

**Endogenizing the Costs of Climate-Induced Violence
in the Optimal Management of the Climate:
A MERGE Modeling Approach**

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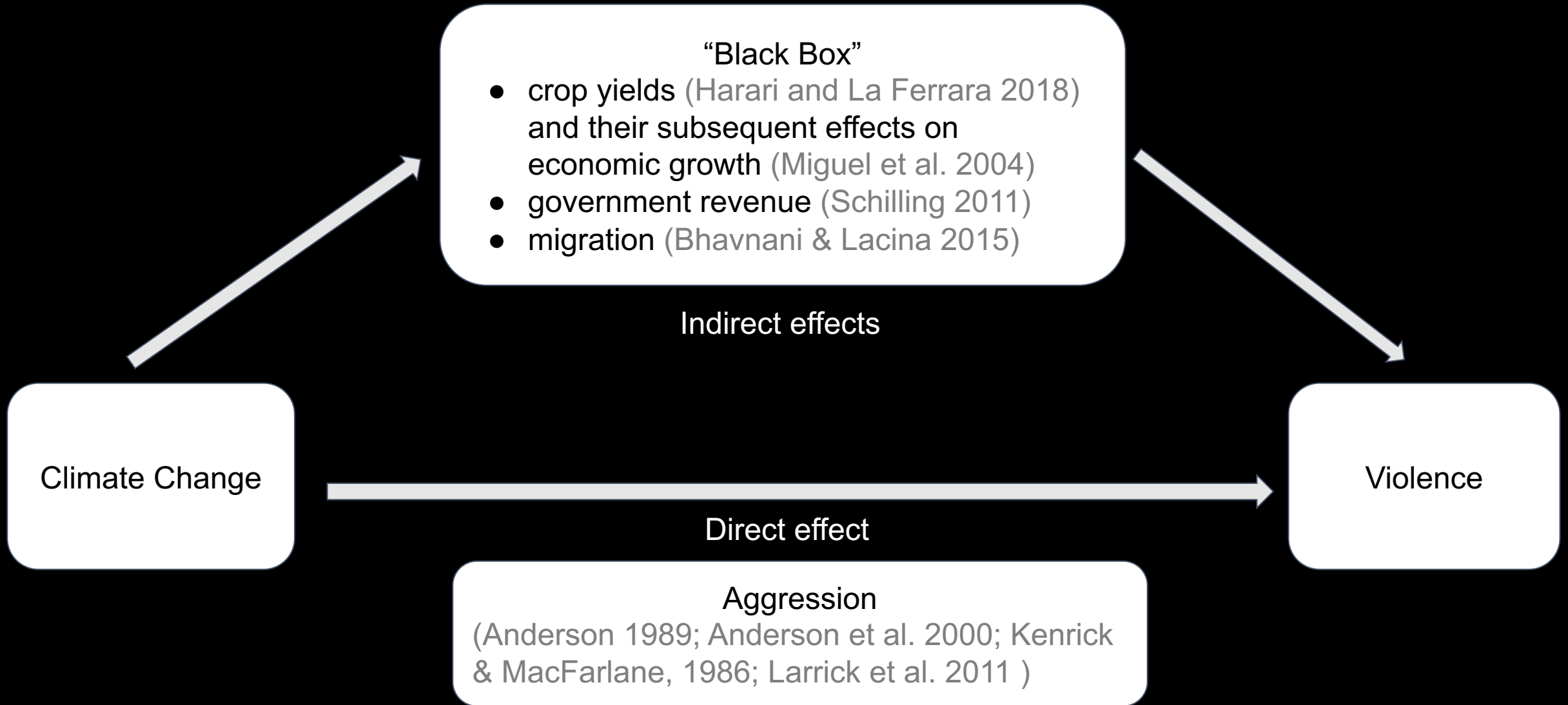
Integrating Political Science into Climate Modeling

- Extant modeling work has integrated economic, technological, and biophysical processes that produce GHG emissions.
- **Political science** has rarely entered the picture, although humans and institutions play significant roles in shaping policy outputs and outcomes.
- Making reasonable assumptions about human behaviors can provide essential insights into alternative future climates.
- It is very challenging, but I try.
- The concept I seek to integrate in the current exercise is:

VIOLENCE

- **1.4 million** deaths from violence every year (WHO, 2017).
- **65.3 million** forced displacement in 2015 alone, demanding **\$28 billion** worth of humanitarian needs (UNHCR, 2015).
- Total (physical) cost of violence per year: **\$9.4 trillion (11% of world GDP)**
- Interpersonal violence costs **6.4 times more** than collective violence (Fearon & Hoeffler, 2014; Hoeffler, 2017; IEP, 2014).

Climate Change and Violence



Climate -- Economy

Climate -- Violence

What is the carbon externality after internalizing the damages from climate-induced violence?

Objectives

- To understand how any increased risk of violence associated with climate change may affect the tradeoff in choices relating to carbon emissions.
- NOT to provide precise predictions or propose a new carbon pricing policy.

