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# Climate and Conflict: Whence the Weather?

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**Abstract:** Researchers have increasingly sought to identify the social repercussions of an evolving climate. Several influential studies claim that climate change is responsible for increases in conflict, while other research finds no such evidence. Relating human-caused changes in the climate to conflict poses a basic endogeneity problem, though: accepting that industrial activity is responsible for altering the climate implies that human agency is indirectly involved in the impact of the climate on conflict. Specifically, industrial activity is closely tied to climate change and to rising economic development, the latter generally being accepted as a determinant of reductions in conflict. In this letter, we discuss this endogeneity problem, outline possible shortcomings for empirical research if this problem is not addressed, and propose a research strategy that might eventually help to overcome it effectively.

**Keywords:** climate change, conflict onset, endogeneity

## 1 Introduction

One of the most controversial assertions in recent years is the claim that climate change may precipitate human conflict (see, e.g. Buhaug 2010, 2015; Buhaug et al. 2014; Burke et al. 2009; Burke, Hsiang, and Miguel, 2015; Hsiang and Meng 2014; Hsiang, Burke, and Miguel 2013; Miguel, Satyanath, and Sergenti 2004). Lacking definitive proof, policymakers, the public, and researchers themselves may be drawn to a given conclusion as much by its content as by the quality of available logic and evidence. However, interest in the consequences of climate change and variability stems from *scientific consensus about its origins*: human industrial activity is a *chief cause* of global warming, which in turn leads (more often) to

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rising temperatures, changes in precipitation, and extreme weather events such as droughts (IPCC 2013).

Yet, researchers have been slow to incorporate the critical implication of this canonical finding into analyses of the *effects* of climate change. Studies of the impact of increasing temperatures or changing precipitation patterns typically treat these measures of climate change as exogenously determined. Properly understood, though, scientific consensus about the human origins of changes in the climate must mean that climate is necessarily an *endogenous* component of at least some of its consequences; human agency cannot be at once responsible for evolving weather patterns and absent from climate's effects on human agency. Assertions of a role for climate in altering various behaviors must thus be considered in light of the causes of climate change.

As this letter argues, development has critical direct and indirect associations with civil conflict. The significant endogenous role of development in determining conflict behavior is an important factor to consider in assessing the impact of the climate on conflict. We thus expand on the rationale for addressing the endogeneity between these three variables: development, climate, and conflict. We discuss the endogeneity problem, outline possible shortcomings for empirical research if this problem is not addressed, and propose a research strategy that might eventually help to overcome it effectively. We conclude with a discussion about the implications of this work.

## 2 Theoretical and empirical proposition: endogenizing climate change

This study relates to two bodies of literature that analyze the relationship between climate, development, and conflict. One area of attention within the broad body of research on the causes of violence has been the role of economic development in discouraging domestic unrest.<sup>1</sup> A second area of interest involves research on climate change and conflict, which is divided between advocates and critics of a relationship between the climate and domestic political violence.<sup>2</sup>

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<sup>1</sup> See Buhaug et al. (2014), Cederman, Weidmann, and Gleditsch (2011), and Blattman and Miguel (2010) for detailed discussion and reviews of the literature on the relationship between economic development and domestic armed conflict.

<sup>2</sup> See Bernauer, Böhmelt, and Koubi (2012), Gleditsch (2012), Scheffran et al. (2012a,b), Meierding (2013), Theisen, Gleditsch, and Buhaug (2013), Nordås and Gleditsch (2014), or Buhaug (2015) for recent and detailed reviews of the relationship between climate change/variability and civil conflict.

## 2.1 Theoretical argument: development, climate change, and conflict

Our core argument suggests that existing work on climate and conflict have to account more thoroughly for the fundamental endogeneity implied by the role of human beings in changing the climate. However, it might at first seem unnecessary to consider the effects of the causes of an altering climate in evaluating the consequences of global warming. After all, these processes involve considerable temporal and spatial lags. Yet, both the deductive and methodological cases for accounting for the determinants of climate change are compelling. Either something causes the weather or it does not. As an exogenous variable, there is no need to consider the causes of climate change. However, this requires assumptions that are fundamentally incompatible with the conclusions of the larger research program on which inquiry into the political consequences of climate change is based. If, instead, social science wishes to embrace overwhelming evidence of human agency in climate change, then researchers cannot escape the implication that climate change is *not* an exogenous variable (see also Couttenier and Soubeyran 2014).

Accepting that humans have, and continue to play, a growing role in shaping the planet's weather requires an intellectually and empirically consistent choice in modeling the impact of climate change and its observable implication, climate variability, on other processes. The issue could be trivial, of course, given temporal and spatial lags between development, climate change/variability, and civil conflict.<sup>3</sup> Yet, this is an empirical question. Logically, and in terms of appropriate methods of inference, one must consider whether omitting the effects of economic development in generating climate change tends to produce biased estimates of the impact of climate on conflict behavior.

The basic relationship examined and debated by existing climate and conflict research is simple. Temperature, precipitation, or droughts more generally (i.e. the observable implications of climate change) are said to alter patterns in the onset of civil conflict (or other forms of conflict dynamics):

$$\text{Climate} \rightarrow \text{Conflict} \quad (1)$$

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<sup>3</sup> A reasonable objection to our critique of treating climate as an exogenous variable could arise from cross-sectional variation. Countries have developed economically at different times and at different rates. Pollution produced in one place will tend to cause climate change and variability regionally or globally, rather than solely within the borders of the polluting nation. It is also important to consider time. If global warming results from fossil fuel consumption in decades past, then this could conceivably misattribute direct or indirect effects of conflict. This process poses important normative concerns that we believe merit their own attention.

