Correlates of War project (COW) and the Uppsala Conflict Data Program (UCDP), maintained in collaboration with the Peace Research Institute Oslo (PRIO), both require that the state be a participant in order for a violent episode to count as a civil conflict, as opposed to just general violence (Gleditsch et al. 2002); (Small and Singer 1982), revised (Sarkees 2000).[4] The state, and its government, is therefore, *by definition*, a critical actor in any civil conflict. It is therefore puzzling why measures of the state or government capacity play a limited role in most empirical analyses.

There are various theoretical reasons, in fact, why government should be expected to play a role: overthrowing the government may be seen as a way to capture the wealth it controls; the government may lack the ability to repress a rebellion; or the government may favor one group at the expense of another, fostering grievances. The most commonly employed measures typically use levels of democracy, which is only one aspect of state capacity, and which in fact often changes as a result of conflict (e.g., regime change). Other measures of government capacity, such as GDP per

[4] The COW definition requires that the national government be an active participant in the conflict; that there are 1,000 battle-deaths per year, on average; that there is effective resistance by both sides; and that the conflict takes place within the national territory (Small and Singer 1982), (Sarkees 2000). UCDP/PRIO defines civil war similarly: the state is one of the parties involved; there is an opposition organization; the incompatability is over control of the government or territory; and there is a minimum of 25 battle-deaths per year, on each side of the conflict (Gleditsch et al. 2002; Harbom and Wallensteen 2007).

capita, or an oil dummy (Fearon and Laitin 2004), may be only loosely related to government capacity. Some efforts to operationalize government capacity use assessments of military capacity (Fearon and Laitin 1999). or attempt to measure the government's ability to accommodate demands for services (Knack 2001). These approaches to measuring government capacity have allowed only a weak role for the state, rather than fully incorporating the state as a key player in a civil conflict.

Hendrix (Hendrix 2010) offers an excellent analysis of the various measures of state capacity and their limitations: he argues that the researcher's intent, and the particular aspect of state capacity that is of interest, should influence what variable is selected. Particularly in studies of conflict onset, it is important to consider whether these measures are reflecting the presence of an underlying institutional infrastructure, like democracy, or if they are capturing annual variation in the government's ability to execute or implement its goals. The institutional structure often does not change from year to year, while the government's implementation capacity is likely to experience annual variations; and such fluctuations in capacity may explain conflict onset, rather than reflecting underlying structural issues that render a country more prone to conflict.

The ability of a government to collect revenue determines whether or not the state will be able to invest in infrastructure, education, health, and other public goods, including its ability to pay, train, and equip its security forces. Effectively, whether or not a government is able to raise revenue determines whether or not it will be able to fulfill its obligations to meet public needs and ensure security against both external and internal threats (Thies 2010); (Acemoglu et al. 2002); (Tilly 1975); (Gurr 1988). In his study of the role of primary commodities, Thies (Thies 2010) incorporated a test of the effect of government revenue on conflict onset, and found that while there is a positive relationship between commodity earnings and state revenue, there was no relationship between government revenue and conflict. These findings run counter to the intuition that state capacity should have some bearing on conflict risk, and are

confounded by the overwhelming effect of GDP, which may be capturing the same theoretical constructs as government revenue itself. While this study uses the same data as Thies, the results indicate that in sub-Saharan Africa, governance does play a significant role, and even at the global level, government capacity is significant when not confounded by GDP.

Government revenue thus relates closely to many conceptions of government capacity. Of course, there are some drawbacks to using aggregate government revenue, as existing data do not allow an examination of the tax structures and their level of sophistication in each country. Revenue, however, does offer a compelling alternative measure of government capacity to include in arguments of weak states and analyses of conflict onset.

2.4 Government Revenue and Conflict: A Theory and Model

This research examines government revenue as an alternative measure of government capacity; and the effect of government revenue on civil conflict in sub-Saharan Africa is then tested.

Changes in government revenue may affect conflict onset in multiple ways: by affecting government's capacity to repress conflict through use of force, through its ability to meet the needs of its people, or by making control of the government an appealing way for the opposition to enrich itself. The ability to collect revenues also reflects an underlying administrative capacity, which does not fluctuate in the same way, but may change more slowly over time. There are effectively two competing theories regarding government revenue and conflict – either decreases in government revenue lead to increases in conflict risk, or increases in revenue lead to increases in conflict risk. This work will test the validity of each of these arguments. Some mechanisms that underlie the former relationship should all work in the same direction – changes in military capacity, social responsiveness, and underlying capacity would parallel changes in government revenue, and move in the same direction. Therefore, a drop in government revenue in either the current year, or the previous year would be

expected to lead to an increase in conflict onset in any given country-year. The latter theory argues that an increase in government revenue would make the government a more attractive "prize" to rebels, which this analysis will also consider. This theory may be particularly relevant for a number of countries in sub-Saharan Africa that have been able to realize substantial profits from oil (or other minerals) or from aid, without simultaneously expanding the other aspects of government capacity that strong states have typically been required to develop (Strayer 1973).

I posit that total government revenue represents government capacity at its most basic level: regardless of the complexity of a government's tax structure, or other non-tax sources of revenue (excluding grants), the availability of money is fundamental to that government's ability to meet its obligations and fulfill its functions. How taxes are collected, and the administrative capacity that develops as a result may be important in terms of state-building as well; however, that more complex definition of state capacity is not explored here.

Data

Government Revenue Data

This research incorporates four measures of government revenue, covering the forty years from 1960-1999, to tackle this question from slightly different angles. The period of analysis was chosen based on the availability of data for all the variables of interest, and allows direct comparisons to other studies in the field. The analysis uses data that are part of an on-going collection effort by Johnson and Rabinowitz (Johnson and Rabinowitz 2005)[5], and used by Thies in an earlier study (Thies 2010) This dataset covers four measures of government capacity: government share, relative political capacity, tax ratio, and total revenue (including resource rents).[6] Each of these measures captures a slightly different aspect of revenue collection, with the

[5] The data were made available by Thies' (Thies 2010) replication data, published through the *Journal on Peace Research*.

[6] In the appendix I also use a slightly different dataset for the total revenue, which I compiled manually from IMF country reports. These reports do not include revenues from oil and minerals.

exception of the government share measure. *Government share* measures the amount of a society's resources consumed by the government, and is a ratio of the government's expenditures relative to GDP. These government expenditures include the amount spent on final goods and services, and include military spending. This variable thus captures the role of government in a country's economy. The *relative political capacity (RPC),* a ratio of the actual revenue collected to the predicted amount of collection[7], and the *tax ratio*, which is the ratio of taxes collected to GDP, both attempt to capture the government's ability to implement its tax collection system according to the law. The RPC is an attempt to capture how well the government is able to both formulate and administer a tax collection system, while the tax ratio reflects how much of the country's wealth (as measured by GDP) the government is able to capture through taxation. Both measures reflect, to some degree the administrative capacity of the government. *Total revenue* is simply the total tax and non-tax receipts collected by the government, and includes revenues from minerals and oil, and from state-owned enterprises. This measure simply captures the total resources available to the government for discharging its responsibilities to its citizens, and is the most basic measure of government capacity as it does not indicate anything about the government's actual administrative capacity, legitimacy, or role in the economy. These data are from the Penn World Tables 6.2 (Heston, Summers & Alten, 2006; Thies, 2010), and from IMF country reports, as collected by the author and analyzed in the Appendix.

None of these measures captures the level of sophistication of tax instruments or distinguishes between different revenue sources, such as state-owned enterprises or import/export taxes. The potential theoretical implications of each of these measures are explored in more detail in the discussion section.

[7] The predicted government revenue is calculated using the share of mining and exports in the economy, and the share of crude oil in exports. In very poor countries the share of agriculture is also included. These variables are used to assess the potential tax collection in each country. The RPC ratio is the actual total revenues extracted over the predicted extraction.

Conflict Onset Data

The conflict onset variable is from the UCDP/PRIO Conflict Data Program (Gleditsch et al. 2002); (Harbom and Wallensteen 2007). This definition of conflict uses a low threshold of 25 or more battle deaths to define a conflict, and counts the onset year as the first year in which that threshold is reached. If the number of battledeaths dips below that threshold there is no conflict counted in that year, although the conflict may be continuing at a low level. This means that in some instances a conflict is on-going, but may be counted as a new conflict onset when the 25 battledeath threshold is reached again. While this dataset may thus count multiple "starts" for the same conflict, it will allow me to capture the maximum number of conflict onsets in the sample. This analysis is already confined to sub-Saharan Africa, allowing for the maximum possible onsets given the already restricted sample size.

Controls

Additional control variables are incorporated, drawn from data from the Collier and Hoeffler (Collier and Hoeffler 1998) and Fearon and Laitin (Fearon and Laitin 2003) models to allow for comparability to commonly used and cited models: mountainous terrain[8], population size[9], ethnic fractionalization[10], religious fractionalization[11], substantial oil exports[12], and years at peace[13]. Mountainous terrain and population

[8] Mountainous terrain is calculated by Fearon and Laitin (Fearon and Laitin 2003) by measuring the difference between the highest and lowest point in the country.

[9] Population size is measured as the logged total population, lagged one year. These data are estimated by the World Bank using national census data, household surveys and UNHCR statistics on refugees. The inclusions of refugees, who may be fleeing wars has prompted researchers to lag this data to account for potential endogeneity problems.

[10] Ethnic fractionalization is measured by the ethnolinguistic fractionalization index (ELF), which reflects the likelihood that two randomly selected individuals from a country speak the same language.

[11] The religious fractionalization measure is similar to the ELF measure, and was estimated by Fearon and Laitin (Fearon and Laitin 2003).

[12] The oil measure developed by Fearon and Laitin (Fearon and Laitin 2003) is a dummy for years in which oil exports were more than one third of export revenues.

size are both theoretically linked to the ability of armed groups to recruit soldiers and effectively remain beyond the state's control (Fearon and Laitin 2003), although mountainous terrain remains a constant, while population is changing over time. Ethnic and religious fractionalization are thought to proxy for the ability of groups to organize and address grievances (Fearon and Laitin 2003), both of these measures remain largely constant over time. Countries that have oil exports exceeding one third of their GDP are thought to suffer from the "resource curse," contributing both to a weaker state, and to a more lucrative potential prize for rebels (Ross 2004b); (Humphreys 2005). Most of these variables are either constant over time, or are dummy variables (as in the oil variable), with the exception of population size and number of years at peace, both of which clearly change over time. Thus, although these variables are commonly used in models of conflict incidence and conflict onset models, there is little reason to expect that they would be related to proximate causes of conflict, although the may create the structural conditions for conflict (Brown 1996). The variable for years at peace allows for the fact that countries that experienced conflict within the last five years are more likely to fall back into conflict (Collier and Hoeffler 1998), and addresses potential temporal interdependence issues if conflict events are related (Beck et al. 1998).

While the main model only includes these controls, I also include a number of other alternative specifications in the Appendix to examine the potential effect that other measures of poverty may have in sub-Saharan Africa, such as infant mortality. Other variables that capture economic opportunity, such as openness to trade are also tested. There are a number of potential control variables that could be included in any specification of conflict onset, as the focus of this paper is the effect of government capacity, I only test alternative measures that have been shown as significant in other

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This is similar to the variable used by Collier and Hoeffler (Collier and Hoeffler 1998).

[13] This variable is simply the number of years since the last year in which there was an on-going conflict.

papers. For this reason, I do not include inequality[14], and other variables whose significance to conflict onset has not been established elsewhere, although I recognize that these may play important roles in ways that the existing proxies do not capture.

Table 2.1: Descriptive Statistics for the Period 1960-1999

		Observations
Countries in Global Sample		158
Countries in Global Sample that have experienced civil conflict		87
Countries in Sub-Saharan Africa		42
Countries in Sub-Saharan Africa that have experienced civil conflict		31
	Onset Count	Observations
Civil Conflict Onset (25 battledeath threshold), Global Sample	141	5270
Civil Conflict Onset (25 battledeath threshold), Sub-Saharan Africa Sample	55	1516
Civil War Onset (1,000 battledeath threshold), Global Sample	83	5270
Civil War Onset (1,000 battledeath threshold), Sub-Saharan Africa Sample	27	1516

Conflict data extracted from UCDP/PRIO Conflict dataset (Gleditsch 2002).

Note: Not all countries have complete data available for all years, only country-years with complete data are included.

The Model

The model developed here uses the Fearon and Laitin model (Fearon and Laitin 1999) as the foundation, as it is often used as a base from which to incorporate extensions (e.g., (Humphreys 2005); (Thies 2010)). I depart from the standard formulation by

[14] The GINI coefficient, which might be an appropriate measure, is problematic because the data are estimated in 5-year intervals, and are not available for many of the countries in sub-Saharan Africa. A more time-sensitive variable to capture income inequality may help researchers address remaining gaps in the literature.

replacing GDP per capita with government capacity. Variations of the model will also include economic measures, such as GDP per capita and openness to trade. The model includes additional control variables that have been found to be repeatedly significant in various studies[15]. It may be useful to think of the control variables as those that contribute to the underlying conditions for insurgency, while government revenue is a dynamic variable that may provide the spark that leads to conflict onset.[16]

The model, thus, is:

$$Onset_{it} = \alpha_{it} + \gamma_{it}GovtCap + \eta_{it}Population + \beta_{it}Instability + \tau_{it}Terrain + \phi_{it}Oil + \theta_{it}RelFrac + \chi_{it}EthFrac + \rho PeaceYrs + \varepsilon_{it}$$

The dependent variable, conflict onset, is a binary measure that takes the value of 1 if a conflict begins in that year, and 0 otherwise, thus this study does not address the question of conflict duration. Government capacity is measured in the four distinct ways outlined above, and each government capacity modeled is shown both with and without GDP included. These variables are also all lagged in order to address potential endogeneity concerns, as it could be argued that a conflict onset in a given year could lead to a drop in these measures, in addition to the effect that these government capacity measures have on conflict onset. Effectively, if the government capacity measures are not lagged, the model could be capturing the effect that conflict has on government revenue, rather than the effect a change in government capacity has on conflict risk. Lagging these government capacity variables by a year helps to address this concern, as conflict onset in a given year cannot directly affect the government capacity measures from a previous year.

[15] The model presented here is refined to exclude some variables that are not consistently significant, such as whether or not there is non-contiguous territory in the state, in order to retain statistical power.

[16] While population also changes from year to year, in general it is trending upward globally, although the rate of increase varies by country and is higher in sub-Saharan Africa. It is also hard to extract useful information from any annual variation in population, since the annual data is interpolated from decadal censuses.

A logistic regression analysis is employed, including the above independent variables in the specification. A logit analysis is designed to handle the binary nature of the dependent variable, and the combination of numerical and categorical independent variables. The inclusion of peace years in the specification also addresses the concern that conflict events are temporally interdependent by treating them as grouped duration data, following Beck, et.al. (Beck et al. 1998). As a conflict in a given year may be related to conflict in a previous period, the inclusion of peace years accounts for the possibility that the length of time at peace (the duration) is related to the risk of conflict.

2.5 Results

Few of the standard control variables retain their significance when the model is applied in sub-Saharan Africa. The only control variable that remains significant is population size, which is consistent with other work (Miguel et al. 2004); (Hendrix 2010). The number of years at peace also is not significant in most models, which is somewhat surprising, but not inconsistent with results in other studies (Fearon and Laitin 2003); (Thies 2010). Religious fractionalization turns out to be significant in the two models that include tax measures.[17] It is unclear what the potential mechanism for this would be, or the conditions under which it might be related, unless government tax agents are unable to collect taxes as efficiently in countries with high religious fractionalization for some reason[18].

The first table includes the results of models in sub-Saharan Africa, with the 25-battledeath threshold used in the UCDP/PRIO conflict onset definition, as the dependent variable. Each of the government capacity indicators is significant when

[17] Ethnic fractionalization and religious fractionalization are somewhat correlated in sub-Saharan Africa (0.33), but not very highly, so these two variables are likely capturing distinct aspects of cultural differences.