Costs of Violence: Data

- Sources: works by James Fearon and Anke Hoeffler
- Approach: “value of a statistical life” (VSL)
- Three general categories:
 - Self-directed
 - Collective (by organized groups)
 - Interpersonal (by individuals)
- Underestimation:
 - Do not consider self-directed violence
 - Psychological costs and additional costs associated with sexual violence are excluded
 - Some relevant costs are excluded when data is unavailable
 - Not valuing the invaluable, such as the decline or loss of social capital (Putnam 1993, 2000)

Costs of Violence by Type and Region

- Market vs. nonmarket damages
 - Market damages: GDP losses from war, economic costs of medical care, criminal justice system, lost income
 - Nonmarket damages: deaths from war, fear

Region	Collective Violence		Interpersonal Violence	
	Market	Nonmarket	Market	Nonmarket
East Asia & Pacific	0.007	0.003	0.119	9.151
Europe & Central Asia	0.963	0.017	0.426	10.394
Latin America & Caribbean	0.494	0.046	0.698	18.512
The Middle East & North Africa	0.877	0.603	0.206	27.424
South Asia	0.249	0.011	0.078	20.502
Sub-Saharan Africa	0.595	0.035	0.166	37.114
High Income	0.000	0.000	0.899	5.371

Costs of collective and interpersonal violence as percentages of GDP for different global regions (Hoeffler 2017), by market versus nonmarket damages classified by the author

The Relationship between Climate Change and the Incidence of Violence

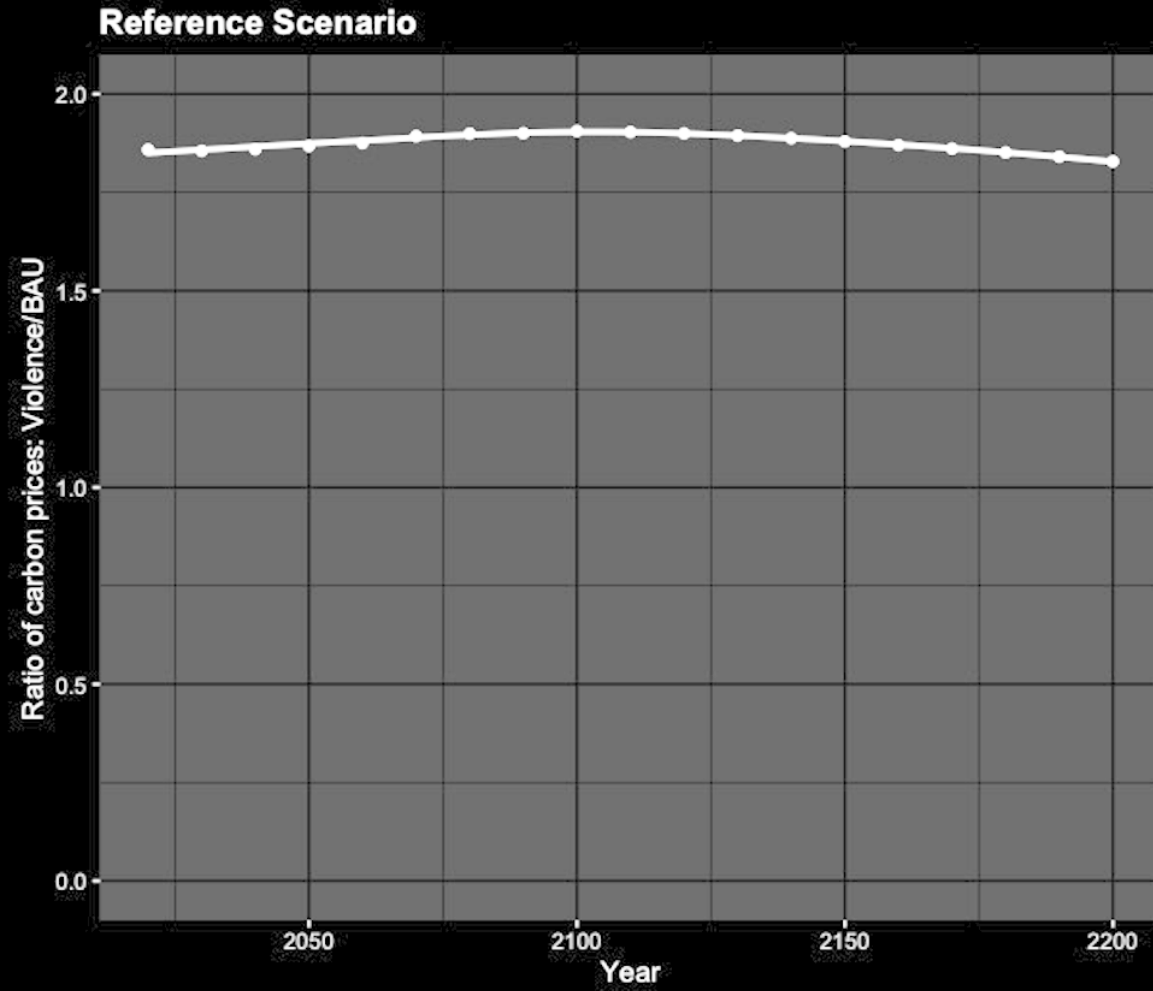
For each **one s.d. change in climate toward warmer temperatures** (or more extreme rainfall), median estimates suggest that the **frequency of interpersonal violence rises 4%** and the **frequency of intergroup conflict rises 14%** (Hsiang, Burke, & Miguel 2013).

