Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

When Development Divides: Chinese Projects, Relative Deprivation, and Conflict in Africa

Haoyu Wang

hwang74@ctbu.edu.cn

Chongqing Technology and Business University

Lina Wang

Chongqing Technology and Business University

Ke Hu

Chongqing Technology and Business University

Research Article

Keywords: Chinese development finance, Relative deprivation, Regional inequality, Local conflict, Africa

Posted Date: November 26th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11027269/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

When Development Divides: Chinese Projects, Relative Deprivation, and Conflict in Africa

September 13, 2026

Abstract

Large foreign-aid and development-finance projects can generate local growth while distributing gains unevenly across nearby places and groups. We study the conflict implications of this uneven growth through the lens of relative deprivation, using geocoded Chinese development projects across Africa, 25-km grids, nighttime lights, and conflict events. Project-centered difference-in-differences estimates show that project implementation raises nighttime luminosity most strongly near project sites, with effects that persist and decay sharply with distance. We then use five-fold project-level cross-fitting to predict the development benefit generated by Chinese projects for each grid. Relative deprivation is constructed as the positive gap between the distance-weighted average benefit of surrounding grids within 75 km and the focal grid's own predicted benefit. We find a strong positive relationship between relative deprivation and local conflict. A similar pattern emerges when relative deprivation is constructed across ethnic groups within project areas. These findings highlight how the uneven distribution of project-induced growth can shape the political consequences of large development investments.

Keywords: Chinese development finance; Relative deprivation; Regional inequality; Local conflict; Africa

JEL Codes: O19, D74, R12

1 Introduction

Large development projects are commonly justified by their capacity to relax infrastructure constraints, connect markets, and expand access to services. Yet the resulting gains need not diffuse evenly across space. Transport improvements can reallocate activity toward already advantaged locations, and reductions in trade costs can generate substantial within-region redistribution rather than uniform convergence (Faber, 2014; Storeygard, 2016). This creates a central question for development economics and political economy: can an intervention raise local economic activity on average while simultaneously widening disparities among nearby places that share the same project environment? If political behavior responds to relative position as well as absolute welfare, the spatial distribution of gains may be as important as their mean effect.

Chinese development finance in Africa provides a useful setting in which to study this question. Chinese state-financed projects are large, geographically concentrated, and often infrastructure intensive. Existing work finds positive aggregate and local economic effects, while also documenting substantial heterogeneity across sectors, locations, and political environments (Bluhm et al., 2025; Dreher et al., 2021b, 2021a). Related studies identify governance and allocation concerns, including local corruption and political favoritism (Dreher et al., 2021a; Isaksson & Kotsadam, 2018). These findings imply that an average treatment effect can conceal meaningful differences in who benefits, how far benefits travel, and which nearby communities become natural comparison groups.

We ask whether such spatially uneven project benefits are systematically related to local conflict. The argument separates two channels. First, an absolute-benefit channel predicts that improvements in local economic opportunities can raise the opportunity cost of violence and strengthen incentives for cooperation with the state. Second, a relative-deprivation channel predicts that conflict risk may rise when nearby places or socially salient groups experience larger gains, even if the focal locality also improves. This distinction connects the economics of local development and conflict with theories of reference dependence, horizontal inequality, and group mobilization (Cederman et al., 2011; Esteban et al., 2012; Gurr, 1970; Luttmer, 2005; Østby, 2008).

The empirical strategy proceeds in two linked stages. First, project-centered spatial difference in differences models compare annual nighttime luminosity across distance rings around geocoded projects, using the 200–300 km band as the spatial reference. Event-study estimates assess pre-implementation dynamics, and natural cubic splines provide a smooth alternative to discrete rings. Second, we use five-fold project-level

cross-fitting to translate the estimated luminosity response into predicted grid-year development benefits. For each focal grid, relative deprivation is defined by comparing its predicted benefit with the inverse-distance-weighted benefit of other grids within 75 km; an ethnic extension constructs analogous comparisons across localized groups within the same project environment. Conflict counts are then modeled by PPML with grid and country-by-year fixed effects.