[18] This is a puzzling relationship – it is possible that countries with high religious fractionalization also have high religious salience, making it more likely that individuals would tithe to their religious institution instead of paying taxes, especially if the government represents a different religious group. However, this is merely speculation and is probably best explored through case studies.

GDP per capita is excluded, and all except the tax ratio remain significant even when GDP per capita is included, while GDP is not significant in any of the models, suggesting that government capacity in sub-Saharan Africa plays a strong role. The results are largely similar with the higher, 1,000-battledeath threshold, included in the Appendix. The results are presented here, and discussed more fully in the following section.

Table 2.2: Conflict Onset and Government Capacity, Logit Regression

	Model 1A	Model 1B	Model 2A	Model 2B	Model 3A	Model 3B	Model 4A	Model 4B
(Intercept)	-8.23^{***}	-7.42^{***}	-6.53^{***}	-5.96^{***}	-6.57^{***}	-6.20^{***}	-8.18^{***}	-7.59^{***}
	(1.45)	(1.62)	(1.30)	(1.45)	(1.31)	(1.43)	(1.34)	(1.57)
Instability	−0.20	−0.16	0.04	0.06	0.06	0.08	0.03	0.06
	(0.41)	(0.41)	(0.37)	(0.37)	(0.37)	(0.37)	(0.37)	(0.37)
Population	0.56^{**}	0.51^{**}	0.53^{**}	0.50^{**}	0.51^{**}	0.49^{**}	0.50^{**}	0.48^{**}
	(0.18)	(0.19)	(0.17)	(0.18)	(0.18)	(0.18)	(0.17)	(0.18)
Mountainous Terrain	0.09	0.09	0.17	0.15	0.14	0.13	0.14	0.13
	(0.13)	(0.13)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
Oil	−0.84	−0.56	−1.28	−1.05	−1.21	−1.03	−1.08	−0.94
	(0.78)	(0.82)	(0.80)	(0.84)	(0.80)	(0.83)	(0.79)	(0.83)
Ethnic Frac.	−0.04	−0.04	0.33	0.30	0.41	0.34	0.42	0.36
	(0.78)	(0.79)	(0.75)	(0.75)	(0.76)	(0.76)	(0.77)	(0.77)
Religious Frac.	−1.04	−1.11	-1.84^{*}	-1.83^{*}	$-1.70^{\dagger}$	$-1.69^{\dagger}$	$-1.72^{\dagger}$	$-1.72^{\dagger}$
	(0.95)	(0.96)	(0.90)	(0.91)	(0.88)	(0.89)	(0.89)	(0.90)
Years at Peace	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00	0.00	−0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
GDP (lagged)		−0.42		−0.32		−0.25		−0.23
		(0.33)		(0.31)		(0.32)		(0.32)
Govt. Share (lagged)	3.66^{*}	3.59^{*}						
	(1.46)	(1.44)						
RPC (lagged)			$-0.62^{\dagger}$	$-0.55^{\dagger}$				
			(0.32)	(0.31)				
Tax Ratio (lagged)					$-3.63^{\dagger}$	−3.00		
					(2.01)	(2.07)		
Total Revenue (lagged)							-0.63^{*}	$-0.54^{\dagger}$
							(0.31)	(0.33)
N	1163	1160	1230	1227	1230	1227	1230	1227
AIC	402.71	402.15	425.31	425.50	425.77	426.47	425.42	426.26
BIC	584.83	604.40	609.44	630.00	609.90	630.96	609.55	630.75
$\log L$	−165.36	−161.08	−176.65	−172.75	−176.89	−173.23	−176.71	−173.13

Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 2.3: Conflict Onset and Government Capacity, Odds Ratio

	Model 1A	Model 1B	Model 2A	Model 2B	Model 3A	Model 3B	Model 4A	Model 4B
Instability	0.82	0.85	1.04	1.06	1.06	1.09	1.03	1.06
Population	1.75**	1.67**	1.71**	1.64**	1.66**	1.63**	1.64**	1.61**
Mountainous Terrain	1.1	1.09	1.18	1.17	1.15	1.14	1.15	1.14
Oil	0.43	0.57	0.28	0.35	0.3	0.36	0.34	0.39
Ethnic Frac.	0.96	0.96	1.39	1.35	1.5	1.41	1.52	1.44
Religious Frac.	0.35	0.33	0.16*	0.16*	0.18·	0.18·	0.18·	0.18·
Years at Peace	1	1	1	1	1	1	1	1
GDP (lagged)		0.66		0.72		0.78		0.8
Govt. Share (lagged)	38.80*	36.15*						
RPC (lagged)			0.54·	0.58·				
Tax Ratio (lagged)					0.03·	0.05		
Total Revenue (lagged)							0.53*	0.58·

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '·' 0.1

The odds-ratios are converted from the coefficients in the first table, so they do not have any significance attached to them; but they have been marked to assist the reader in identifying the relevant coefficients.

The coefficients on a logit model cannot be readily interpreted; therefore they have been converted to the more easily understood odds ratio presented in Table 2.3. As the above table shows: if the government share increases by one standard deviation, the odds (effectively the likelihood) of conflict occurring increase by nearly

40%, holding all else equal.[19] When GDP per capita is included (Model 1B), the results drop only slightly so that conflict becomes 36% more likely when government share increases by one standard deviation. For each of the other variables, an increase in the government capacity indicators lowers the risk of conflict onset. Increasing the relative political capacity, which means that the government is collecting more revenue relative to how much it expects to collect, lowers the risk of conflict by 46%. This result remains consistent when GDP per capita is included (Model 1B), with the risk of conflict now lowered by 42%. The tax ratio, which shows the amount of taxes collected relative to GDP, lowers the risk substantially, although this effect is no longer significant when GDP is included. Finally, the effect of increasing total revenue by one standard deviation lowers the risk by 47%, dropping to 42% if GDP per capita is included.

In addition to the results presented here, a number of models that used alternative economic indicators are included in the Appendix. The effect on conflict onset of negative shocks to government revenue was tested, following Miguel, et.al. (Miguel et al. 2004). Neither a 10% nor 20% drop from the previous year in total government revenue had a significant effect, although they had the expected positive sign: a revenue shock increases the risk of conflict onset. Infant mortality was also included in a specification with total government revenue, as an alternative to GDP per capita, to test for the effect of poverty more generally (Goldstone et al. 2005). Again, the coefficients were insignificant. Another proxy that is sometimes used to capture economic opportunity potential is openness to trade, which was found to be insignificant in each of the models.

Each model was also run with GDP included; the results are shown in the Appendix. Including GDP in the regression with government revenue is somewhat problematic,

[19] For instance, the average government share is approximately 20% (again, government share is the government's expenditures relative to GDP). If the share increases by one standard deviation, the government share would then be close to 30% of the economy, and represent an increased risk of conflict onset of 40%.

as the two variables are correlated – as one would expect.[20] In the global sample, the effect of GDP per capita swamps the effect of the government revenue measures when both are included, which matches the results found by Thies (Thies 2010). When the model is confined to sub-Saharan Africa, however, most of the government revenue measures remain significant (with a large coefficient) regardless of whether or not GDP per capita is included, while GDP per capita by itself never emerges as significant. Again, this is likely due to the lack of variation with GDP per capita in sub-Saharan Africa, and suggests that a better variable is required to proxy for poverty, if that is indeed the theoretical mechanism that GDP per capita is capturing.

A variety of additional model specifications can be found in the Appendix, including the effect of military expenditures, different specifications of conflict for the dependent variable, and the addition of foreign assistance. These models do not significantly alter the implications of the results presented here.

2.6 Discussion

The results outlined above provide useful insights into conflict onset more generally, and for sub-Saharan Africa, in particular. The following section will discuss each of the four measures of government capacity in turn: government share, relative political capacity, tax ratio, and total revenue (including resource rents).

Government Share

Government share is the only variable that looks at expenditures, rather than revenue. Government expenditures include the amount spent on final goods and services, including military spending, but excluding transfers or debt payments. Higher expenditures require that the government has more money to spend, so these factors should be related to the revenue collected by the government; but more importantly,

[20] In the global sample, the correlation is 0.44 between government revenue and GDP. It drops to 0.29 in the sub-Saharan Africa sample, suggesting that government revenues may be less tied to GDP in these countries, which may indeed be the case in countries that are overly reliant on commodity exports, like oil. The low correlation in sub-Saharan may also explain why government revenue remains significant when GDP is included

government share reflects the government's spending decisions. How much a government should spend, or the appropriate size of government is a matter of debate – in developed and developing countries alike. Interpreting this variable therefore is tricky, as it makes no distinction about what the government spends money on: in one country the government may be investing heavily in education, while elsewhere it is spending on military materiel; yet the government share of the total economy may be the same for both.

The empirical analysis shows that increasing the government share by one standard deviation substantially increases the chance of conflict beginning by almost 40%. Since this variable is the ratio of government expenditures to GDP, the government share may increase either because expenditures increase (relative to GDP), or because GDP shrinks. From the available data it is difficult to determine which is the stronger effect, and indeed it may vary over time and by country. The literature suggests that one of two mechanisms is at work: the first is that as the government share of GDP increases, it appears to be a more lucrative target for potential rebel groups, who see the government as the primary pathway to access wealth. The alternative mechanism is that the government share increases, not because the government is taking over more of the economy, but because the overall economy is smaller; and fewer jobs makes some people turn to fighting. These two mechanisms may also reinforce each other: a large government may seem to be "the only game in town," and thus a more attractive target, at the same time that employment alternatives to fighting (and looting) are becoming scarce. In either case, this factor may be reflecting the health of the larger economy, in addition to government capacity. There is a very weak negative correlation (-0.09) between GDP and government expenditures, suggesting that the government share may become less important as countries become wealthier. However, as most countries in sub-Saharan Africa are so poor, it is likely that both effects are at play at different times. Indeed, because these countries are so poor the government's expenditures, particularly those that are visible to the public, may make

the government seem like an attractive "prize." How this interacts with inequality would be an interesting area for future research.

Relative Political Capacity and Tax Ratio

The relative political capacity and the tax ratio both relate specifically to the government's ability to raise revenue through taxes. Relative political capacity (RPC) captures the capacity of government to formulate a tax system and collect taxes, which is a function of both the government's administrative capacity, and its legitimacy. Legitimacy, particularly, is a difficult concept to disentangle; and how closely tax collection tracks legitimacy is arguable (Lieberman 2002); (Gilley 2006). Paying taxes may signify an implicit agreement that the government has the right to levy and collect taxes (Johnson et al. 2006); but tax collection may be entirely coercive, and payment of taxes may reflect nothing other than fear of reprisal. The ratio of actual revenues to expected revenues (the RPC) is a good indicator of how well the government is able to implement its tax collection laws, however, and theoretically is closely linked to administrative capacity. The tax ratio is in relation to GDP, but unlike the government share variable discussed above, one would expect the numerator (tax revenue) and denominator (GDP) to move in the same direction – as GDP goes up, tax revenues go up. While this is not always the case, it helps to explain why these two variables have similar effects, and keeps the interpretation clear.

In the sample for sub-Saharan Africa examined here, there is a clear link between improving the RPC or the tax ratio, and lowering the likelihood of civil conflict onset. Whether or not the risk of conflict is lowered because of an increase in "legitimacy" or administrative capacity is unclear. A change in the perceived legitimacy of the government would be linked to a change in the proximate causes for conflict (i.e., a conflict trigger), while changes to administrative capacity could indicate a shift in the underlying structural conditions that make conflict more likely. These results cannot distinguish which mechanism is doing the heavy lifting. Taken together, however these measures suggest that the ability to collect taxes is important to a government's

ability to head off civil conflict – either because the government has the resources to meet the needs of its people, or to suppress rebellions.

Total Revenue and Lagged Total Revenue

The above measures are remarkably consistent. They suggest that a better understanding of tax collection would help clarify the role of government capacity and how it relates to conflict onset, particularly in sub-Saharan Africa. The effect of total revenues, lagged one year, show that the effect of increasing revenues themselves, regardless of the source of revenue, or the tax structures also significantly lowers the risk of conflict onset. This measure does not break down the sources of government revenue, but taken in conjunction with the insignificance of the oil dummy variable, it suggests that the level of government revenue alone is extremely relevant.

When total revenues are interacted with the oil dummy, the coefficient for total revenue remains negative and significant, but the coefficient for the interaction effect is positive (results in the Appendix). The difference between the effect of government revenue in oil states and non-oil states highlights the importance of understanding what mechanisms are at work, and under what circumstances. For non-oil states, an increase in revenues likely represents an increase in government capacity that decreases the risk of conflict onset – through improved service delivery, better economic conditions, or more repressive capacity. In contrast, an increase in government revenue for oil states may serve to increase the "prize" value of the central government. State-level conditions thus can help determine which of these mechanisms is more relevant, and when. Understanding the distinction is likely to improve predictions about when a rise in total revenue increases the probability of conflict, and when it will not.

The significance of the government revenue variable in sub-Saharan Africa is notable, particularly as it retains its significance even when GDP per capita is included . This suggests that in sub-Saharan Africa, increased government capacity plays a critical in

offsetting the likelihood of conflict. In contrast, good economic opportunities are more likely to mitigate the effects of a poor government in other parts of the world. The government revenue variable is consistently significant throughout sub-Saharan Africa, even when other economic variables are included, such as openness to trade, foreign direct investment, and infant mortality (results in the Appendix). The importance of government capacity may thus be more relevant in sub-Saharan Africa than elsewhere, in part because poverty alone cannot explain why conflict occurs only in some countries at certain times, when poverty is pervasive throughout the region. The data used here make it difficult to determine if it is the redistribution effects of a wealthier government, or the repressive capacity of the government that accounts for the strength of government revenue in explaining conflict onset. These results should not be taken to mean that the overall levels of poverty in sub-Saharan Africa are irrelevant to conflict. On the contrary, there is a strong argument to be made that the widespread poverty helps create the conditions for insurgency, and inequality may also play a role. However, as both of these factors are widespread across the continent and vary only slowly over time, it is difficult to link them directly to conflict onset.

It is interesting to note that government revenue is significant, while GDP by itself is not. Globally, government revenues are weakly linked to GDP[21]; in sub-Saharan Africa, this relationship is even weaker.[22] This finding is contrary to some theories that propose that higher government revenues make the government is a bigger potential "prize" to be captured by rebels (Besley and Persson 2008). This result should not be so surprising, however: the government is becoming an attractive prize at the same time that its ability to secure its position is becoming stronger, and for the same reason (Strayer 1973). When government revenues derive largely from sectors like oil, which can be closely controlled by the state, the "prize" mechanism may be more relevant as control of the government leads to control of these revenues. And that may be a sufficiently attractive motivation for rebel leaders to attack the

[21] Correlated at 0.44 in the global sample.
[22] Correlated at 0.29 for the sub-Saharan Africa sample.

government, despite the government's relatively stronger position. When the government is earning revenues from sectors that have broader reach within the economy, such as agriculture, this argument may not be as salient. Moreover, it is important to remember that while a wealthy government may represent an attractive target for rebels, it is also wealthier governments that are best able to repress potential uprisings. The "prize" argument is not entirely without merit however, as in some cases even a government with low revenues, relative to other countries (or time periods), may still represent an absolute prize to rebels, whose alternative options have even lower returns. Whether or not this argument holds at the country level would have to be investigated through case studies.

Of the additional variables that were included in alternative specifications, the one most intuitively related to government capacity is military expenditure – the military capacity of a country represents the Weberian concept of the state as controlling legitimate means of violence. Including the military expenditures of the government as a variable was not significant, however. Models with military expenditures as a ratio to government share (which is related to overall government expenditures), to government revenue, and to GDP consistently found these variables to be insignificant. Nor was there any interaction effect between government revenue and military expenditures. This may be because the correlation between military expenditures and total government revenue is quite small (0.13). The very low correlation between military expenditures and government revenue, or even GDP (0.24), suggests that the role of the military cannot be measured simply by government expenditures on the military. In some countries, the legitimate use of force may be in the hands of the police, which would not be represented in military expenditures. Improving measures to capture the government's control of force, and its ability to project that force may help address this gap between intuition and empirical results.