Growing unpredictability of temperature resulting from climate change will likely lead to sustained increases in violence.

Choice of Model: MERGE

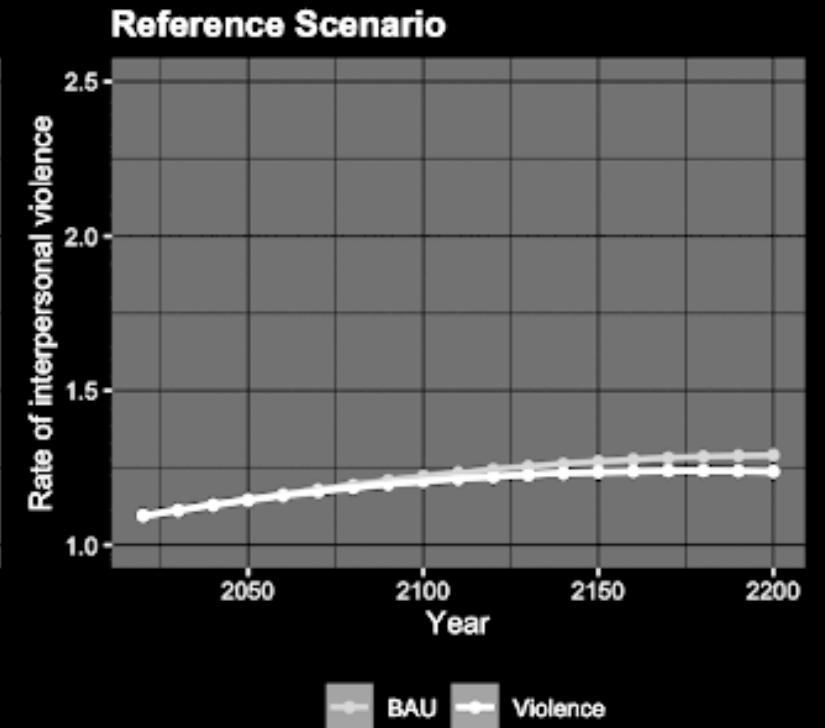
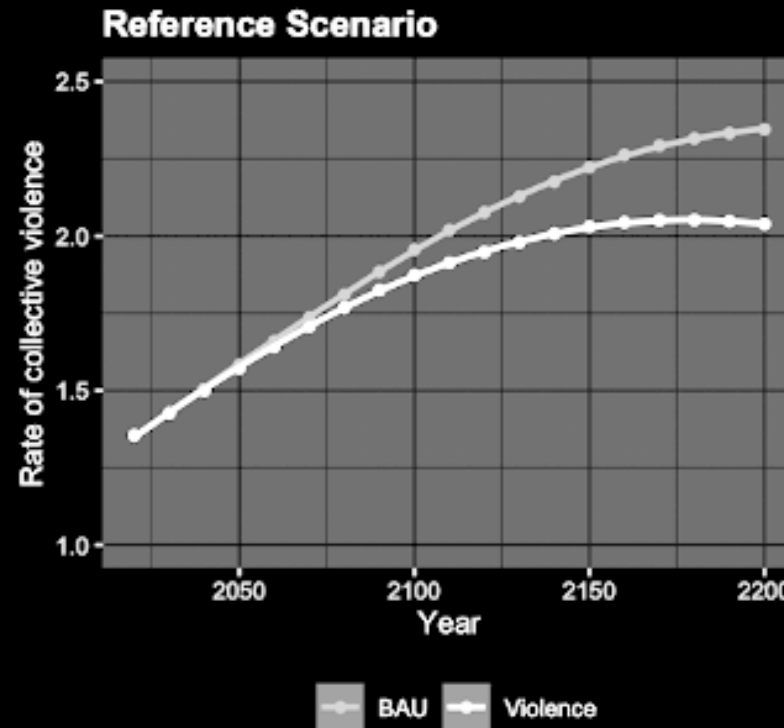
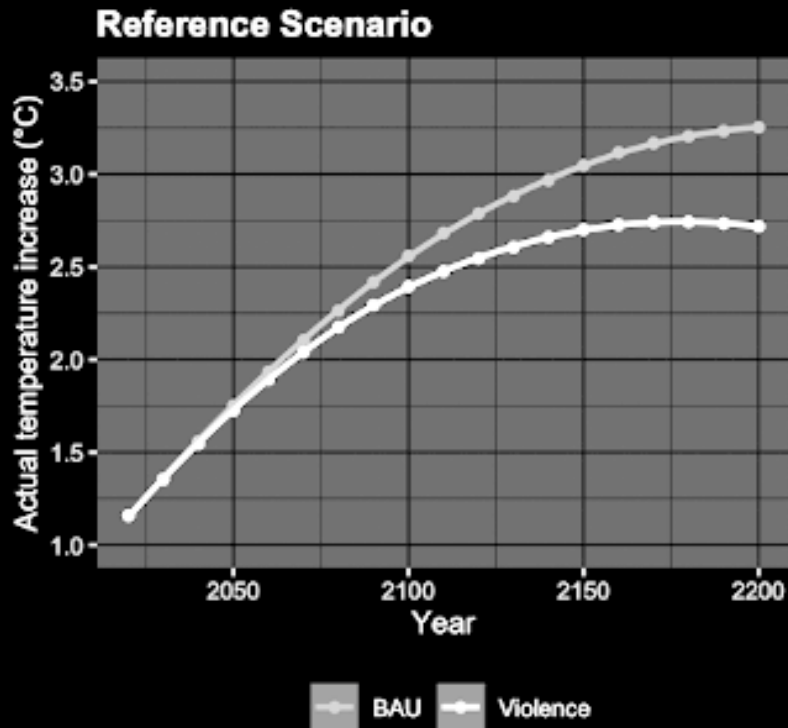
- Reasons
 - Detailed climate module
 - Sufficient flexibility for alternative view on damages from climate change
 - Coverage of multiple global regions
- “Benefit-cost” mode for optimization
 - Seeks the socially optimal price of carbon, given assumptions, needed to internalize the externalities associated with climate change and maximize the net benefit to society

