

# Evaluating Empirical Explanations for State-Sponsored Violence with Ensemble Models\*

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## Abstract

The literature on state-sponsored violence has grown significantly over the last decades. Although scholars have suggested a number of potential correlates of mass killings, it is unclear whether those factors increase our ability to forecast state-led violence. Here we employ ensemble learning algorithms to test the predictive performance of 40 variables on a sample of 177 countries from 1945 to 2013. We find that most variables fail to improve out-of-sample predictive power (*mention opportunity logic*). We also find high-order interactions between the covariates, which the existing literature generally does not account for. We argue that empirical studies on mass atrocities should adopt more flexible modelling techniques and use predictive accuracy to validate theories and inform public policy decisions.

**Keywords:** ensemble models, genocide, mass killings, random forests, state-sponsored violence

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# 1 Introduction

Since the end of World War II, mass killings, genocides, and politicides have claimed over 34.5 million lives (Marshall et al. 2017).<sup>1</sup> The international community has responded with an effort to prevent further state-sponsored mass murder by strengthening laws against war crimes and crimes against humanity. Furthermore, the United Nations established a Special Adviser on the Prevention of Genocide and recognised its members' responsibility to protect civilian populations within and outside their own borders. Yet, such atrocities still occur. Recently, President al-Assad of Syria has massacred tens of thousands of civilians during the Syrian Civil War (Goldman 2017). Similarly, South Sudan's President Kiir is actively starving and killing civilians from dissident and rival tribes (Nichols 2017). While there is some evidence that such atrocities may be declining since the Cold War (Valentino 2014), the international community has been far from successful in realising slogans like "Never Again" and "Not on My Watch" (Cheadle and Prendergast 2007).

Ultimately, effective prevention requires us to infer when mass killings are likely to occur. In this vein, the academic community suggests a myriad of factors that correlate with government brutality, such as population dynamics, military spending, trade indicators, and regime characteristics (e.g., Colaresi and Carey 2008; Eck and Hultman 2007; Harff 2003; Krain 1997). But despite the rapid growth of the literature on mass atrocities, existing theories have not been followed by systematic evaluations of their relative predictive performance. With few notable exceptions, such as Ulfelder and Valentino (2008) and Ulfelder (2012), out-of-sample testing of mass killings theories remains scarce.<sup>2</sup> Prediction tests are key to adjudicate between rival explanations and direct academic efforts towards more promising areas of research (Ward et al. 2010; Ward 2016). Moreover, if the predictions the theories generate are unable to explain future events, current findings offer little guidance to policy-makers. In this regard, identifying robust predictors of mass killings improves the accuracy of early warning systems, which in turn leads to more effective genocide-prevention strategies.

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<sup>1</sup>Genocide and politicide are the attempted intentional destruction of communal or political groups, respectively (see Harff and Gurr 1988). Mass killing includes these atrocities, as well as attacks against civilians that result in at least 1,000 deaths but are not intended to destroy a particular group (see Ulfelder and Valentino 2008). While some conflate these types of atrocities (e.g., Rummel 1995; Valentino et al. 2004), others claim genocide and politicide follow a different logic from other forms of government violence (Kalyvas 2006; Stanton 2015). For discussion on these important differences in conceptualisation see Straus (2007) and Finkel and Straus (2012).

<sup>2</sup>The Early Warning Project (<https://earlywarningproject.ushmm.org>) provides a noteworthy attempt to identify countries at risk of genocide. The Project deserves our highest praise and our paper partly overlaps with their efforts. However, their forecasts do not present estimates for variable importance nor partial dependence plots for the most relevant predictors of genocide. We build on their findings and not only provide our own out-of-sample forecasts, which can be compared to theirs, but we also assess the relative impact of the covariates suggested by the specialised literature.