2.7 Conclusion

This research underscores the difficulties inherent in attempts to apply findings from large-N data analyses to regional and country levels when evaluating the potential for

conflict. Globally, aggregated economic performance indicators seem to have shown that economic downturns are accompanied by an increased risk of conflict. At the regional level of sub-Saharan Africa, however, that correlation breaks down. I have shown that a major reason why these factors are not significant in sub-Saharan Africa is that they show relatively little variation among sub-Saharan African countries – the very countries that are in fact most prone to civil war. Indeed, GDP per capita has varied relatively little over time or between countries in sub-Saharan Africa. Yet the general literature on civil wars persists in relying on these very factors as key factors in causing civil conflict. This explains, perhaps, why this literature has been unhelpful in predicting the onset of violence.

This paper has focused on the effect of government capacity, as captured by multiple government revenue measures, on conflict onset in sub-Saharan Africa, and has shown it to be critical to understanding both the underlying conditions that make conflict more likely, and the proximate changes in a country that contribute to a conflict actually starting. Government revenue captures the administrative capacity of government, and is a more direct measure of the resources available to the government to offset conflict risk. In sub-Saharan Africa, where government revenue is not closely tied to GDP or military expenditures, this measure offers an important perspective on government capacity. Government revenue provides a better tool to assess inter-annual variation than some other measures of government capacity, such as POLITY measures. Indeed, the government revenue variable represents a government's ability to carry out two fundamental government functions: the administrative capacity to collect taxes in some form, and the fiscal capacity to provide at least some government services (be it social services or security operations).

In the analysis of sub-Saharan Africa, government revenue measures are consistently significant in relation to conflict onset risk, even when multiple other economic health indicators are included. This offers an improvement over the general model, which

has very little explanatory power when applied specifically to sub-Saharan Africa – and indeed, one suspects is likely to break down when applied to other regions or individual countries as well. One potential explanation for this difference with the global conflict models is that poverty is so widespread throughout the continent that it may provide a systemic reason why sub-Saharan African countries are prone to conflict more broadly, but not why some countries fall into conflict and not others. Government revenues, on the other hand, have ample variation between countries, and over time, and can thus offer more leverage in explaining conflict in sub-Saharan Africa. Changes in these measures indicate a shift in the underlying conditions for conflict, which may in turn prompt responses in factors that then trigger conflict onsets. Disentangling these mechanisms offers a number of new opportunities for future research.

Moving Forward

Government revenue relates closely to many conceptions of government capacity, but current measures do not allow researchers to identify which theoretical concept of government capacity is at work. The existing data do not allow an examination of the tax structures and their level of sophistication in each country. It may be that government revenues are collected from the population directly, as taxes (such as income taxes, or value-added taxes), in which case government revenues could reflect the legitimacy of the government. It is also possible that the government extracts revenue through indirect taxes, such as taxes on imports or exports, or from rents paid by outside companies to extract resources, like oil. A high level of government revenue can thus create a misleading picture of the level of legitimacy and accountability the government actually enjoys. Understanding *how* the government is collecting revenues, and from whom, would help to distinguish between the importance of simply having resources on hand; where those revenues come from; and what the revenue collection methods indicate about the relationship between the government and the citizenry. Further research on the sources of government revenue will help demonstrate the importance of disaggregating primary commodities so as to

understand how variation in revenues from distinct types of commodities, such as oil versus coffee, affects government revenue, and thereby the risk of conflict.

While the additional variables tested in the Appendix offer alternative measures for theoretical controls, such as poverty, none address the larger macroeconomic environment in which changes in government revenue, and conflict risk occur. Both GDP per capita and government revenue data were deflated to 1985 US dollars, which accounts for some aspects of the macroeconomic environment, but there were a number of other changes going on in this period. Structural adjustment programs, which enforced austerity measures on many governments in sub-Saharan Africa, could affect how government revenues were used, at the same time as efficiency in revenue collection was a major donor focus (World Bank 2008). Analyses of civil conflict rarely take these macroeconomic issues into account, although their implications may be embedded in control variables, such as GDP per capita. For comparability to other studies, the macroeconomic environment was taken as given in this analysis as well, although it is important to note the potential implication of these changes for conflict risk. As structural adjustment programs particularly affected how government revenues were collected and spent, this will be an important area for future research. The linkages between government revenue, government capacity and the economy thus need to be more clearly understood in order to determine the precise mechanisms through which the level of government revenue affects conflict onset. The hope is that this cross-national study has introduced not only new answers, but new questions to be broached at the country-level.

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APPENDIX 1: Data

Government Revenue Data Collection

I collected data on government revenue from publicly available documents of the International Monetary Fund (IMF) – supplementing the replication data made available by Thies (Thies 2010) on the JPR web-site. The IMF makes available, for subscribers, a Government Finance Statistics database on CD-ROM. This database, however, is an incomplete assemblage of the data available from the IMF, offering data only for selected years and countries (reference the "Guide to Country Tables"). The IMF archives have the country reports and statistical appendices available on all member countries, either on their web-site or electronically at the physical archives in Washington, DC. Using these sources a complete file for each of the 46 countries of sub-Saharan Africa, back to 1970 was compiled.

Using mostly the Statistical Appendices, and the country reports in earlier years, it was possible to extract government revenue data. The data was disaggregated according to the level of detail in the reports, including tax and non-tax revenue, grants, and other applicable revenue streams. Oil data was always disaggregated at some level in the original reports, so it was possible to keep these separate. Mineral revenues were also usually listed in a separate line item, so those revenue streams could also be maintained separately.

In the original data file, a notation was made for any specific variation. The most common issue was standardizing the fiscal year, so the data in the year in which the fiscal year ended was used. The other main issue was ensuring that the data were recorded in the same currency and magnitude for each year (e.g., millions or billions). For countries in which the currency changed, it was generally only a minor problem as the currency change was often just a name change, and therefore converted at par. To convert each country's currency into US dollars, the average exchange rate for the year was used to change from the country's currency into US dollars. Then the Consumer Price Index converter was used to deflate each year to 1985 US dollars.

The data used by Thies (2010), which was compiled by Johnson and Arbetman Rabinowitz (Johnson and Arbetman Rabinowitz 2005) used a largely similar method in regards to the currency conversion, although they used a different method to standardize the fiscal year, weighting the total revenue by the number of months in a given calendar year. They also included all revenues, including those from oil and minerals.

Variable Description

Variable	*Description*
Civil conflict onset	1 = civil conflict (25 battledeath threshold reached) starts current year, 0 = otherwise
Civil war onset	1 = civil conflict (1,000 battledeath threshold reached) starts current year, 0 = otherwise
GDP per capita	Thousands of 1985 US dollars, lagged one year
Population	Logged population size, lagged 1 year
Mountainous terrain	Estimate of highest and lowest point in a country
Oil exporter	1 => 1/3 of export revenues, 0 = otherwise
Instability	1 => 3 in polity in last 3 years, 0 = otherwise
Ethnic fractionalization	Probably that 2 randomly chosen individuals belong to different ethno-linguistic groups
Religious fractionalization	Probably that 2 randomly chosen individuals belong to different religious groups
Government share	Government expenditures/GDP
Total revenue	Taxes on income, profits, and capital gains, social security contributions, payroll, property, domestic goods, international trade and transactions, and non-tax revenue
Tax ratio	Total revenue minus non-tax revenue and social security contributions/GDP
RPC	Actual/predicted level of tax revenue extraction
Trade openness	Imports plus exports/GDP
ODA	Official grants and/or total revenue
Military expenditures	Military expenditures by the government, including procurement and salaries
Infant mortality	Estimate of annual infant mortality rate, extrapolated between census data
10% revenue shock	10% drop in revenue from prior period to current period
20% revenue shock	20% drop in revenue from prior period to current period

APPENDIX 2: Additional Model Regression Results

Table 1: Civil War as Dependent Variable

	Model 1A	Model 1B	Model 2A	Model 2B	Model 3A	Model 3B	Model 4A	Model 4B
(Intercept)	-9.75^{***}	-9.60^{***}	-5.88^{***}	-5.88^{**}	-6.50^{***}	-6.75^{***}	-9.85^{***}	-10.40^{***}
	(2.09)	(2.20)	(1.72)	(1.88)	(1.79)	(1.86)	(1.78)	(2.06)
instab	0.13	0.16	0.42	0.45	0.47	0.52	0.41	0.45
	(0.54)	(0.54)	(0.47)	(0.47)	(0.47)	(0.47)	(0.47)	(0.48)
lpopl1	0.49^{*}	$0.49^{\dagger}$	$0.37^{\dagger}$	$0.38^{\dagger}$	0.34	0.37	0.32	0.36
	(0.25)	(0.26)	(0.21)	(0.22)	(0.22)	(0.23)	(0.22)	(0.22)
lmtnest	0.10	0.10	0.25	0.25	0.19	0.20	0.20	0.20
	(0.19)	(0.19)	(0.20)	(0.20)	(0.19)	(0.19)	(0.19)	(0.19)
oil1	0.38	0.39	0.35	0.34	0.54	0.44	0.74	0.62
	(0.85)	(0.87)	(0.76)	(0.79)	(0.75)	(0.77)	(0.74)	(0.76)
ethfrac	−0.45	−0.44	0.51	0.48	0.52	0.48	0.67	0.62
	(1.15)	(1.16)	(1.12)	(1.12)	(1.12)	(1.12)	(1.15)	(1.15)
relfrac	2.05	1.88	−0.03	−0.15	0.48	0.32	0.35	0.27
	(1.66)	(1.71)	(1.57)	(1.59)	(1.51)	(1.55)	(1.54)	(1.58)
peaceyrs	$-0.04^{\dagger}$	$-0.04^{\dagger}$	-0.04^{*}	-0.04^{*}	$-0.04^{\dagger}$	$-0.04^{\dagger}$	−0.03	−0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
gdpenl		−0.04		0.01		0.14		0.17
		(0.30)		(0.28)		(0.29)		(0.28)
govtsharl1	4.53^{*}	4.48^{*}						
	(2.29)	(2.28)						
rpcl1			-1.68^{***}	-1.67^{**}				
			(0.51)	(0.51)				
taxratl1					-7.17^{*}	-7.61^{*}		
					(3.18)	(3.35)		
logrevl1							-1.25^{**}	-1.30^{**}
							(0.41)	(0.42)
N	1273	1260	1346	1333	1346	1333	1346	1333
AIC	231.93	233.60	243.73	245.38	250.26	251.62	247.23	248.55
BIC	417.30	439.15	431.11	453.19	437.63	459.42	434.60	456.36
$\log L$	−79.97	−76.80	−85.87	−82.69	−89.13	−85.81	−87.61	−84.27

Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 2: Civil Conflict as Dependent Variable, with Military Expenditure

	Model 1	Model 2	Model 3	Model 4
(Intercept)	−9.31***	−7.36***	−7.38***	−9.14***
	(1.61)	(1.43)	(1.46)	(1.82)
instab	−0.15	0.08	0.09	0.35
	(0.41)	(0.37)	(0.37)	(0.48)
lpopl1	0.69***	0.64***	0.60**	0.19
	(0.20)	(0.19)	(0.19)	(0.23)
lmtnest	0.10	0.17	0.15	0.19
	(0.13)	(0.14)	(0.14)	(0.20)
oil1	−0.39	−0.85	−0.79	0.47
	(0.81)	(0.83)	(0.83)	(0.78)
ethfrac	0.03	0.38	0.43	0.56
	(0.78)	(0.75)	(0.75)	(1.18)
relfrac	−1.20	−1.96*	−1.77*	0.80
	(0.95)	(0.91)	(0.88)	(1.62)
peaceyrs	−0.00	−0.00	−0.00	−0.03
	(0.01)	(0.01)	(0.01)	(0.02)
milex	−0.00	−0.00	−0.00	0.00*
	(0.00)	(0.00)	(0.00)	(0.00)
govtsharl1	3.90**			
	(1.46)			
rpcl1		−0.57†		
		(0.32)		
taxratl1			−3.04	
			(2.04)	
logrevl1				−1.34***
				(0.40)
N	1163	1230	1230	1346
AIC	401.50	424.58	425.65	245.81
BIC	603.85	629.17	630.24	454.01
log L	−160.75	−172.29	−172.82	−82.91

Standard errors in parentheses

† significant at $p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

Table 3: Civil Conflict as Dependent Variable, with Infant Mortality

	Model 1	Model 2	Model 3	Model 4
(Intercept)	−10.65***	−8.70***	−8.37***	−9.75***
	(2.00)	(1.83)	(1.92)	(1.75)
instab	−0.11	0.10	0.11	0.08
	(0.48)	(0.42)	(0.42)	(0.43)
lpopl1	0.80***	0.80***	0.77***	0.75***
	(0.23)	(0.21)	(0.21)	(0.21)
lmtnest	−0.02	0.03	0.01	0.02
	(0.16)	(0.16)	(0.15)	(0.15)
oil1	−1.79	−2.13†	−2.06†	−1.86†
	(1.10)	(1.10)	(1.10)	(1.10)
ethfrac	−0.64	−0.29	−0.19	−0.17
	(0.89)	(0.85)	(0.86)	(0.87)
relfrac	−0.77	−1.52	−1.48	−1.56
	(1.09)	(1.02)	(1.01)	(1.03)
peaceyrs	−0.00	−0.01	−0.01	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)
infmortest	0.01	0.00	−0.00	−0.00
	(0.01)	(0.01)	(0.01)	(0.01)
govtsharl1	3.60*			
	(1.69)			
rpcl1		−0.48		
		(0.34)		
taxratl1			−3.42	
			(2.45)	
logrevl1				−0.64
				(0.39)
N	1038	1105	1105	1105
AIC	329.12	350.94	350.78	350.50
BIC	526.92	551.24	551.08	550.80
log L	−124.56	−135.47	−135.39	−135.25

Standard errors in parentheses

† significant at $p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

Table 4: Civil Conflict as Dependent Variable, with Openness to Trade

	Model 1	Model 2	Model 3	Model 4
(Intercept)	−6.34***	−5.27**	−5.78***	−7.29***
	(1.74)	(1.61)	(1.58)	(1.74)
instab	−0.24	0.01	0.03	0.02
	(0.41)	(0.38)	(0.38)	(0.38)
lpopl1	0.37†	0.42*	0.43*	0.43*
	(0.20)	(0.19)	(0.20)	(0.19)
lmtnest	0.11	0.16	0.14	0.14
	(0.14)	(0.14)	(0.14)	(0.14)
oil1	−0.58	−1.14	−1.10	−1.00
	(0.79)	(0.80)	(0.80)	(0.79)
ethfrac	0.28	0.54	0.55	0.55
	(0.79)	(0.77)	(0.77)	(0.78)
relfrac	−1.05	−1.79*	−1.63†	−1.65†
	(0.93)	(0.90)	(0.87)	(0.88)
peaceyrs	0.00	−0.00	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
open	−1.22*	−0.79	−0.55	−0.50
	(0.62)	(0.63)	(0.65)	(0.64)
govtsharl1	4.33**			
	(1.49)			
rpcl1		−0.62†		
		(0.32)		
taxratl1			−3.21	
			(2.08)	
logrevl1				−0.56†
				(0.32)
N	1163	1223	1223	1223
AIC	400.47	425.18	426.60	426.39
BIC	602.82	629.54	630.96	630.76
log L	−160.23	−172.59	−173.30	−173.20

Standard errors in parentheses

† significant at $p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

Table 5: Civil Conflict as Dependent Variable, with Official Direct Assistance (ODA)