Reference Scenario



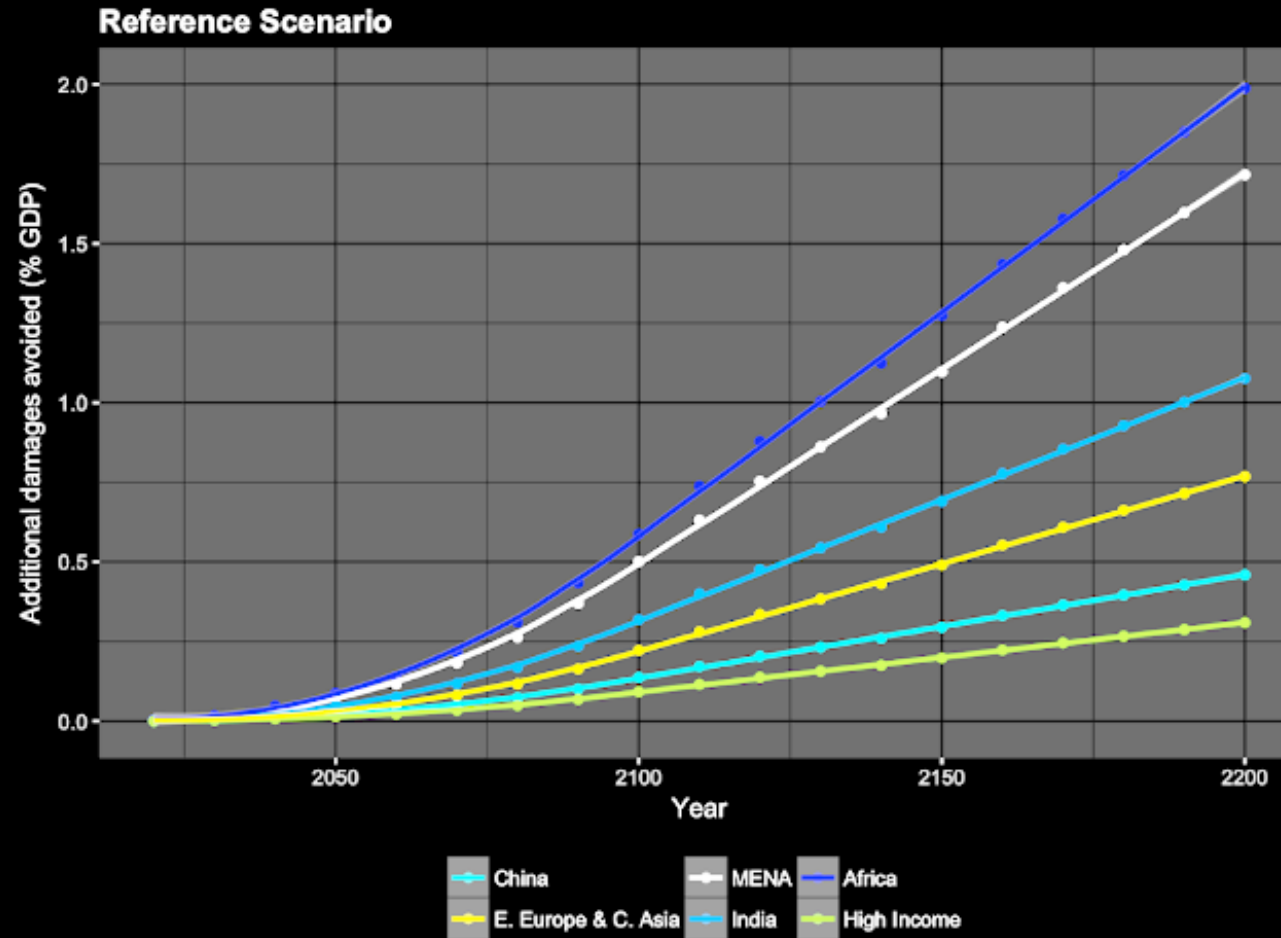
Projections of the ratio of optimal carbon prices in the Violence vs. BAU scenarios