Still, before the climate can cause anything, something must first lead to it. There is very little controversy within the scientific community about the role of human agency in altering the climate, although of course this relationship was, and remains, highly politicized. Energy for industrialization has historically been derived from burning fossil fuels, resulting in the emission of greenhouse gases that have in turn altered the chemical composition of the earth's atmosphere (e.g. Couttenier and Soubeyran 2014; IPCC 2013; Stern 2006). In simple terms:

$$\text{Development} \rightarrow \text{Climate} \quad (2)$$

Needless to say, the primary purpose behind the consumption of carbon-based fuels is to provide heat, light, and energy for manufacturing, transportation, and communication networks. The relationship between energy consumption and prosperity is indeed so strong that research has used the former to represent the latter. Prosperous industrialized countries seldom experience civil conflict or political instability (Collier and Hoeffler 2004; Fearon and Laitin 2003; Koubi and Böhmelt 2014; Miguel, Satyanath, and Sergenti 2004; Ward, Greenhill, and Bakke 2010):

$$\text{Development} \rightarrow \text{Conflict} \quad (3)$$

Combining these three relationships creates both theoretical and empirical challenges for research on climate and conflict as the three causal claims outlined combine into two different causal pathways. First, development affects the climate (e.g. Couttenier and Soubeyran 2014; IPCC 2013; Nordås and Gleditsch 2014; Stern 2006), which may in turn increase the risk conflict, as some scholars suggest (e.g. Burke et al. 2009; Burke, Hsiang, and Miguel, 2015; Hsiang, Burke, and Miguel 2013). Second, however, another mechanism ties development directly to conflict (equation 3), complicating interpretation of the overall impact of these linkages and also making it difficult to assess each relationship separately. There is thus the likelihood of both a direct and an indirect (through climate) relationship between development and armed conflict.

Estimating the effect of climate change/variability on conflict onset (equation 1) alone ignores the direct and indirect effects of economic development. A debate in the climate and conflict literature exists over whether to include the direct effect of development on conflict (equation 3), or to use econometric controls to account for this direct effect as part of what is deemed largely within country variation (fixed effects). Neither approach addresses the role of economic development as a critical determinant of climate (equation 2), implying the need to estimate at least the indirect effects of development and possibly also the direct ones. Again, details of modeling and estimation choices are prone to controversy. What is presumably not in debate among students of climate and conflict is the

need to treat the climate as an endogenous function of human economic development, since failing to do so assumes away the role of human agency in producing climate change and variability.

## 2.2 A possible empirical approach

Our argument contends that the risk of conflict might be affected by climate change, but where both climate and conflict might in turn be influenced by human industrial activity. We suggest a potential empirical solution that may effectively deal with this issue. Specifically, one could employ two-stage estimators that directly address the issue of endogeneity persistent at the two stages of climate and conflict. For example, Greene (2003, 710) and Maddala (1983, 122) outline the specifications for a bivariate probit regression, which estimates two separate equations with correlated disturbances: one for an outcome equation and one for a selection equation.

Following several studies in the field (see Koubi et al. 2012), the dependent variable for the outcome equation could thus be a conflict-onset item, i.e. whether a conflict occurs in a specific year (1) or not (0). For the dependent variable in the selection equation, one could rely on a widely used proxy for climate variability, e.g. the Standardized Precipitation Index (see McKee, Doesken, and Kleist 1993). The second equation relying on armed conflict as the outcome variable is then estimated simultaneously with the first equation, while taking into account the correlation in the equations' error processes (Greene 2003; Maddala 1983). Hence, this estimation strategy not only addresses the concern that both climate variability and the onset of armed conflict are likely to be interrelated, but also that the two factors have common (un-) observed influences that serve to shape these variables. This seems particularly important as climate change and variability are, in fact, driven by some factors that we cannot capture here.

## 3 Conclusion

Researchers have begun to debate whether environmental byproducts of prosperity – in the form of climate change and variability – also cause conflict. Our concern here is that evidence on both sides in this debate of the effects of climate change/variability on civil conflict must also take into account the (human) causes of changes in the climate, as well as the (environmental) causes of violent conflict.

Research on climate and conflict is largely motivated by extensive scientific research that establishes a connection between human activity (primarily the burning of fossil fuels) and a secular rise in global temperatures, changes in localized rainfall, and the onset of droughts. As such, researchers are faced with stark alternatives. One can choose to treat climate change, climate variability, and thus the weather as an exogenous outcome. In this case, there is nothing logically inconsistent in directly assessing the effect of climate change on conflict behavior. Problems with the validity of these findings arise, however, because most students of climate change appear to accept the consensus perspective of climate science. If instead one accepts the overwhelming conclusion of climate-change science, then one must also accept, at least conceptually, that the causes of climate change and variability themselves potentially contribute to variation in conflict behavior. In the case of economic development, there is also a direct (negative) relationship between the variable in question and conflict.

In other words, the argument put forward in this letter is in line with earlier studies (e.g. Buhaug 2010, 2015; Buhaug et al. 2014): endogeneity is a concern for climate variability and that future studies may want to take it more seriously into account in order to avoid biased findings. This letter should therefore help in the effort to further clarify what the effects of climate change might (and might not) be, information that we expect will prove helpful in formulating policy to make the most effective use of limited public resources.

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