	Model 1	Model 2	Model 3	Model 4
(Intercept)	−8.33***	−6.80***	−6.85***	−8.35***
	(1.45)	(1.32)	(1.34)	(1.35)
instab	−0.23	−0.00	0.02	−0.01
	(0.41)	(0.38)	(0.38)	(0.38)
lpopl1	0.57**	0.55**	0.53**	0.52**
	(0.18)	(0.17)	(0.18)	(0.17)
lmtnest	0.11	0.18	0.16	0.15
	(0.14)	(0.14)	(0.14)	(0.14)
oil1	−0.78	−1.16	−1.10	−0.98
	(0.78)	(0.80)	(0.80)	(0.80)
ethfrac	−0.04	0.36	0.41	0.42
	(0.78)	(0.75)	(0.76)	(0.77)
relfrac	−1.22	−1.96*	−1.82*	−1.84*
	(0.97)	(0.91)	(0.89)	(0.90)
peaceyrs	−0.00	−0.01	−0.00	−0.00
	(0.01)	(0.01)	(0.01)	(0.01)
oda	0.77	1.02	0.99	0.96
	(0.76)	(0.75)	(0.73)	(0.74)
govtsharl1	3.36*			
	(1.50)			
rpcl1		−0.57†		
		(0.31)		
taxratl1			−3.37†	
			(2.01)	
logrevl1				−0.59†
				(0.31)
N	1163	1230	1230	1230
AIC	403.83	425.80	426.28	426.04
BIC	606.18	630.39	630.87	630.63
log L	−161.92	−172.90	−173.14	−173.02

Standard errors in parentheses

† significant at $p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

Table 6: Civil Conflict as Dependent Variable, with 10 and 20 percent revenue shocks

	Model 1	Model 2	Model 3	Model 4
(Intercept)	−7.28***	−6.26***	−7.28***	−6.26***
	(1.19)	(1.39)	(1.19)	(1.38)
instab	−0.00	0.02	−0.01	0.02
	(0.37)	(0.37)	(0.37)	(0.37)
lpopl1	0.51**	0.45*	0.51**	0.45*
	(0.17)	(0.18)	(0.16)	(0.18)
lmtnest	0.19	0.17	0.18	0.16
	(0.13)	(0.13)	(0.13)	(0.13)
oil1	−0.78	−0.43	−0.73	−0.38
	(0.67)	(0.72)	(0.66)	(0.71)
ethfrac	0.43	0.40	0.41	0.38
	(0.74)	(0.74)	(0.74)	(0.74)
relfrac	−1.39	−1.43	−1.38	−1.42
	(0.86)	(0.88)	(0.86)	(0.88)
peaceyrs	−0.01	−0.01	−0.01	−0.01
	(0.01)	(0.01)	(0.01)	(0.01)
gdpenl		−0.53		−0.53
		(0.35)		(0.35)
revshock10	0.32	0.29		
	(0.35)	(0.35)		
revshock20			0.37	0.34
			(0.45)	(0.46)
N	1271	1268	1271	1268
AIC	449.22	447.53	449.43	447.70
BIC	634.53	653.34	634.74	653.50
$\log L$	−188.61	−183.77	−188.72	−183.85

Standard errors in parentheses

† significant at $p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

Chapter 3: The Effect of Agriculture on Government Capacity in sub-Saharan Africa

3.1 Introduction

Agriculture plays a dominant role in the economies of sub-Saharan Africa, and its improvement has occupied development professionals and academics alike for decades. The contribution of the agricultural sector to other aspects of a country's development, such as government capacity is less established. This paper explores the question of how agriculture affects government revenue in sub-Saharan Africa from a structural perspective and, importantly, introduces a new measure of the agricultural sector to demonstrate the value-added contribution of agriculture. The role of agricultural exports in generating government revenues, specifically, is compared to the effect of the agricultural sector as a whole on revenues.

The theory of structural transformation suggests that improving productivity in the agricultural sector allows for resources, especially labor, to shift into other economic activity, particularly industry. This shift then drives the economy as a whole forward as labor is absorbed into industrial and service jobs (Timmer 1998). The potential for agricultural growth to drive a structural transformation from an agrarian to an industrialized economy has, in fact, been realized in many countries, including the United States. In some places, particularly in sub-Saharan Africa, however, the excess labor force has not been absorbed by activities with higher productivity, leading to a situation in which neither the agricultural sector nor other sectors have been able to drive the economy forward (Badiane 2011). The focus in sub-Saharan Africa on industrialization as distinct from non-farm rural activity has over-looked the prominent role that agriculture can play as a foundation for early industrialization particularly through agricultural processing (Badiane 2011). In this paper, agricultural exports are closely examined as they often bridge the distinction between the agricultural sector and industrial sector by including both raw primary commodities,

such as green coffee beans, and processed agricultural goods, like instant coffee powder. It also distinguishes between subsistence agriculture, which remains in the informal market[1], and cash crops, which enter the formal sector. I find that agricultural exports are positively related to government revenue, while the traditional measure of agriculture as a percentage of gross domestic product (GDP) in fact has a negative effect on government revenue.

This paper examines research on export agriculture and how governments have intervened so as to capture revenue, in order to build a theoretical case for why, and how agriculture is relevant when considering government revenue. I then use empirical evidence to argue that future research should consider using the value of agricultural exports, rather than the contribution of agriculture to GDP, when examining the revenue-generating capacity of the government, in addition to other social outcomes.

3. 2 Background

The prime role of agriculture in developing economies is well-established – in 2003, 28 of 48 sub-Saharan African countries[2] had more than a quarter of GDP deriving from agriculture – and in five of those countries over half of GDP came from agriculture (Bank 2007).[3] Moreover, agriculture is a critical source of employment, absorbing more than half of the labor force in 38 countries and more than three quarters in 16 of those countries (Bank 2007).[4] These measures reflect the dominant

[1] The informal market in these economies should not be considered illegal, as it might be in more developed contexts. It would include markets in small towns where farmers sell produce, and small home restaurants, etc. that the government simply does not have the capacity to monitor or tax in the way that small businesses would be elsewhere.

[2] Not including Somalia, for which there is no data for that year.

[3] The five countries are: Comoros (50.5%), Democratic Republic of the Congo (51%), Central African Republic (56.8%), Guinea-Bissau (61.8%), and Liberia (71.6%) (Bank 2007).

[4] The sixteen countries are: Eritrea (76.6%), Seychelles (76.9%), Djibouti (77.4%). Gambia (78.1%), Uganda (78.6%), Tanzania (79.1%), Mali (79.3%), Mozambique (80.6%), Ethiopia (81.1%), Malawi (81.7%), Guinea-Bissau (82%), Guinea (82.7%),

role of agriculture in the economic structure of these countries, but are not adequate measures of the contribution of agriculture to the economy (Bank 2008), and to government revenues specifically.

The relationship between export-oriented cash crops and government intervention has been studied extensively, concentrating on the distortionary effect on the agricultural sector, and the economy more broadly (Kasara 2005); (Bates 1981); (McMillan 2001); (Bleaney and Greenaway 2001); (Besley 1997). These studies emphasize how government actions affect agriculture, and clearly focus on export-oriented agriculture. Research that examines how government capacity is affected by the agricultural sector, on the other hand, does not make the same distinction between export and subsistence agriculture. The measure used most commonly is the percentage of GDP derived from agriculture, or the percent of the labor force involved in agriculture, which includes estimates of activity in both subsistence agriculture and cash crops, and thus combines two distinct aspects of the agricultural sector into a single measure. Studies using these crude measures to understand how agriculture contributes to government revenue find little or negative effect (Cheibub 1998); (Snider 1990). These findings run counter to the intuition that governments, particularly in developing countries, rely heavily on the agricultural sector for foreign exchange (Mesfin 2011) (Bates 1983) (Kasara 2005). This disconnect between research that examines the effect of government intervention in export-oriented agriculture, and research that uses the percent of GDP from agriculture to investigate the relationship between agriculture and other economic, political and social outcomes has made it difficult to reconcile the idea that agriculture is an important, positive contributor to the economy, and the seeming dampening empirical effect of the agricultural sector on economic, social and political outcomes.

Niger (87.1%), Burundi (89.9%), Rwanda (90.3%), Burkina Faso (92.2%). It is important to note that even countries like the Seychelles, which have a low contribution of agriculture to GDP (3% in 2003), a large portion of the population is still employed by the agricultural sector (76.9%). Other countries have similar relationships, under-lining the importance of agriculture (World Bank 2007).

The contribution of agriculture to economic development has been examined in a variety of ways. Empirical analyses of growth and export earnings include agriculture as one type of primary commodity, along with oil or minerals (Bleaney and Greenaway 2001; Love 1986) that are all subject to similar exogenous price fluctuations. The contribution of the whole agricultural sector has also been tested, grouping cereal and other subsistence crops with cash crops, muting the potential effect of export crops and ignoring their role in the agriculture-related industry (Massell 1970; Combes and Guillaumont 2002). Both approaches obscure the potential role of agriculture by combining it with other marketable, but non-agricultural commodities, like oil; or by aggregating all agricultural production – including non-market products, such as subsistence crops like cassava.

How agriculture is measured matters a great deal when considering its relationship to specific outcomes, such as growth or government revenue, and it is critical to understand how agriculture relates to the theory being tested in order to select the appropriate measure. The distinction between subsistence agriculture and export agriculture is particularly relevant when considering government revenue. Subsistence agriculture rarely enters the formal market, and is difficult for the government to tax – particularly if the government's administrative infrastructure for collecting revenues is weak. Improving subsistence agriculture may indirectly increase government revenue by freeing up income for families to purchase other items from which the government does earn income; but this is likely to be a small effect. Export-oriented agriculture, on the other hand, is a broadly accepted source of revenue for government (Ndulu and O'Connell 1999; Massell 1970; Love 1986; Bates 1981; Tarschys 1988), as it is easily taxed at the export point (Bates 1981; Tarschys 1988), and the government may even control the sale and export of various crops. A recent headline from an Ethiopian paper reads: "Reduced Coffee, Oil Seeds Exports Knock Government Earning Targets" (Mesfin 2011), underlining the clear link between government revenue and exports – in particular agricultural exports. Despite

the intuition that agricultural exports are an important component, much of the tax collection literature includes the share of agriculture in GDP to assess agriculture's contribution to government revenue (Agbeyegbe et al. 2004), leading to misleading conclusions about agriculture's relative importance to government revenue.

The need to distinguish between types of agriculture is clear, but it is also important to note that the agricultural sector contributes significantly to both the industrial and service sector (which includes transportation) in many developing economies. The structural transformation from agriculture to industry is a gradual one, with early industries closely tied to the agricultural sector. Many agricultural exports are processed before export, even if only crudely (Barrett et al. 2001). A look at the top agriculture exports reveals how difficult it can be to draw clear lines between the agricultural and industrial sectors in many sub-Saharan countries.

Table 3.1. Top Agricultural Exports for sub-Saharan Africa

1980	1985	1990	1995	2000
Fruit, Prepared (including frozen and preserved fruits, nuts, and peels)	Wool, greasy	**Cocoa Butter**	Coffee, green	Coffee, green
Wool, greasy	Cloves	**Groundnut Oil**	**Rubber, including sheets, powders, and technically specified natural rubber**	Tobacco, unmanufactured
Cloves	**Fruit, Prepared**	**Fruit, Prepared**	**Fruit, Prepared**	**Wine**
Sorghum	**Cocoa Paste**	Vanilla	**Cocoa Butter**	**Rubber**
Groundnut Oil	**Groundnut Oil**	**Coffee Extracts**	**Palm Oil**	Grapes
Cocoa Paste	Vanilla	**Pineapples, Canned**	**Cocoa Paste**	**Cocoa Paste**
Sisal	**Cocoa Powder & Cake**	**Cocoa Paste**	**Pineapples, Canned**	**Fruit, Prepared**
Groundnuts, Shelled	**Coffee Extracts**	Cake of Groundnuts	Wool, greasy	**Cocoa Butter**
Cocoa Powder & Cake	**Pineapples, Canned**	Grapefruit	**Groundnut Oil**	Boneless Meat, Cattle
Karakul Skins	Groundnuts, Shelled	Cloves	**Coffee Extracts**	**Groundnut Oil**

Items that are in bold require some processing, and thus are often included in the industrial sector, although they are clearly tied to the agricultural sector.

To fully understand how government revenues are linked to agriculture it is important to expand the agricultural category to include processed agricultural goods: for example, not just cocoa, but cocoa butter. If processed agricultural goods are excluded from the analysis the additional value-added is not captured and the contribution of agriculture to the industrial sector is also under-appreciated. This leads to an under-estimation of the cumulative contribution of agriculture to government revenues, specifically, and to other economic effects.

The role of agriculture has also been considered in relation to a number of other outcomes of interest in social science, and is usually measured as the portion of GDP from agriculture, or labor in the agricultural sector. This approach has the potential to mask the inter-relationship between agriculture and other non-farm activities (Pender et al. 2004), tempering the effect of agriculture on a number of other outcomes of concern, such as economic growth. Some scholars have focused on the role played by specific crops, but have found relatively little effect on government revenue, in part because the focus on one, or small group of crops may mask the potential for other export crops to supplement government revenue (Love 1986).

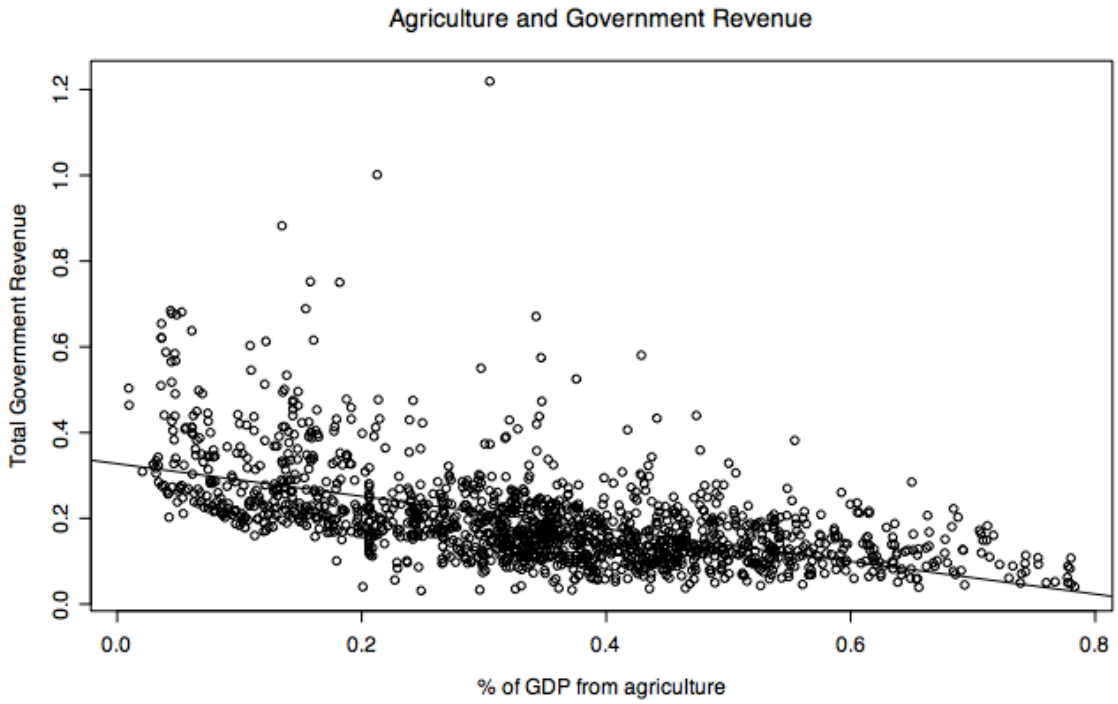
Agriculture serves a variety of functions beyond just the production of food: it provides political leverage (Bates 1981; Deaton 2004); foreign currency (Bates 1981); feeds into industrial production (Bryceson 1996); and creates demand for transportation services. In order to identify the role that agriculture plays in different contexts, it is appropriate to consider different measures of agriculture that link to distinct theoretical relationships. To the extent that agriculture drives the economies of sub-Saharan African countries, researchers need a better handle on how to measure that contribution. This paper therefore focuses on how agricultural exports, including those that may undergo processing, contribute to government revenues.

3.3 Approach and Method

This research tests how agriculture affects government revenue using both aggregate measures of agriculture, and more specific measures of export agriculture. Based on the literature, there are two distinct yet potentially complementary theories of how agriculture might affect government revenue. The first theory holds that a large agricultural sector may be indicative of an economy that is in the early stages of the structural transformation from agrarian (low value-added) to industrial (high value-added) (Lewis 1954) (Timmer 1988). Countries with this economic profile are likely to be poorer overall, offering lower revenue potential to governments. A simple graph, as shown in Figure 1, demonstrates the negative relationship between the share

of GDP from agriculture and government revenue, with the two variables negatively correlated at -0.55.