Reference Scenario



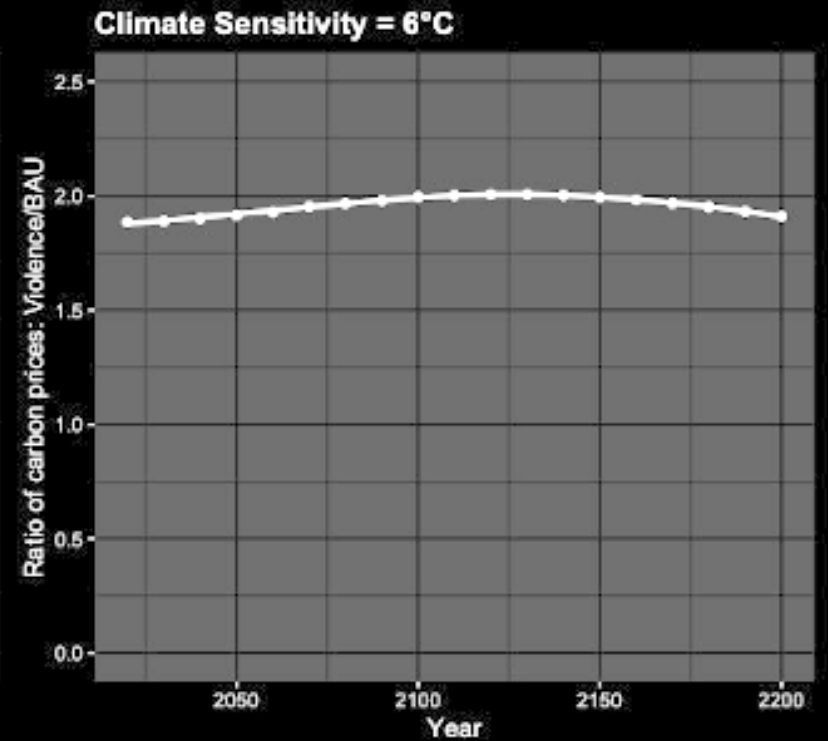
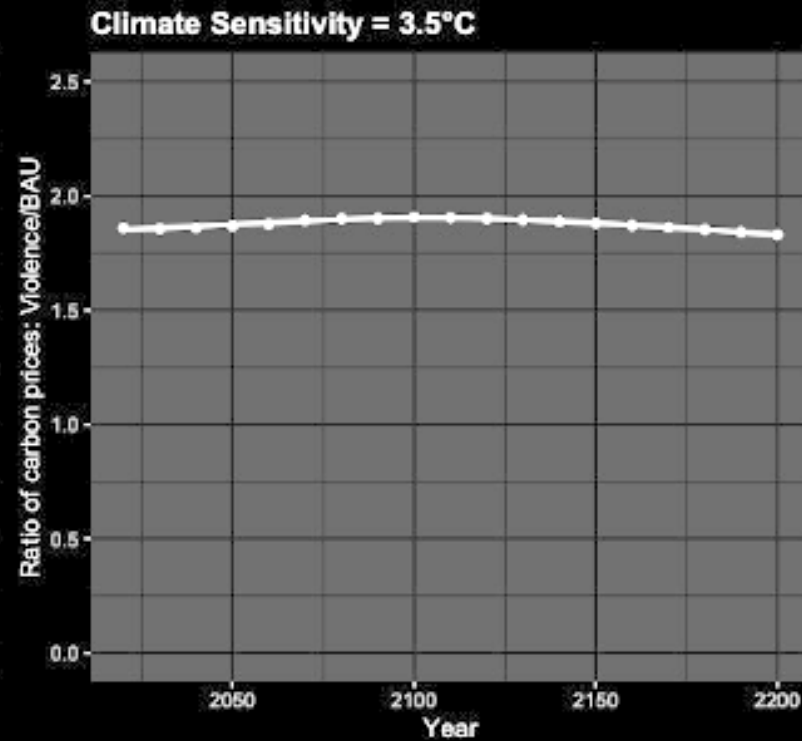
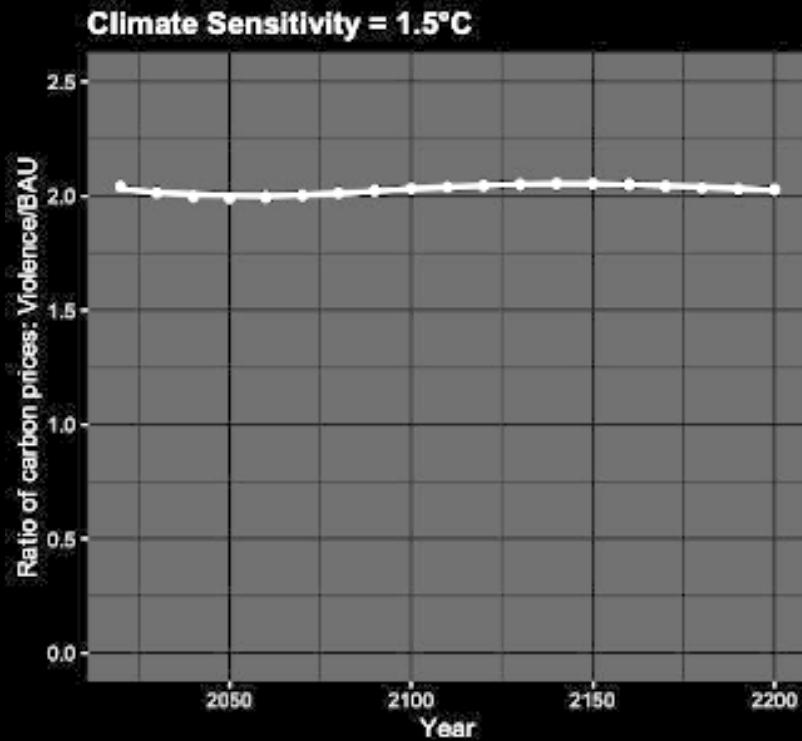
Projections of temperature increase and the rates of collective and interpersonal violence using the pre-industrial levels as the baseline