In this paper, we employ random forests, a machine learning algorithm, to test the predictive ability of 40 variables seen as strong determinants of mass killings. Although a small group of variables does increase the predictive accuracy of our models, most of the factors do not perform well in out-of-sample forecasts. We find that economic variables are the most significant predictors of state-sponsored violence, while political and demographic factors fare poorly in our models. When we assess the marginal effects of the predictors, we also find that they are mostly non-linear, showing high-order interactions and complex prediction patterns. Our results indicate that the literature on mass atrocities would benefit from focusing on a particular set of structural factors and adopting more flexible modelling techniques.

We first present a brief overview of the recent scholarship on mass killings and discuss its main empirical findings. We then explain how the random forest algorithm allows us to accurately evaluate the predictive power of the determinants of mass killings indicated by the literature. We proceed to a discussion of our results and conclude with suggestions for new avenues of research.

## **2 An Overview of the Correlates of Mass Killings**

## References

- Cheadle, D. and Prendergast, J. (2007). *Not on Our Watch: The Mission to End Genocide in Darfur and Beyond*. Dublin: Hachette Books. Cited on page 2.
- Colaresi, M. and Carey, S. (2008). To kill or to protect: Security forces, domestic institutions, and genocide. *Journal of Conflict Resolution*, 52(1):39–67. Cited on page 2.
- Eck, K. and Hultman, L. (2007). One-sided violence against civilians in war: Insights from new fatality data. *Journal of Peace Research*, 44(2):233–246. Cited on page 2.
- Finkel, E. and Straus, S. (2012). Macro, meso, and micro research on genocide: Gains, shortcomings, and future areas of inquiry. *Genocide Studies and Prevention*, 7(1):56–67. Cited on page 2.
- Goldman, R. (2017). Assad’s history of chemical attacks, and other atrocities. Cited on page 2.
- Harff, B. (2003). No lessons learned from the holocaust? assessing risks of genocide and political mass murder since 1955. *American Political Science Review*, 97(1):57–73. Cited on page 2.
- Harff, B. and Gurr, T. R. (1988). Toward Empirical Theory of Genocides and Politicides: Identification and Measurement of Cases Since 1945. *International Studies Quarterly*, 32(3):359–371. Cited on page 2.
- Kalyvas, S. N. (2006). *The Logic of Violence in Civil War*. Cambridge: Cambridge University Press. Cited on page 2.
- Krain, M. (1997). State-Sponsored Mass Murder: The Onset and Severity of Genocides and Politicides. *Journal of Conflict Resolution*, 41(3):331–360. Cited on page 2.
- Marshall, M. G., Gurr, T. R., and Harff, B. (2017). Pitf state failure problem set, 1955-2016. Cited on page 2.
- Nichols, M. (2017). South sudan’s government using food as weapon of war - u.n. report. Cited on page 2.
- Rummel, R. J. (1995). Democracy, power, genocide, and mass murder. *Journal of Conflict Resolution*, 39(1):3–26. Cited on page 2.

- Stanton, J. (2015). Regulating militias: Governments, militias, and civilian targeting in civil war. *Journal of Conflict Resolution*, 59(5):899–923. Cited on page 2.
- Straus, S. (2007). Second-generation comparative research on genocide. *World Politics*, 59(3):476–501. Cited on page 2.
- Ulfelder, J. (2012). Forecasting onsets of mass killing. Technical report. Accessed: January 2018. Cited on page 2.
- Ulfelder, J. and Valentino, B. (2008). Assessing risks of state-sponsored mass killing. Technical report. Accessed: January 2018. Cited on page 2.
- Valentino, B. (2014). Why we kill: The political science of political violence against civilians. *Annual Review of Political Science*, 17:89–103. Cited on page 2.
- Valentino, B., Huth, P., and Balch-Lindsay, D. (2004). “draining the sea”: Mass killing and guerrilla warfare. *International Organization*, 58(2):375–407. Cited on page 2.
- Ward, M. D. (2016). Can we predict politics? toward what end? *Journal of Global Security Studies*, 1(1):80–91. Cited on page 2.
- Ward, M. D., Greenhill, B. D., and Bakke, K. M. (2010). The perils of policy by p-value: Predicting civil conflicts. *Journal of Peace Research*, 47(4):363–375. Cited on page 2.