Figure 3.1 Agriculture and Government Revenue



This graph plots the log of total government revenue against the percent of GDP from agriculture for each country-year in sub-Saharan Africa.

The second theory distinguishes between agriculture as a whole, and agricultural exports, predicting that agricultural exports will have a positive effect on government revenues. It is important to note that agricultural exports may include some processing. This formulation allows for some overlap between the agricultural and industrial sectors, which underlines the gradual process of structural transformation as agriculture drives much of the industrial sector in the earlier stages. This close relationship between agriculture, agribusiness and processing is a more accurate reflection of the industrial sector in sub-Saharan Africa (Barrett et al. 2001).

I use a linear model to test these proposed relationships, using both a fixed effects estimation, and an expanded version. The dataset includes all continental countries in sub-Saharan Africa, plus Madagascar and Mauritius, from 1970-1999. The dependent variable is government revenue, which is calculated both including and excluding revenues from oil and minerals. The unit of analysis is the country-year, which reflects the cross-national, time-series nature of the data.

To test the proposed relationship between government revenue and either the percent of GDP from agriculture, or the total value of agricultural exports I first use a model with country and year fixed-effects to account for other characteristics that might influence levels of government revenue. The formula below shows the basic conceptual model.

$$Revenue_{it} = Agriculture_{it} + \gamma t + c_i + \varepsilon_{it}$$

Agriculture is measured as the share of agriculture in GDP in the first set of models; and the total value of agricultural exports is used in the second set of models. In this model, c_i represents country fixed-effects that will account for time-invariant country-specific factors, such as resource wealth or freshwater availability, and t represents a time trend to control for other long-run factors related to trends in government revenue. Potential confounding factors at the country level, such as colonial legacy or political systems, are controlled for, as are time-related factors, such as the end of the Cold War in this approach. The fixed effects model has the advantage of controlling for any possible omitted variable bias, and presents a rigorous test of the possible effect of agriculture on government revenues.

In the second specification I incorporate additional control variables that are frequently used to explain variations in government revenue, which allows for consideration of the role of agriculture relative to certain other factors that are thought to influence government revenue.

$$Revenue_{it} = Agriculture_{it} + GDP_{it} + Openness_{it} + Aid_{it} + Mining_{it} + \varepsilon_{it}$$

As with the previous specification, the measure for agriculture will be the percentage of GDP from agriculture to test the first hypothesis, and the total value of agricultural exports to test the second. The measure of GDP per capita is included to capture the level of development (Agbeyegbe et al. 2004; Adam et al. 2001). One would expect revenues to rise and fall with GDP when there is a larger base from which to collect revenues, and because countries with a higher GDP per capita are more developed and have better capacity to collect revenues. Openness to trade is used to capture the level of liberalization, which is often associated with higher degrees of sophistication in institutions, as governments move to non-tariff taxes in order to collect revenue (Agbeyegbe et al. 2004). The level of openness may also capture some of the opportunities to trade that are generally considered beneficial to economic development and thus to government revenue (de Soysa and Wagner 2003). The role of foreign aid may have a negative effect on government revenues, as it decreases the need for the government to collect revenue from its own population in order to satisfy its consumption or expenditure needs (Agbeyegbe et al. 2004; Cheibub 1998), but this depends on the structure and purpose of aid given. I am including mining to capture at least part of the industrial sector that is not taken up by agricultural processing. I am using this instead of the usual measure of industry, due to the likely overlap with agricultural exports, and because mining in sub-Saharan Africa does capture a significant portion of industry (Agbeyegbe et al. 2004; Adam et al. 2001). These variables do not represent the full gamut of possible factors, but those that are most consistently significant. One in particular, which I am excluding, is regime type as thus far there is little evidence that democracies or autocracies have an advantage in collecting revenues (Cheibub 1998).

Data

I use a dataset from an ongoing data collection effort by Johnson and Arbetman Rabinowitz (Johnson and Rabinowitz 2005) for the total government revenue dependent variable, that is based on data and reports from the International Monetary

Fund (IMF). This dataset covers the period 1970-1999 and includes both oil and mineral resource revenues.[5] I supplement this with data I collected from IMF country reports and statistical appendices, from which I was able to exclude any revenues explicitly indicated as accruing from oil or mineral resources. These data cover only the period from 1970 to 1999, however, as the older country reports do not disaggregate revenue sources. This still may include some residual government revenue from oil and minerals, but will exclude the majority of revenue from these sources.

The measure of the agricultural sector that I will use to test the first hypothesis is the percent of GDP that comes from the agricultural sector, from the World Development Indicators. This measure is the annual net output of the agricultural sector, after adding up all outputs and subtracting intermediate inputs, and includes forestry, hunting and fishing, as well as crops and livestock production (Bank 2007). This approach to measuring agriculture includes both subsistence output and cash crop output in terms of their respective values in dollar terms. For subsistence crops this value is estimated, as they are not sold in the market.

I extracted data from the Food and Agriculture Organization (FAO) which collects data on the total value each year of the top twenty agricultural exports for each country, in dollar terms (FAOSTAT 2010).[6] I collected data on the top twenty agricultural exports from 2007 for each country, and calculated the total value for all agricultural exports. The FAO data on agricultural exports include products that are unprocessed, such as tobacco, and processed items, such as cigarettes. These data do not include transportation, which might be captured in the service sector, but they reflect a more complete picture of the value that agricultural exports contribute to the

[5] In their dataset, the total revenue is measured as a fraction of GDP, so the variable was multiplied the by real GDP in 1985 dollars (the reference year for the dataset) to obtain total revenue.

[6] While the precise order of the top twenty exports may change over time, the crops that are in the top twenty are mostly consistent over time, particularly for the top ten crops.

economy. These data were adjusted to 1985 US dollars to account for inflation and match the other data.

The data for the control variables, openness to trade, foreign aid, and mining, were compiled from the World Development Indicators. The measure of GDP per capita is in 1985 US dollars. Openness to trade is measured as the ratio of imports plus exports to GDP. The foreign aid variable is measure by the ratio of official grants and aid to total revenue. Finally, mining is simply the value of mineral production relative to GDP.

3.4 Results and Discussion

In the simple linear regression including agriculture and country and year fixed-effects, the portion of GDP derived from the agricultural sector is a strong determinant of the level of government revenue. As expected, a larger share of GDP from agriculture has a strong negative effect on government revenue: a one percent increase in the share of GDP from agriculture reduces government revenue levels by five percent.[7] While a five percent change may seem relatively small, it is important to consider as the economies of sub-Saharan Africa are still largely driven by agriculture. A more significant structural shift out of agriculture, say a decrease of 5%, could thus have a substantial positive effect on levels of government revenues, potentially increasing them by 25%. The size of this coefficient is worth noting, as it is somewhat substantial, even though much of the variation is explained by the country, and time fixed effects. This inverse relationship between the percent of GDP from agriculture and government revenues demonstrates the macro-level role that the economic structure plays in determining the potential for governments to extract revenues from the economy, and explains a substantial amount of the variation in government revenue. When revenues from oil and minerals are excluded, the effect of the agricultural sector is still negative, although it is neither as significant, nor does it explain as much of the variation. This may be due to the fact that in many of these

[7] As the dependent variable in this case is logged, to calculate the effect of a one percent increase in the independent variable, the coefficients must be exponentiated.

economies where primary commodities are the driving force, the role of agriculture is more muted, or even crowded out to some degree, as Dutch disease makes agricultural exports less competitive with exports from other countries. The agricultural sector in these economies may be even more driven by subsistence agriculture, which may not be taxed, and thus may not contribute to government revenues.

Table 3.2 The effect of agriculture as a % of GDP, country and year fixed effects

	Total Government Revenue Log		Government Revenue, excluding oil and minerals Log	
	Estimate	**Std. Error**	**Estimate**	**Std. Error**
(Intercept)	6.169***	0.138	-0.610	0.536
Agriculture as a %age of GDP	-2.995***	0.118	-1.229	0.841
Country Fixed Effects	YES		YES	
Year Fixed Effects	YES		YES	
R^2	0.856		0.678	

*p < .05, **p < 0.01, ***p<.001.

While this simple fixed effects model demonstrates the role of agriculture, controlling for other country and time-invariant factors, it cannot account for the potential effect of other factors, like the presence of oil or other natural resources. When additional variables are included in the linear regression model, the percent of agriculture in the GDP still has a negative relationship with total government revenue, as expected; and the effect is somewhat larger – an increase of one percent in the agricultural sector decreases government revenues by almost ten percent. The control variables are largely consistent with what one would expect. Government revenues are greater when the GDP is larger, and when countries are more open to trade. Both of these variables have a relatively large effect, potentially increasing the levels of government revenue by 65% and 15%, respectively. Foreign aid also has the expected negative effect on government revenues, as it appears to supplant some of the need for governments to collect revenues to provide services. Only the variable capturing mining is insignificant in the model including all revenues.

Table 3.3 The effect of agriculture as a % of GDP, expanded model

	Total Government Revenue Log		Government Revenue Log, excluding oil and minerals	
	Estimate	**Std. Error**	**Estimate**	**Std. Error**
(Intercept)	5.188 ***	0.073	4.850***	0.417
Agriculture as a %age of GDP	-2.32 ***	0.119	-2.149**	0.739
GDP per capita	0.506 ***	0.019	0.730***	0.092
Openness to Trade	0.142 *	0.053	0.562*	0.269
Foreign Aid	-0.201 *	0.083	0.076	0.364
Mining	0.225	0.169	-7.859***	0.869
R^2	0.737		0.138	

*p < .05, **p < 0.01, ***p<.001.

When oil and mineral revenues are excluded, the negative effect of the size of the agriculture sector is about the same so that a one percent increase in the size of the sector reduces revenues by eleven percent. The positive effect of GDP remains strong while the effect of openness to trade is no longer significant. Foreign aid is no longer significant. Mining is now extremely significant and has a negative effect on government revenue, which may indicate that mining crowds out other sources of government revenue. Much less of the variation is captured in the model that excludes oil and mineral revenues, suggesting that those sectors may be contributing more to the overall economy, through industry or transportation.

These results support the conventional wisdom that economies that are largely agrarian have lower levels of government revenue. Given that this measure of agriculture includes a significant amount of production that never makes into the formal economy, and may not ever be monetized even in the informal markets, it is not surprising that governments are unable to leverage the production from this sector for revenues. The critical factors here are the informal and subsistence components of the agricultural sector in many sub-Saharan African countries. While the portion of GDP derived from agriculture captures one aspect of the important role played by the

sector, it does not give an appropriate handle for assessing how agriculture may affect government revenue, specifically.

The effect of agricultural exports on government revenue, is quite the opposite – it has a large positive effect on government revenue. In this analysis the dependent variables remain the same, but the independent variable of interest is now the log of the total value of agricultural exports. This variable captures the critical part of the agricultural sector that can be taxed by the government – either through export taxes or other taxes on the large, formal entities that export these products. It is important to underline that these agricultural exports include both raw goods and processed goods, such as vegetable and nut oils and beverages, which are linked to the domestic agricultural sector. The relationship between the agricultural sector and government revenues now becomes more apparent: when agricultural exports are considered with country and time fixed effects there is a small but significant, positive relationship with government revenue in the expected direction – an increase of one percent in the total value of agricultural exports results in almost a 9% increase in government revenues.[8] Removing oil and resource revenues from the government revenue measure, the effect is even larger, with a resulting 13% increase, although the significance does drop. A significant portion of the variation is explained in each of these models, due in part to the influence of the country and time fixed effects, which capture many of the relevant factors. The strong effect of even a one percent change in the value of total agricultural exports is thus particularly striking: it is larger than the negative effect of the share of GDP from agriculture, when country and time fixed effects are included. This indicates that agricultural exports have a broader multiplier effect that ripples through the economy – for instance, rural wage workers have income with which to buy goods and services, and there is ample demand for transportation services. Investments in agricultural exports, either in large holdings, or small holdings, have

[8] For these regressions the interpretation of the variables is somewhat easier as both the independent variable of interest and the dependent variable are logged, so they can interpreted directly as elasticities.

the potential to drive the economy in a way that has been under-appreciated in the drive to industrialize.

Table 3.4 Effect of agricultural export value, country and year fixed effects

	Total Government Revenue (Log)		Government Revenue, excluding oil and minerals (Log)	
	Estimate	**Std. Error**	**Estimate**	**Std. Error**
(Intercept)	4.449***	0.262	-1.853*	0.731
Total Value Agricultural Exports (log)	0.089***	0.022	0.1298*	0.065
Country Fixed Effects	YES		YES	
Year Fixed Effects	YES		YES	
R^2	0.835		0.674	

*p < .05, **p < 0.01, ***p<.001.

The relationship between agricultural exports and government revenue holds when the model is expanded to include other potential sources of government revenue. There is again a significant relationship between agricultural exports and total government revenue, although the effect is now smaller: a one percent increase in agriculture now increases government revenues by three percent. When the revenues from oil and minerals are excluded, however, a one percent increase in agricultural exports results in a 40% rise in government revenue levels. These results reinforce the strong role that agriculture plays in these economies, and clarify why governments spend so much energy extracting resources from this sector. Agricultural exports offer a good representation of the value obtained from agriculture, and show the strong role they play in the economy at large compared to traditional measures of agricultural contribution to GDP as a whole.

Table 3.5 Government Revenue, expanded model

	Total Government Revenue, Log		Government Revenue, excluding oil and minerals, Log	
	Estimate	**Std. Error**	**Estimate**	**Std. Error**
(Intercept)	3.833***	0.109	-1.212**	0.467
Total Value Agricultural Exports (logged)	0.034***	0.009	0.402***	0.036
GDP	0.549***	0.022	0.668***	0.082
Openness to Trade	0.416***	0.063	1.471***	0.243
Foreign Aid	-0.547***	0.096	0.635 .	0.344
Mining	1.532***	0.22	-4.446***	0.798
R^2	0.66		0.22	

. p < 0.10, *p < .05, **p < 0.01, ***p<.001.

The other variables, again behave largely as expected, with GDP and openness to trade having consistently significant and positive effects on government revenues. These results confirm the intuition that a larger economy, and more well-developed trade institutions offer governments a better opportunity to extract resources from their economies. Foreign aid also changes signs, and becomes less significant when oil and mineral revenues are excluded. This suggests that in countries where revenues from oil and minerals are available, foreign aid may not substitute to the same degree as in other places, supporting findings by Girod (Girod 2008). Finally, mining again has a strong positive effect on total government revenues, but again has a negative effect when revenues from this sector are excluded. The relationship between foreign aid and resource revenues has been explored in depth elsewhere, but these results further support the idea that revenues from oil and minerals do have an effect on how governments choose to collect revenues.

These results offer some insight into how agriculture can have a negative effect on government revenues, despite the intuition that such a large segment of the economy must contribute to government revenues in some way. The contribution of agriculture to GDP is indicative of the structural development of the economy, and a large number means that other, more profitable areas, like the industry and service sectors, are under-developed. Using this measure to capture how agriculture might contribute to government revenue is thus misleading, as it is not capturing the value that agriculture contributes, but rather reflects the structural profile of the economy. The value of agricultural exports, on the other hand, is a better measure of how agriculture does contribute to the formal economy, and in a way that the government would be able to extract revenues from it. The positive relationship between agricultural export value and government revenues provides empirical evidence for the intuition that agriculture does contribute positively to both the economy and to government revenues, specifically. Separating agriculture from other primary commodities, such as oil and natural resources, marks an improvement over previous attempts to include agriculture into various analyses (Collier and Sambanis (Eds.) 2003), and more accurately focuses attention on the role of agriculture specifically, as distinct from other primary commodities.

3.5 Conclusion

This research addresses a lacuna that exists between research that focuses on government tax efforts, and that which examines the role government intervention plays in export agriculture. The results demonstrate clearly that while a dominant agricultural sector depresses government revenues, agricultural exports, actually have a strong positive effect. This distinction is also important when considering how agriculture does, or does not, contribute to other social, political, and economic outcomes like civil conflict, and underlines the importance of ensuring that the variable being used matches the theoretical implications being tested.