Reference Scenario

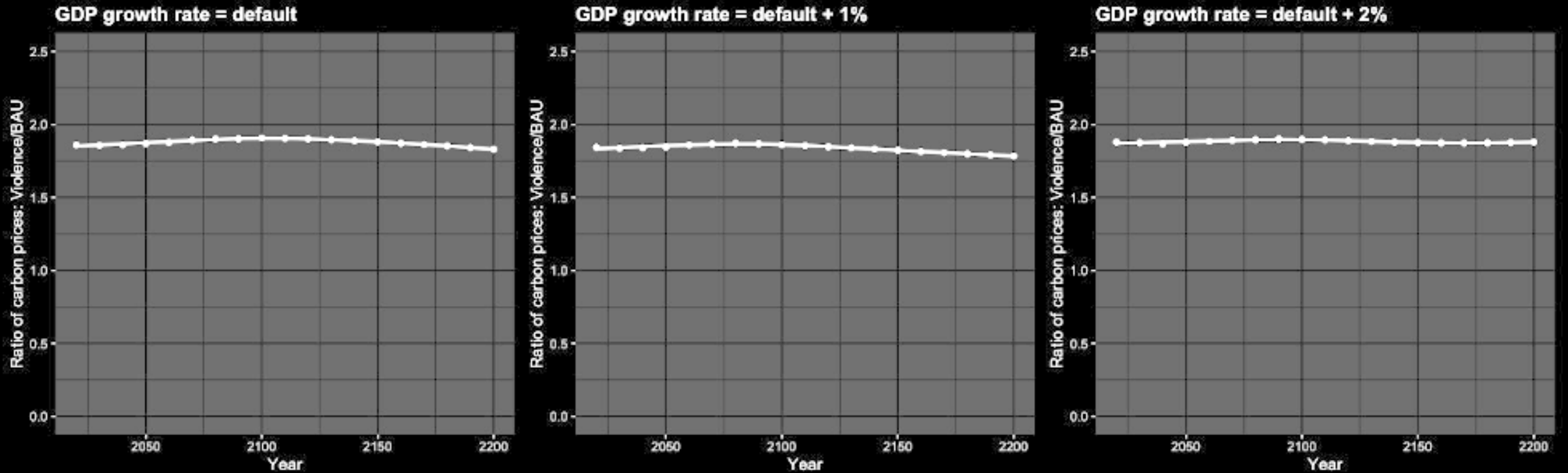


Avoided damages from climate-induced violence as a percentage of regional GDP

1: Climate Sensitivity

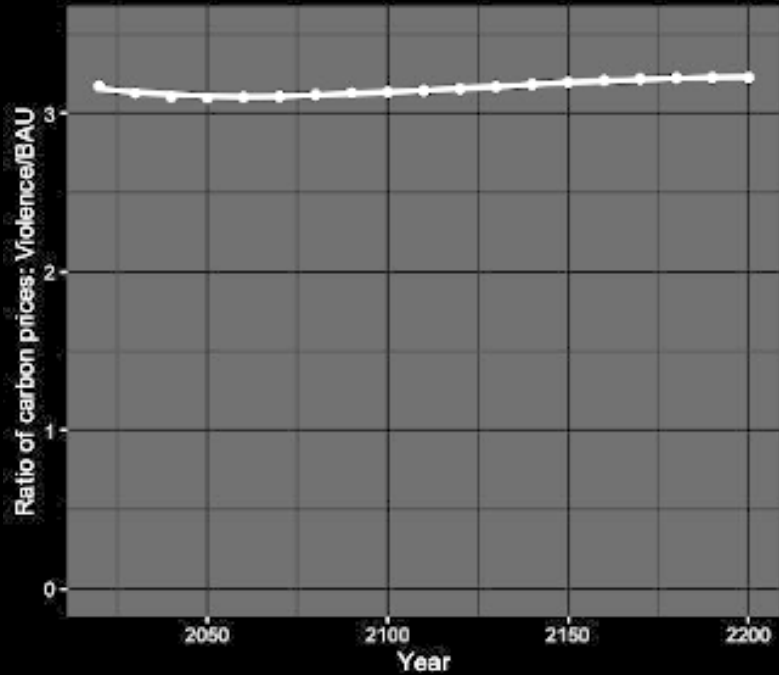


2: GDP Growth Rate

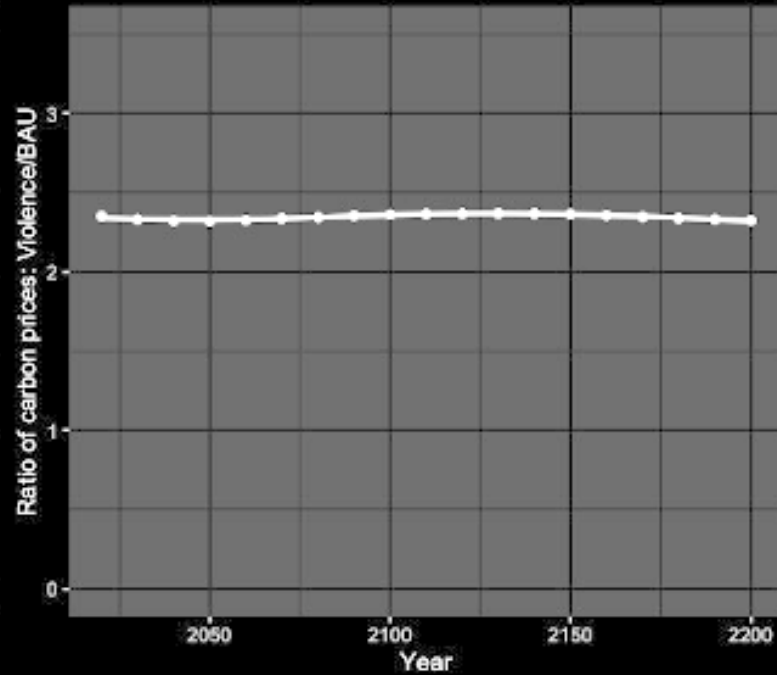


3: WTP for Nonmarket Damages

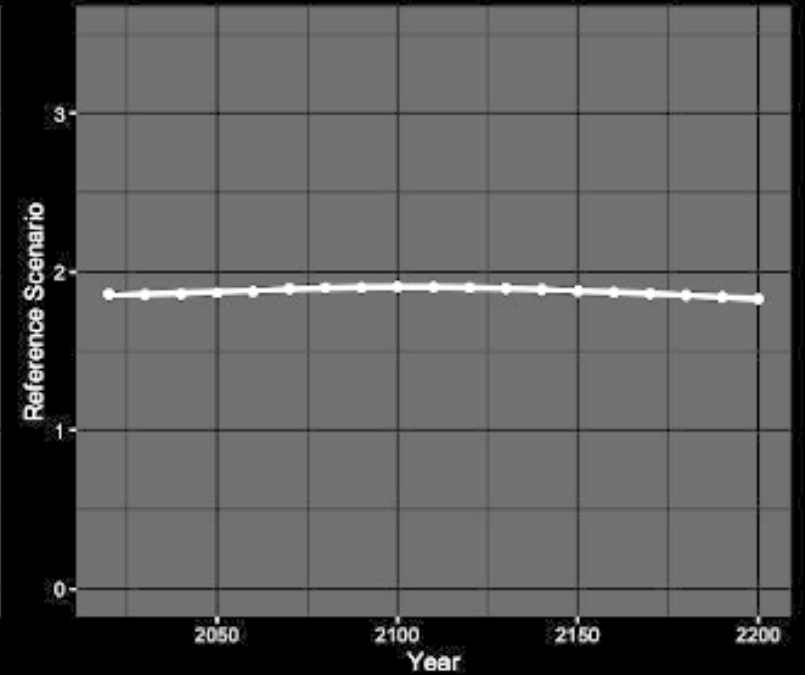
WTP to avoid nonmarket damages = 1% GDP



WTP to avoid nonmarket damages = 2% GDP



Reference Scenario



Two Caveats

- First, the costs of violence are plausibly low-bound estimates, downwardly biasing the estimates of carbon externality.
- Second, since the climate-violence relationship coefficient in Hsiang, Burke, and Miguel (2013) is mainly based on local temperature deviations, which are likely higher than the global temperature variation, the estimates of carbon externality could be biased upward.