A large agricultural sector may indeed reflect a less-developed, largely agrarian economy that has a substantial informal sector, which makes it difficult for the

government to fulfill the simple task of collecting revenues. The negative relationship between the simple measure of the percentage of agriculture in GDP and government revenue reflects the challenges the government faces in collecting revenue from the informal sector, and the agriculture sector in particular. Yet, it is clear that agriculture does play a critical role in these economies, which has been difficult to adequately capture using the percent of agriculture from GDP. By including some processed goods, and excluding agriculture that does not enter the formal markets, such as subsistence agriculture, the role and importance of agriculture becomes more evident. Using the value of agricultural exports thus demonstrates the relevance of agriculture, without confusing agribusiness with subsistence agriculture.

This analysis has shown that using the total value of agricultural exports captures the portion of the agricultural sector that enters the formal economy, in addition to its contribution to the industrial sector. The positive relationship that emerges between agricultural exports and government revenues is just one way that this new measure of agriculture may capture relevant theoretical mechanisms that are distinct from other structural effects of having a large agricultural sector. In this analysis I focused on the effect of making this distinction on government revenues in sub-Saharan Africa, but there are both other questions and other regions where this distinction could provide critical insights. In region such as Latin America, for instance, where there are large plantation style farms geared towards exports, which are controlled by elites, the relationship between agricultural exports and government revenues may be different, as the power of the landholders could affect how governments tax agricultural exports (Dube and Vargas 2006). Yet the distinction between agricultural exports and the agricultural sector as a whole remains important, even if the implications of the distinction are likely to be different in Latin America compared to sub-Saharan Africa. The results of this analysis demonstrate that conflating agricultural exports with the agricultural sector as a whole can lead to the opposite conclusions.

The policy implications that arise from these distinct conclusions are important for considering investments in agriculture, agricultural exports, and agricultural industry (such as food processing). The contribution of agricultural exports to government revenues, and to the economy suggests that further developing this sector could provide sub-Saharan Africa the engine it needs for promoting broader economic growth. The role of smallholder farmers, and rural wage workers needs to be further examined so that the benefits of promoting agriculture are widely dispersed. This argument is in contrast with that of Collier, who argues that large-scale, commercialized agriculture will address the challenges sub-Saharan Africa faces in meeting its food needs and modernizing its agricultural sector (Collier 2008). While sub-Saharan Africa's agricultural production has lagged the rest of the world's, this strategy may neglect the potential that does exist in a vibrant sector that has been neglected in favor of other large-scale industrial programs in the past. Shifting wholesale to commercialized, efficient production that may not employ as many people without developing demand for labor elsewhere could dramatically reduce the contribution of agriculture to the local economy, even as it meets demand for agricultural exports. Distinguishing between agricultural exports and the agricultural sector as a whole suggests that a more nuanced understanding is required to develop appropriate programs to promote agricultural development. This research has highlighted the role played by agricultural exports, which include some processed goods, and suggests that agriculture's positive contribution to sub-Saharan African economies has been under-appreciated, and should be an area of focus for development research and investment alike.

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Appendix: Additional Tables/Regressions

Agriculture as percentage of GDP

Table 1. Expanded model, without mining

	Total Government Revenue (logged)		**Government Revenue, excluding oil and minerals**	
	Estimate	**Std. Error**	**Estimate**	**Std. Error**
(Intercept)	5.21 ***	0.071	3.654***	0.409
Agriculture as a %age of GDP	-2.359***	0.116	-0.007	0.723
GDP	0.509***	0.19	0.691***	0.095
Openness to Trade	0.153**	0.053	0.453	0.279
Foreign Aid	-0.205*	0.083	0.213	29.45
R^2	0.74		0.07	

. p < 0.10, *p < .05, **p < 0.01, ***p<.001.

Agricultural export values

Table 2. Expanded Model, without mining

	Total Government Revenue		**Government Revenue, excluding oil and minerals**	
	Estimate	Std. Error	Estimate	Std. Error
(Intercept)	4.004***	0.109	-1.816***	0.461
Agricultural Export Value	0.019*	0.009	0.447***	0.036
GDP	0.587***	0.022	0.558***	0.081
Openness to Trade	0.492***	0.064	1.266***	0.244
Foreign Aid	-0.616***	0.099	0.869*	0.346

. p < 0.10, *p < .05, **p < 0.01, ***p<.001.

Chapter 4: Climate Change and Civil Conflict: Asking the Right Question

4. 1 Introduction

Climate change and conflict seem inextricably linked in the policy arena: Sir Nicholas Stern has warned of "extended global war" as a result of climate change (Stern 2009); US President Obama has connected climate change to "the security and stability of each nation and all peoples" (Obama 2009) – a claim based at least in part on multiple assessments by US military and security branches (2008); (Campbell et al. 2007); (CNA 2007); and Ban-Ki Moon, Secretary-General of the United Nations, has attributed the conflict in Darfur to "ecological crises, arising at least in part from climate change" (Ki-Moon 2007).

Such statements convey certainty; but few policy debates are more prone to speculation in the absence of solid, academic work: in fact, the majority of academic research finds little support for any link between conflict and climate change, or even environmental factors more generally. Distinguishing clear climate change signals from historic weather patterns has been one obvious difficulty in connecting climate change and conflict. More troublesome is the divergence between the conflict literature that has emerged from political science and economics in the last fifteen years, and the environmental security literature, leading to distinct hypotheses that in turn have little relation to findings that have emerged in conflict analyses.

The link between climate change and conflict is considered to be a potential existential threat to human populations by policy makers, making the need for more rigorous grounding to this critical debate clear. In this paper, I develop an alternative approach to assessing the importance of climate change as a cause of conflict, building on what political science and economics have learned about large-scale societal conflict. I argue that both large-N quantitative analyses and case studies are needed to understand how environmental stressors may affect structural causes of conflict, and

act as triggers for conflict onset. This framework reveals the potential for environmental factors to affect conflict risk through multiple pathways, depending on the region and on specific vulnerabilities to climate effects.

Climate change is complicated, with multiple, distinct consequences, each of which varies over time and space. Two particular characteristics of climate change need to be considered, in particular as they relate to two persistent weaknesses in conflict research. First, climate change will engender a number of distinct, though related, effects from sea-level rise to changes in temperature that will affect geographical regions differently. The Intergovernmental Panel on Climate Change (IPCC) continues to advance, refine and communicate what the impacts of climate change will be, when and where the will occur, and with what levels of certainty (Meehl et al. 2007; Parry et al. 2007), and the differences in the location of various impacts needs to be taken into account when linking the effects of climate change to other social, economic and political outcomes. The IPCC breaks down the effects by region (eg. (Boko et al. 2007)), although more needs to be done to understand how global phenomenon, like changing sea surface temperatures, relate to local outcomes. Second, these effects will manifest differently over time: temperature increases are already having a reported effect in some areas (Parmesan and Yohe 2003), and climate change factors are frequently cited in media reports on the frequency and intensity of storms (Faris 2009), while no island-states have yet been submerged due to sea-level rise. Scholars have honed in on the potential effects of temperature changes as increases in temperatures are likely to be felt in the near- to medium-term, and there are useful historical analogs against which future impacts can be compared (Battisti and Naylor 2009; Burke et al. 2009). Using the information highlighted by climate science to identify factors that may be important to civil conflict provides a starting point for considering how to link climate change to civil conflict.

These two characteristics of climate change – multiple effects and impact over time – highlight two persistent weaknesses of conflict research: first, variables that are

significant in global models are not consistent at the regional level; and second, conflict research to-date has had little to say on what causes any of these variables to shift in a way that causes conflict to begin. The spatial variation of climate effects underscores the difficulty of adapting large-N quantitative analytical approaches in conflict research to specific regions – few of the variables that are significant in global analyses are significant when those conflict models are confined to a region, such as sub-Saharan Africa. Case studies can compensate for this issue, but it is difficult to generalize from case studies, prompting a persistent divide between these two approaches. The variation in the time-scale on which effects will manifest speaks to the difficulty conflict researchers have had in distinguishing structural causes that predispose countries to conflict, and factors that trigger specific onset events. Changes in temperature and the attendant effects on agriculture, for instance, are likely to affect underlying structural issues, while a natural disaster such as a hurricane, may trigger a conflict event. The framework proposed in this paper does not solve these issues, but rather suggests useful avenues of research that will better incorporation climate change factors into conflict analysis, and push conflict researchers to improve existing models of civil conflict.

Designing research to address these issues will have to incorporate multiple strategies: quantitative and qualitative; large-N analyses and case studies. In any approach, the first step is to identify the right question; but much of the research on the climate change and conflict nexus has struggled to identify tractable questions. The environmental security literature to-date has taken a highly deterministic route, following the effects of climate change inevitably through to conflict, while ignoring key variables that have emerged from conflict research. My own work leads me to argue that this approach should be reversed: researchers should *begin* by asking what the conditions for insurgency are, and then ask how specific climate change impacts will alter those conditions to make conflict more likely. This will push researchers to identify the mechanisms through which climate change will affect conflict, which in turn may point toward specific policy prescriptions.

I first briefly discuss the environmental security literature, and some of the models that emerge from traditional studies of civil conflict. This leads me to make explicit proposals about how the question of climate change and conflict should be framed. I then outline how conflict factors may be affected by specific climate change impacts, and demonstrate how this new framework, that more closely links these literatures, can provide better traction for researching this topic. I conclude with suggestions for further research that builds on this framework, and allows policy-makers to identify opportunities for intervention.

4.2 Background

The preponderance of literature on climate change and conflict begins by looking at the consequences of climate change: sea level rise, increased droughts, flooding, and extreme events. Often they are considered together, with little distinction among the different geographic and temporal scales. The hypotheses most common in the literature are that these effects will lead to conflict directly, through resource scarcity and migration (Homer-Dixon 1994); (Kahl 2006); (Reuveny 2007); (Suhrke 1997) or indirectly, through effects on social, political and economic systems (Miguel et al. 2004); (Hendrix and Glaser 2007); (Hendrix and Salehyan 2010); (Meier et al. 2007). Neo-Malthusian arguments that posit an increase in resource scarcity and migration as a result of environmental degradation and climate change were developed by Homer-Dixon as causal mechanisms (Homer-Dixon 1994), and later expanded on by Kahl (Kahl 2006), and others (Kaplan 1994); (Kennedy et al. 1998); (Nordås and Gleditsch 2007). These arguments rarely credit either citizens or governments with much agency, and assume that there will be little in the way of adaptation that might mitigate either the effects of climate change or the risk of conflict.

Theories of conflict and/or conflict onset that emerge from large-N, quantitative political science and economics research are dismissive of the environmental security literature (Fearon and Laitin 1999); (Collier and Hoeffler 1998); (Gleditsch 1998); (Buhaug 2010). Instead, this research has focused on the effect of economic, political

and social factors to explain how insurgents obtain funding (Gleditsch et al. 2008) (Ross 2004b); the effect of depressed economies on the opportunity cost of fighting (Collier 2006) (Fearon and Laitin 2003b); and how weak governments are more vulnerable to rebellion (Fearon and Laitin 2003a). These scholars argue that those looking for a link between conflict and the environment privilege environmental factors to the exclusion of explanatory variables that dominate the quantitative models they have developed. Conversely, conflict scholars have, with some notable recent exceptions (Bernauer et al. 2010) (Hendrix and Salehyan 2010); (Miguel et al. 2004), dismissed the potential relationship between climate change and conflict, without considering how climate change might affect the intermediating risk factors that have been identified in the conflict literature.

A cursory review of the conflict literature in the political science or economic disciplines reveals the importance of quantitative analysis in those fields (both Hegre and Sambanis (Hegre and Sambanis 2006) and Blattman and Miguel (Blattman and Miguel 2009) offer excellent reviews of the political science and economic literature on conflict). While a quantitative approach may sometimes lead to mismatches between variables and concepts (e.g. GDP as an indicator of government capacity) (Treier and Jackman 2008) (Hendrix 2010), such analyses do require researchers to define their variables concretely. The definition of conflict turns out to be crucially important for the debate surrounding climate change and security. Early research on the effects of environmental scarcity relied on general definitions of "violent conflict," that could mean anything from sub-national violence to international conflict (Homer-Dixon 1994), making systematic analysis difficult. More recent research has adopted variations on definitions used by the Correlates of War project (COW) and the Uppsala Conflict Data Program (UCDP), maintained in collaboration with the Peace Research Institute Oslo (PRIO). The COW definition requires that the national government be an active participant in the conflict; that there are 1,000 battle-deaths per year, on average; that there is effective resistance by both sides; and that the conflict takes place within the national territory (Small and Singer 1982), (Sarkees

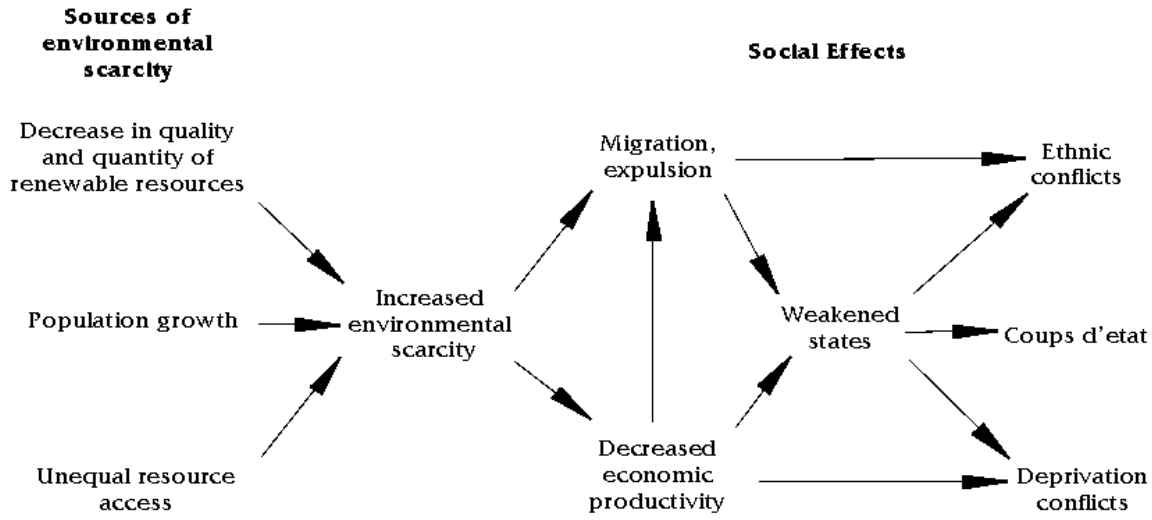
2000). UCDP/PRIO defines civil war similarly: the state is one of the parties involved; there is an opposition organization; the incompatability is over control of the government or territory; and there is a minimum of 25 battle-deaths per year, on each side of the conflict (Gleditsch et al. 2002; Harbom and Wallensteen 2007). These formal definitions have allowed conflict scholars to develop quantitative models that lend statistical support to theories of conflict, and provide a useful starting point for analyzing how climate factors may play a role in conflict risk.

The theories that garner the most support from the statistical models relate conflict to: economic deprivation, which lowers the opportunity cost of fighting (Collier and Hoeffler 1998) (Fearon and Laitin 1999) (Miguel et al. 2004); resource abundance, particularly oil, which fosters poor governance, offers conflict financing opportunities, or simply induces greed (Collier 2004) (Ross 2004a) (Le Billon 2004); or poor governance, which lowers the repressive capacity of government (de Soysa and Wagner 2003; Fearon and Laitin 1999) (Hendrix 2010) (Thies 2010). Other theories of conflict causes, such as ethnic factors or income inequality, have not found much statistical support in these models. The large-N quantitative models are constrained by their focus on variables that can be measured and for which data are available, which limits their ability to uncover causal mechanisms and accurately predict conflict onset (Tarrow 2007) (Ward et al. 2010). These models privilege structural factors, which create the conditions for conflict, over variables that act as triggers, prompting conflict onset. Nonetheless this empirical research on conflict has helped to identify relevant questions to probe in more depth; and it has further helped to reveal what further information is required to make useful policy prescriptions (Tarrow 2007). These models thus provide a helpful entry point for including climate change into conflict analysis, and can illuminate the questions researchers and policy-makers should be asking.

As climate change has moved to the forefront of discussions of environmental dangers, it has prompted a new line of research into the relationship between

environment and conflict. Much of this research has returned to early work by Homer-Dixon, who was one of the first to examine how environmental factors might affect violent conflict (Homer-Dixon 1991, 1994). This research has been heavily criticized (Gleditsch 1998), and in fact spawned much of the subsequent research on resource abundance, or the "Resource Curse", as a counter-argument to the resource scarcity argument Homer-Dixon put forth. Nonetheless, the main pathways, migration and decreased economic productivity, are the foci of much current research. The figure below is the conceptual model of environmental security originally proposed by Homer-Dixon (Homer-Dixon 1994).

Figure 4.1 Homer-Dixon's model of Environmental Security

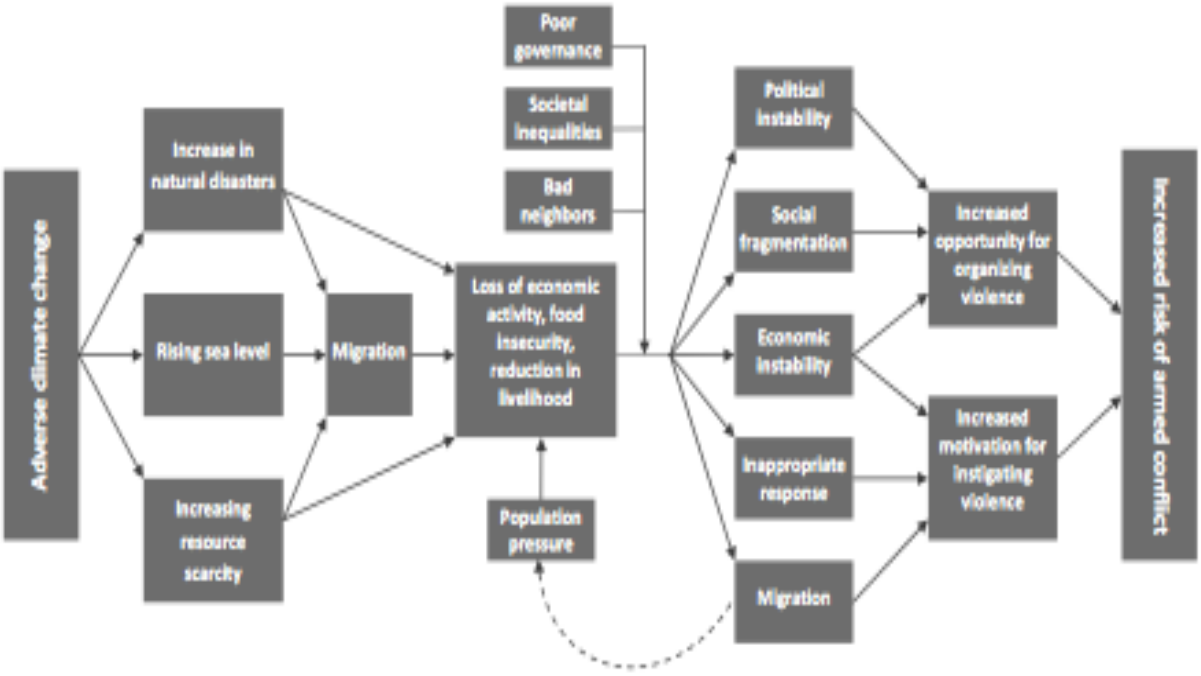


Source: Homer-Dixon (1994).

As the environmental security debate has begun to revolve around the impacts of climate change, the model proposed by Homer-Dixon has been adapted and expanded in response. The model in the below figure, from a World Bank report (Buhaug et al. 2008) builds more closely on the theories common in quantitative research. As in the Homer-Dixon model, environmental factors have a negative effect on economic activity, either directly or through environmentally induced migration. Buhaug, et.al., expand on the Homer-Dixon model by including governance, social inequality, and bad neighbors as exogenous factors that then influence how the loss of economic

opportunities may then lead to conflict. While the authors acknowledge that this model is simplified (Buhaug et al. 2008) (Gleditsch 2011), the focus on the effect of climate change impacts on economic outcomes is characteristic of most research on climate change and conflict (Miguel et al. 2004) (Burke 2009) (Bernauer et al. 2010). Yet it seems unlikely that government capacity or social inequalities would be completely unaffected by climate change – the effect of migration in exacerbating existing social inequalities is, in fact, an active area of conflict research (Salehyan and Gleditsch 2006) (Fearon and Laitin 2010). Privileging the economic consequences to the exclusion of all other factors remains a serious problem in research on climate and conflict, as much as previous work on environmental security was flawed for privileging environmental factors to the exclusion of economic and political considerations.

Figure 4.2 Including Climate Change in Environmental Security Model



Source: Buhaug, Theisen, Gleditsch (2008).

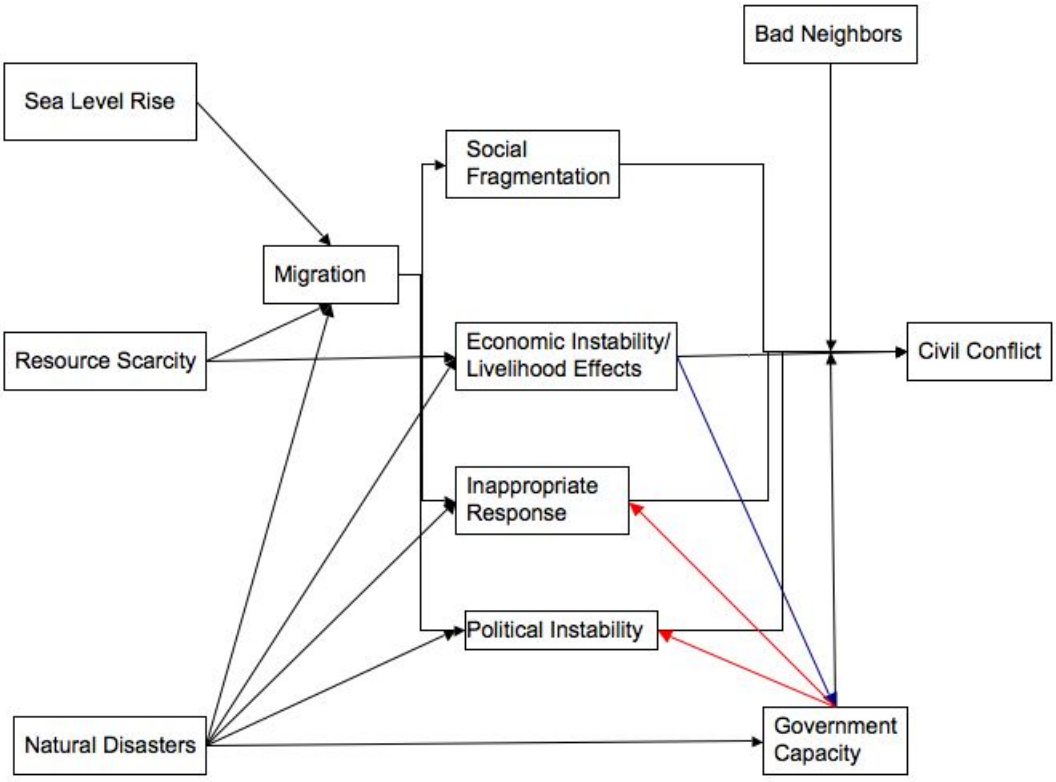
The growing debate on climate change and conflict is split into two general categories: those who have an activist goal, where the potential security consequences of climate change are used to create a sense of urgency for action to mitigate climate change; and those with a more academic perspective, where the consequences of climate change are one more potential type of variable that might explain conflict. The more activist approach, on one side, takes as given that climate change will have catastrophic consequences that occur on a scale and at a speed that will cause rapid changes in social, economic and political structures. Many of these arguments rely on dire future scenarios in which conflict is an unavoidable outcome (CNA 2007). On the other side, academic research has been unable to convincingly demonstrate that climate factors are related to conflict at any level, from sub-national violence to civil conflict to inter-state war (Meier et al. 2007) (Jensen and Gleditsch 2009) (Young 2009). Repeatedly, factors of economic health and good governance emerge as more relevant to determining conflict risk than environmental factors (Buhaug 2010). Missing from both treatments of the climate change and conflict question is a deep understanding of what mechanisms are at work; what drives changes in these systems; and how climate change may act as a lever prompting shifts in economic, political and social factors.

4.3 Re-Framing the Question

The environmental security literature has for the most part ignored the cumulative findings of over fifteen years of conflict research in political science and economics, prompting skepticism by many conflict scholars. The question thus needs to be re-framed in order to capitalize on insights from the science of climate change, as well as from quantitative and qualitative approaches in political science, and economics. Rather than asking if and how climate change will cause conflict, the question should be*: what are the links between conflict risk factors and the environment, and how will those relationships change in the face of specific climate change impacts?* This re-framing of the question takes advantage of what is known about conflict risk and potential climate change impacts, to ask new questions in environmental security research. The below figure illustrates this new framework at a macro-level. In the following section I offer a test case of how this framework can be used to ask new and

different questions that identify what and how underlying mechanisms affect change in these relationships.

Figure 4.3 A New Framework for Linking Climate Change and Civil Conflict



It seems counterintuitive to suppose that the environment would not play a role in shaping conflict and determining conflict risk. Indeed, many of the variables included in conflict and peace studies are affected by the environment in some way: agricultural economies are intimately related to the environment; government structures may vary depending on the size of the country; and group identity and behavior develops in response to particular environments. Economic development options, moreover, are in fact both created and constrained by the environment at some level: fishing is not an option without healthy bodies of water; agricultural production is not possible without land and water; industry requires raw materials; and all of the above require energy – the options for which may depend in part on locally

available mineral or water resources. By looking at historical environmental events in the broader context of climate change, researchers can begin to link micro-scale events like conflict, to macro-level processes like climate change, through specific causal pathways.

4.4 Research based on the proposed framework

The consequences of climate change introduce a new set of challenges and questions for advocates of both quantitative analysis and case studies. Conflict studies have made significant advances in developing general models of conflict, based on large-N quantitative analysis (Fearon and Laitin 1999) (Collier and Hoeffler 1998). The model that is most often used as a basis for additional work includes GDP per capita, population, a measure of government capacity (often the level of democracy), population, and a dummy variable to control for the presence of oil. Most quantitative analyses use some form of this model as a starting point. In recent years, there has been a push to identify specific mechanisms that cause conflict, much of this through case studies (Kalyvas 2006) (Collier and Sambanis (Eds.) 2003). These detailed approaches have been informed by the relationships revealed through the large-N models and have in turn informed research on the mechanisms at work in specific contexts, identifying ideas for how those might be included in more generalized quantitative analyses.

Adopting conflict models to specific regions is a first step towards using quantitative analysis to address questions around the climate change and conflict nexus. Determining the regional effects of climate change is equally important, so that researchers can understand how climate change consequences link to conflict risk factors. For instance, glacial melt in the Himalayas and Andes will be a major concern for countries that rely on the glacial run-off for energy, water and food, while the melting of the glaciers on Mt. Kilimanjaro will have a more narrow impact on the economic and social fabric of Kenya (Barnett et al. 2005).[1] It is also important to

[1] While the speed of glacial melt is still highly uncertain, the point here is that countries have a different level of reliance on seasonal glacial melt which will lead to varying social and economic impacts.

consider the very different time-scales on which these changes will occur – no one disputes the impact that sea-level rise will have on small island countries, but it may be 100 years before the Maldives are completely uninhabitable (Bryant 2004), whereas the effect of changes in temperature in sub-Saharan Africa almost certainly will have significant consequences there within the next twenty years (Lobell et al. 2008) (Hertel et al. 2010). Considering the time-scale of climate change consequences helps to identify which of these impacts to study first, and where. The more immediate changes in temperature and precipitation also make it more realistic to consider how these consequences will affect social, political and economic systems within a generation, rather than try to predict those interactions on human systems fifty to a hundred years from now.

Much of the climate and conflict literature has focused on sub-Saharan Africa because of the prevalence of conflict there, and the region's dependence of on rain-fed agricultural. . Miguel et.al.'s novel use of precipitation as an instrumental variable for the economy (Miguel et al. 2004) served as a jumping off point for subsequent research (Burke 2009) (Jensen and Gleditsch 2009) (Buhaug 2010; Theisen et al. 2010) (Hendrix and Salehyan 2010), which also assumes that the most likely causal relationship between climate and conflict operates through the effect on the economy. This assumption highlights the weakness of existing conflict models as they are applied at the regional level. Many of the variables that are consistently significant at the global level have no significant effect when these models are confined to specific regions. Neither Miguel, et. al., nor their detractors (Jensen and Gleditsch 2009) (Ciccone forthcoming), however, have commented on the insignificance of GDP per capita when the traditional conflict models are applied to sub-Saharan Africa (Hendrix and Salehyan 2010) (Miguel et al. 2004). Thus, even if there is a relationship between precipitation and conflict in sub-Saharan Africa, it is not at all clear that it is operating through an economic mechanism, as has been assumed. This warrants a more careful application of the global model to sub-Saharan Africa in order to elucidate relevant

causal mechanisms for conflict, generally, and those mechanisms that are particularly vulnerable to the impacts of climate change.

Miguel et.al's initial assumption that precipitation affects agriculture is sound (Miguel et al. 2004), and Burke's extension of this to include the effects of temperature on agricultural yield (Burke 2009) is also well-founded (Lobell et al. 2008). The translation of these assumptions into the base large-N quantitative models, however, is somewhat flawed. First, GDP per capita is not significant when these models are applied to sub-Saharan Africa (Miguel et al. 2004) (Hendrix and Salehyan 2010). Second, it is implicitly assumed that agriculture in the African context consists largely of subsistence agriculture, so that when farmers have a bad year they have nothing to lose by joining a rebel movement. This ignores the diversified approaches to household income-generating activities employed in rural areas, which may also include working for large cash-crop plantations, seasonal migration to cities, and other off-farm activities (Barrett et al. 2001). The "fight or farm" calculus thus is not as obvious as is often presented. Finally, these models assume that only economic variables are affected. The dominance of agriculture, and agriculture-related industry (such as food-processing), however, means that governments rely on receipts from taxes on agriculture, and particularly agricultural exports; so a hit to crops such as coffee or oilseeds can significantly impact government revenues and capacity (Mesfin 2011) (Shilling Available on request), in addition to its other effects on the economy. Delving deeper into these alternative mechanisms is important to furthering civil conflict research, and addressing the question of how climate change may influence conflict risk factors.

A Test Case: Uganda and Coffee

A first step in any attempt to understand conflict risk is to identify what conflict risk factors are and how they change. Miguel et.al. (Miguel et al. 2004) showed that rainfall patterns affect GDP per capita in sub-Saharan Africa, but they did not test whether it might affect other factors, such as governance. While state capacity is a

tricky concept to measure (Treier and Jackman 2008) (Hendrix 2010), it is a critical factor that has been either poorly proxied, using measures such as GDP per capita or Polity, or neglected altogether in quantitative conflict analyses. There is a deep literature on the importance of revenue generation for developing state capacity (Tilly 1975) (Levi 1981), which recently has been brought into the quantitative literature on conflict by Thies (Thies 2010) and Besley (Besley and Persson 2008). While the effect of government revenue in conflict models at the global level is somewhat mixed, drop in revenues emerges as a significant variable for determining conflict risk in sub-Saharan Africa (Shilling Available upon request), and is weakly related to conflict globally (Bazzi and Blattman 2011). This is theoretically satisfying, as there are multiple mechanisms through government revenues can affect conflict onset: a drop in revenues may lead to decreased repressive capacity, or to reduced public services. Distinguishing between the relative influences of these mechanisms is more difficult and will require more in-depth analysis at the country-level – indeed the causal mechanisms may be different in different countries. If government revenue is a decent proxy for government capacity, which is in turn related to conflict onset, then the next question to ask is: what causes government revenues to change?