Future Research

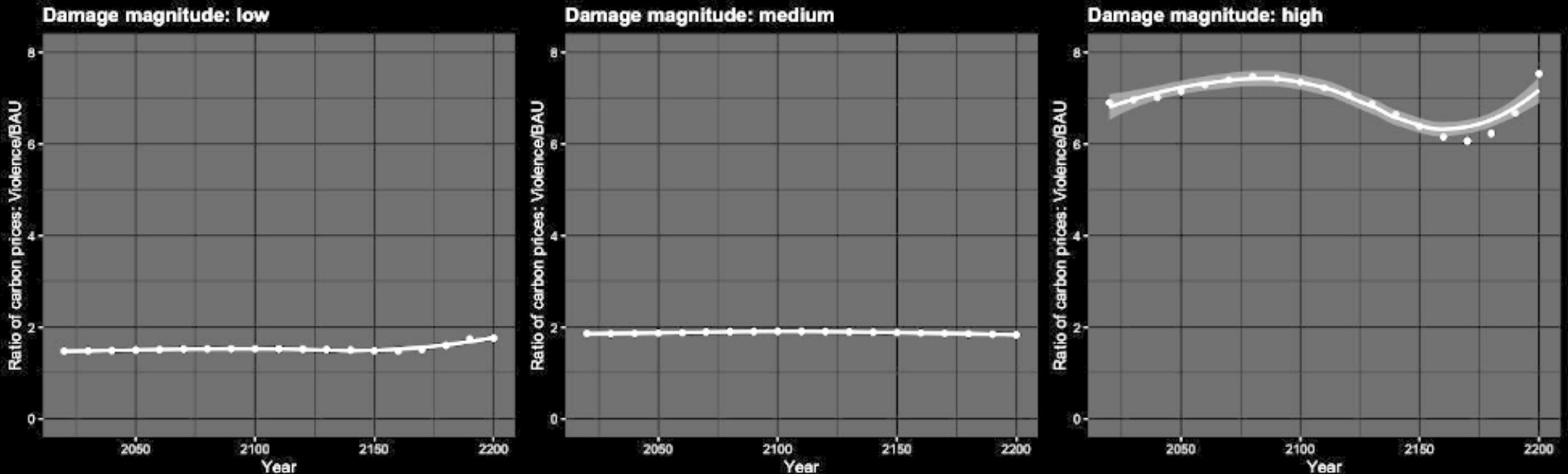
- Utilize improved estimates of the costs of violence, which would be based on the country-level estimate of the value of a statistical life (VSL), projected country-level weather trends, and country- or region-level climate-violence relationships, when such estimates become available.
- Since Hsiang, Burke, and Miguel (2013) provide one approximation of the “true” functional form of the relationship between climate change and conflict, future research can utilize other functional forms in the modeling exercise (e.g., linear).
- Conduct similar analyses using other IAMs and perform inter-model comparisons of results.
- Try to factor in the effects of projected adaptation.

Preliminary Conclusions and Implications

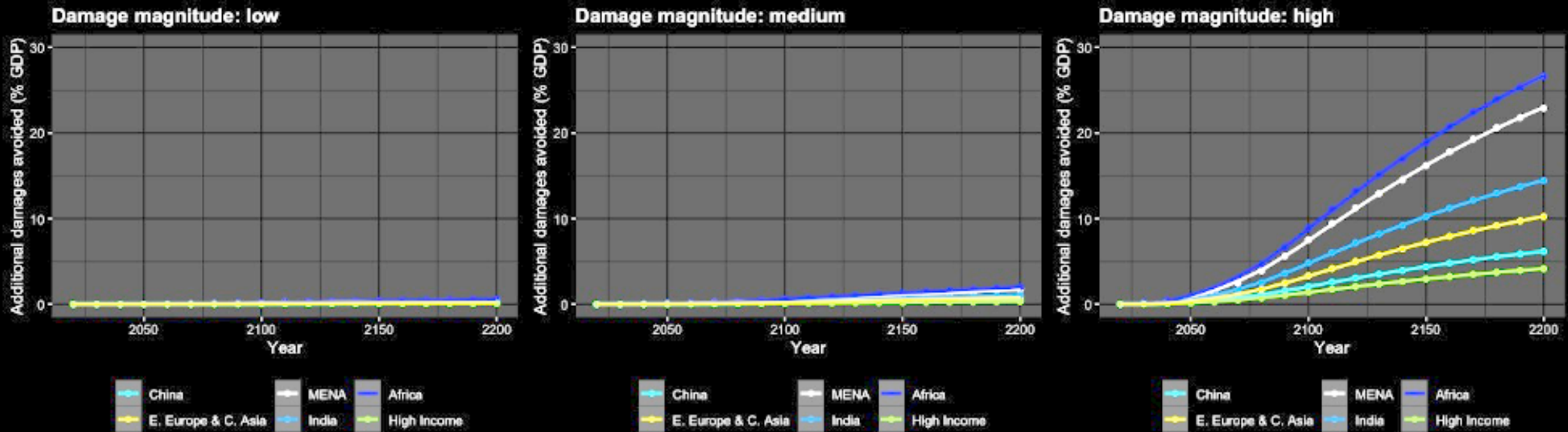
- This study connects the climate-economy and the climate-violence systems by putting forth a new way of modeling carbon externality to endogenize a critical yet previously missing aspect of climate impacts – violence.
- By internalizing such costs in MERGE, which is a methodological contribution of the paper, I find that the optimal carbon price roughly doubles across most scenarios.
- For the modeling community, the take-home message is that climate-induced violence may have a material impact on results, and should be considered in any model trading off the costs and benefits of greenhouse gas emissions.

Bonus Slides

4: Accounting for Uncertainty: The Magnitude of the Climate-Violence Response Relationship



Highlight: Projections of avoided damages from climate-induced violence as % regional GDP under different assumptions about the magnitude of the climate-violence response relationship



5: Inclusion/Exclusion of Nonmarket Damages