Certainly there are many factors that cause government revenue to vary over time, many of which are linked to global economic systems, rather than local or regional environmental factors. There are distinct ways, however, in which local climatic conditions can affect economic productivity, and thereby government revenues. The agricultural sector is an obvious place to begin analyzing how government revenue may change in response to climate change, as agricultural production is quite clearly responsive to climatic variables, such as temperature and precipitation. How does variation in agricultural production affect government revenues or the economy? Through effects on subsistence crops, like cassava? Through locally-traded crops, such as wheat? Or through agricultural exports, such as cocoa or coffee? It is possible to examine these questions, without insisting that climate change, per se, be at the root of any variation.

To capture the potential effect of agricultural exports on government revenue, researchers have focused on the percentage of GDP that comes from the agricultural sector. I argue there are two main reasons why such traditional measures of agriculture do not adequately capture its contribution to government revenue. The first is that the percentage of GDP derived from agriculture is largely a reflection of the size of the subsistence sector (Cheibub 1998), and thus does not necessarily reflect its contribution to the formal economy. The second reason is that agriculture usually is considered as wholly distinct from the industrial sector, despite the fact that much of the industrial sector in developing economies is taken up with processing agricultural products (Haggblade et al. 1989). An analysis of agricultural exports, which by definition enter into the formal market, shows that variations in the value of these products are significantly related to government revenue (Shilling Available on request), backing up anecdotal evidence (Mesfin 2011).

These analyses help to understand why and how government revenue varies with agricultural production, and the attendant implications for conflict risk. While a negative shock to agricultural production may alter the "fight or farm" equation, it also affects the government's revenues, and potentially its ability to respond to newly emergent threats. Again, I want to emphasize that I am not arguing that economic factors are unimportant, simply that they are not the only mechanism through which climate change impacts may affect conflict risk.

This example, linking agricultural exports to government revenue to conflict risk, does not address any additional fall-out of a drop in the value of agricultural exports, such as the potential economic effects or the potential for urban migration to disrupt social systems. My intention is to highlight the importance of examining how conflict risk factors change, and how those changes might be linked to climate change in the future. An important aspect of this approach, moreover, is to ask questions that further our understanding of conflict risk and how environmental factors may play a part *without*

requiring there to be a clear "climate change" signal. Given the relatively short time period covered in most conflict analyses, and the longer period over which changes in the climate manifest, this approach will help improve the research on the climate and conflict nexus without waiting for the more dire climate change predictions to materialize.

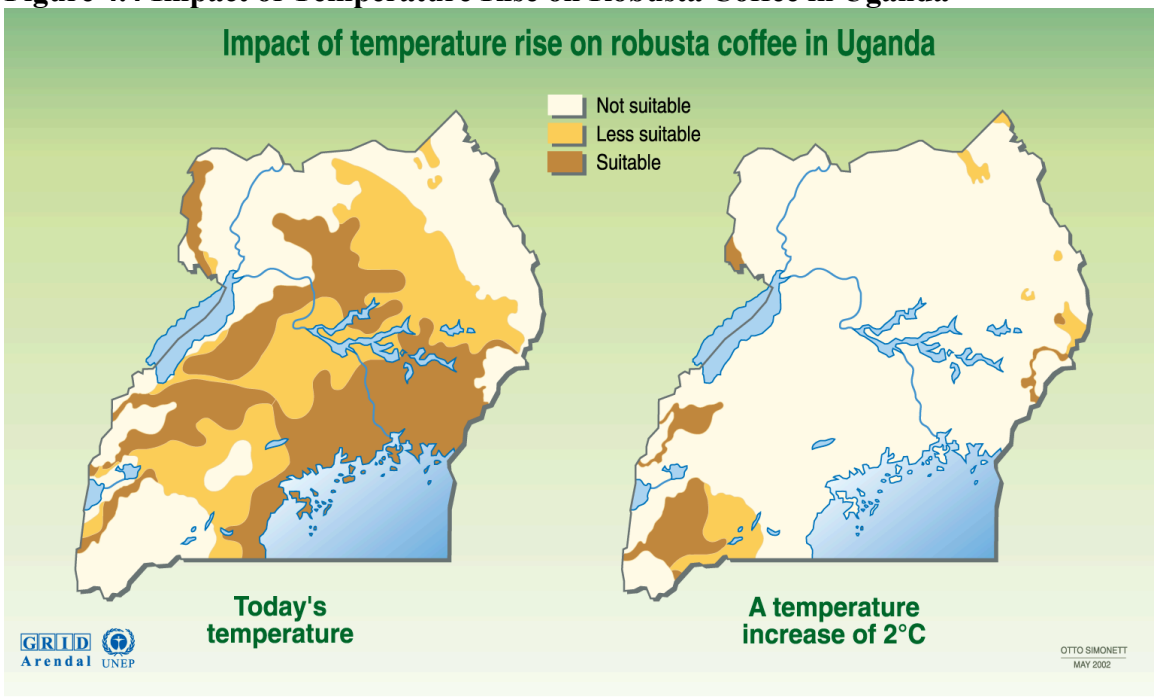
With the link between government revenue and agricultural exports established, it is possible to layer in the likely effects climate change will have in a specific country or region. To do this, a clear understanding of specific crops and their vulnerability to changes in temperature and precipitation, soil moisture, and a variety of other factors is required. For export crops, many of the critical parameters for optimal production are known, and geographic and climatic attributes are critical in selecting what crops are grown, and where. The potential for climate to alter the suitable conditions for specific crops can be readily identified for many of sub-Saharan Africa's most important crops.

The case of Uganda

To consider how climate change may factor in more strongly in the future, it is useful to consider a country that is heavily reliant on a few agricultural exports for government revenues. I will briefly review the illustrative case of coffee in Uganda, although it would be just as easy to look at cocoa in Ghana or oilseed in Ethiopia. A cursory examination of Uganda's economy shows the potential impact of climate change on a major source of revenue and employment. Uganda mainly grows the Robusta variety of coffee, which is generally considered to be of lower quality and value than its competitor, Arabica -- although Robusta is a much hardier variety, able to withstand higher temperatures and less rainfall (Willson 1999). The crop provides up to 30% of the country's foreign exchange earnings, relies on 500,000 smallholder farmers for production of the actual coffee beans, and further employs over 3.5 million families in coffee related activities (Uganda 2011).

While the government revenue statistics do not report how much of the government's total revenue was derived from the coffee sector, it is safe to assume that the sector contributes significantly through both direct taxation on exports and through taxation on related activities. If we accept that government revenues in Uganda depend, at least in part, on a thriving coffee sector, then understanding the vulnerabilities of that sector to climate change can inform a risk assessment of the country to climate change. The map below shows how Uganda's suitability for coffee growing will change with a 2 degree rise in temperature – keeping in mind that Uganda grows primarily Robusta, which already is better suited to higher temperatures, and that this map does not show the effects of changes in precipitation.

Figure 4.4 Impact of Temperature Rise on Robusta Coffee in Uganda



Source: Otto Simonett, Potential impacts of global warming, GRID-Geneva, case studies on climatic change. Geneva, 1989.

(Simonett 2002)

While a 2 degree increase is outside the upper range of most scenarios for 2030, a one degree temperature increase is well within the range of possible changes (Lobell et al. 2008), and may render "Unsuitable" those areas that are currently considered "Less suitable" for coffee cultivation. An important point of these maps is to show how

narrow the temperature tolerance for coffee is, as a 2 degree increase makes most of the current coffee producing areas unsuitable for Robusta. The potential to adapt coffee to higher temperatures may be possible; but coffee, like "terroir" in wine, is very sensitive to micro-climates and soil attributes that determine the flavor and value of beans (Daviron and Ponte 2005), limiting the potential for bringing new areas under cultivation. Temperature increase thus clearly risks having a strong negative effect on coffee production in Uganda. Farmers in Uganda are already concerned about the potential impacts of climate change, and believe they are seeing some changes already, with patterns of rain and sunshine shifting in ways that negatively affect production (Braden Balderas 2011). Other top coffee-producing countries, such as Ethiopia, Kenya and Côte d'Ivoire, are likely to be similarly affected, and indeed may already feeling some effects. While the link between recent drops in coffee production and climate change has not been established with certainty, the specter of rising temperatures and falling production looms large in countries that are heavily reliant on such climate sensitive crops.

The implications for government revenues are likely to be drastic – particularly as other crops are simultaneously affected. In the specific case of Uganda, where oil has just been discovered, the loss of government revenues from agricultural exports may be offset by income from newly-discovered oil. Nevertheless, the overall effect of a coffee sector collapse on the economy, and on other mechanisms relevant to conflict, may overwhelm the potential benefits to the government of increased oil revenues. Political, economic and social systems are often vulnerable to the same forces, and there is a strong potential that any negative shock to agricultural exports will have repercussion effects not just in the economy, but also through government capacity and social networks – creating a combination of conditions under which any pretext can serve to spark a civil conflict.

This example demonstrates how historic information can be help identify how a mechanism, like government capacity, is vulnerable to changes wrought by climate

change, such as temperature increases. Linking these mechanisms to specific climate predictions makes the connections between conflict risk factors and climate change effects explicit. Of course, the effect on government revenues is only one avenue through which impacts on the coffee sector may affect conflict risk. The economic implications should also be closely analyzed in order to understand potential risks. As those who are employed in the coffee sector lose their economic livelihoods, the effects are likely to ripple through social structures in both rural and urban areas – a process that is only poorly understood at the moment. Thus, while this example offers insights along one causal pathway, it raises additional questions along others.

Other Climate Effects

The above example illustrates how one climate change impact, a rise in temperature, could affect conflict risk in Uganda. Not only are there other causal mechanisms through which increased temperatures could affect conflict risk, there are other consequences of climate change that may be significant. Careful consideration should be given to whether these are cumulative effects that will become apparent over time, like sea-level rise, or if they are sudden disruptive events like floods or hurricanes that are difficult to attribute directly to climate change, but are likely to occur more frequently (Webster et al. 2005). The framework I have proposed here suggests that in order to understand these other types of changes, a more detailed understanding of past events will be required. Under what conditions do sudden events lead to conflict or not? Does it matter if a significant proportion of the infrastructure is destroyed, or how quickly the government responds?

4.5 Conclusion

The historical debate about environment and conflict has influenced current debates about the effects of climate change on conflict risk. A misguided preoccupation with the dramatic effects of climate change has led some to reach stark conclusions about how climate change will inevitably lead to climate wars. But it is hard to find empirical support for such a scenario; and the risk is that this type of approach leads to

esoteric arguments about methodology, rather than furthering our understanding about how climate change may, indeed, affect conflict.

The framework proposed here echoes calls for conflict research to improve both the relevance of selected variables to the theoretical concepts they are meant to capture, and to uncover important underlying mechanisms. Understanding the causal mechanisms becomes critical when considering how such mechanisms themselves might be altered by the impacts of climate change. In order to understand how climate change might affect security, political science will have to bridge the gap to other disciplines, rather than just treating climate variables as new data. Conflict researchers will need to team with agricultural, migration, and other experts in order to understand how the consequences of climate change will affect those factors, that are, in turn, important for identifying how structural factors may change, and what new triggers are likely to emerge.

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Conclusion

The four papers in this dissertation make stand-alone contributions to distinct bodies of knowledge, and taken together mark a substantial contribution to understanding the relationship between climate change and security. I have explored the limits of the extant literature on environmental security, civil conflict, and specifically on the topic of climate change and conflict. The continuing disconnect between the risk factors identified in the environmental security literature, such as migration, and those identified in the civil conflict literature, such as poverty, has stymied progress in research on the potential relationship between climate change and civil conflict.

In order to move the conversation beyond questions of *if* there will be war as a result of the consequences of climate change, I have framed the question in terms of *how* climate change will affect civil conflict risk factors. To determine what mechanisms will be affected, I focused on identifying how one specific factor, government capacity, influences the risk of civil conflict in sub-Saharan Africa. My focus on a single region is a step forward in bridging the gap between large-N, quantitative analyses at the global level, and single country-case studies. My analysis demonstrated that factors that are important at the global level are not as significant at a regional level. This finding led me to focus on the link between government capacity, as proxied by government revenues, and civil conflict. I show that lower levels of government capacity do lead to a higher risk of civil conflict, underscoring the importance of considering the government's role in creating a more or less permissive environment for nascent rebellions and/or violent unrest. While my focus has been on sub-Saharan Africa, these findings suggest that understanding conflict risk factors at the regional level can assist researchers to identify how climate change may alter the conditions for conflict in specific areas.

To further explore the mechanism through which government capacity might be affected by climate change, I examined the link between government revenues and

agricultural exports, establishing that the distinction between agricultural exports and the agriculture sector as a whole is important. There has been substantial research on how climate change will affect cereal and subsistence crops, which are an important part of the livelihood profile; but there has been considerably less attention paid to cash crops, which make up an important part of off-farm rural employment, and contribute significantly to government's coffers. My focus was on how these exports relate to government revenues, and I demonstrated that while a dominant agricultural sector may lead to lower levels of government revenue overall, agricultural exports do make an important contribution to government revenue. This conclusion is based on the total value of agricultural exports, and may under-estimate additional contributions to government revenue that accrue from employment and other activities driven by the production of agricultural exports.

In the final chapter of my dissertation I use the empirical results from the previous two chapters to demonstrate why it is important to consider additional pathways from climate change to conflict. The ripple effects of climate change are sure to expand to encompass more than just economic livelihoods. Natural disasters are already beginning to demonstrate the potential strains that governments will face. Hurricane Katrina in the United States highlighted the high expectations that citizens have of the government. A poor response by the Federal Emergency Management Agency fostered resentment, and was deeply embarrassing for the Bush administration. In a more fragile environment, the 2010 earthquake in Haiti highlighted the nearly complete inability of the government to respond. While widespread disaster was averted by a strong response from the United States, the United Nations and other international agencies, the government was largely absent in the response and relief efforts, which has led to a change in government. It is not so difficult to imagine a scenario with a different outcome.

This dissertation outlined one of many possible pathways that lead from climate change impacts forward to an increased risk of civil conflict. By no means do I mean

to imply that civil conflict is an inevitable result of climate change consequences. Rather, my intent has been to illustrate the importance of expanding the scope beyond economic livelihood implications to include other possible pathways. Indeed, my research demonstrates that government capacity itself is likely to be a major factor in mitigating the risk of conflict in the face of climate change and other stressors, at the same time that it is facing stress brought on by the consequences of climate change.

In terms of the broader questions around climate change and conflict posed by my dissertation, my findings suggest promising directions for additional research: it will be important to investigate further, for example, how negative effects on cash crops will affect rural employment, sub-national revenues and other factors that are important from a stability perspective. There are important questions that remain around the short- versus long-term implications that a drop in production would have, as prices may go up for certain crops in the short-term, even as their long-term potential is decreasing. Some countries may be able to shift to other cash crops, while some may no longer have favorable climate conditions to support crops that are as profitable. The effects of climate change on agricultural disease vectors, and productivity also need to be explored in order to understand the full range of costs that may be imposed by an increase in temperature. Farmers may be able to adapt by changing their cultivation practices, for instance, even though it may be expensive for them to do so; and the government, or donor agencies, then may be called upon to intervene. The implications of changes in temperature or precipitation patterns will also vary by crop, and need to be understood, so that countries can prepare to respond appropriately to the unique challenges that they will face as a consequence of climate change.

The conclusions of my dissertation have raised new and important questions that need to be addressed by additional quantitative work, and by case studies. More work needs to be done in order to understand how the pathways between climate factors, cash crop production, employment and government capacity are linked, and reinforce

– or offset -- each other. Some of this research will require further cross-national analysis; but I also believe that there is a strong need for more in-depth country analysis to illuminate what climate change risks are specific to particular countries, and to identify how those would relate to civil conflict risks.

The policy implications of this research suggest that investing in government capacity will be critical to mitigating the potential risk posed by climate change. For security analysts who are concerned about climate change, this analysis suggests that there are additional levers, beyond economic development, that can be used to mitigate the risk of civil conflict as the consequences of climate change become manifest.

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