Three results organize the paper. First, project implementation is followed by a pronounced and persistent increase in nighttime light close to project sites, with effects that decay over distance. By contrast, the direct post-implementation conflict gradient is non-monotonic. Second, in the grid-level conflict models, own benefit is negatively associated with conflict while relative deprivation is positively associated with conflict. The same qualitative pattern appears in the unrestricted decomposition: conditional on neighboring gains, stronger own gains predict less conflict; conditional on own gains, stronger neighboring gains predict more conflict. Third, the relative-deprivation relationship is clearest for state-based violence. Ethnic-group comparisons are positive and statistically precise under the ring construction, but the corresponding spline estimates are less precise, making the ethnic evidence more specification-sensitive than the grid evidence.

The paper contributes to four related literatures. First, it extends work on the local effects of development finance by shifting attention from whether projects raise activity to how project-induced gains are distributed across nearby space. Second, it contributes to the aid-conflict literature by separating the economic benefit received by a locality from the gains received by its comparison set, rather than treating geographic proximity as a single exposure. Third, it operationalizes relative deprivation using project-induced predicted benefits and examines both geographic and ethnic reference groups, linking spatial development to the horizontal-inequality literature. Fourth, the empirical design combines ring and spline first stages, project-level cross-fitting, signed-gap and own-versus-neighbor decompositions, conflict-type heterogeneity, and comparison-radius checks. The first-stage spatial estimates admit a difference-in-differences interpretation under the stated parallel-trends assumptions; the second-stage models are deliberately interpreted more narrowly because the benefit measures are generated regressors. This distinction keeps the empirical claims aligned with what each stage identifies.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 describes the data and variable construction. Section 4 develops the conceptual framework. Section 5 presents the empirical strategy and identifying assumptions. Section 6 reports the main results and robustness evidence. Section 7 discusses interpretation, scope conditions, and policy implications. Section 8 concludes.

2 Related Literature

2.1 Development Finance, Infrastructure, and Spatial Economic Change

A growing empirical literature studies development interventions at the spatial scale at which projects are actually implemented. Early geocoding efforts showed why country-year aggregation can obscure local treatment, spillovers, and conflict mechanisms (Findley et al., 2011). Satellite-based measures have further expanded this agenda by providing a common, spatially detailed proxy for economic activity where administrative statistics are sparse or incomparable (Donaldson & Storeygard, 2016; Henderson et al., 2012). These tools are particularly valuable for infrastructure and development-finance projects because their effects can cross administrative boundaries while still decaying with geographic distance.

The broader infrastructure literature also cautions against assuming spatially uniform gains. Faber (2014) shows that improved highway integration in China can reallocate industrial activity away from peripheral counties, while Storeygard (2016) demonstrates that transport costs shape city growth across sub-Saharan Africa. For Chinese development finance specifically, Dreher et al. (2021b) find positive short-run growth effects at the cross-country level, and Dreher et al. (2021a) document local nighttime-light gains around Chinese projects, including in politically favored regions. Bluhm et al. (2025) further show that Chinese-financed transport infrastructure can diffuse economic activity within subnational regions. Together, these studies motivate treating spatial incidence—not merely project presence—as an empirical outcome.

At the same time, luminosity is a proxy for economic activity rather than a complete welfare measure, and project placement may reflect political priorities, accessibility, or local state capacity. Isaksson and Kotsadam (2018), for example, associate active Chinese projects with greater reported local corruption, while Dreher et al. (2021a) show that political allocation can coexist with local economic effects. Our approach therefore uses within-project spatial comparisons, project-site-by-grid fixed effects, and project-site-by-year fixed effects in the first stage, and it treats the second-stage conflict regressions as a mechanism-oriented exercise rather than assuming that predicted benefits are externally assigned.

2.2 Development Interventions, Economic Shocks, and Violent Conflict

The relationship between economic development and violent conflict is theoretically ambiguous. A standard opportunity-cost mechanism predicts that higher income, employment, and service access make participation in violence more costly. Consistent with this logic, negative economic shocks have been linked to higher

conflict risk in Africa (Miguel et al., 2004), while commodity-price evidence shows that the sign of the effect depends on whether shocks operate primarily through labor income or through appropriable rents (Dube & Vargas, 2013). The broader literature therefore emphasizes that economic gains can pacify when they improve civilian opportunities, yet destabilize when they create contestable resources or alter the strategic value of territory (Ray & Esteban, 2017).

Development assistance exhibits the same ambiguity. Reconstruction spending and service provision can reduce insurgent violence when they improve information and local cooperation (E. Berman et al., 2011), but aid can also become a target of contestation. Crost et al. (2014) show that insurgent violence increased around a development program in the Philippines, and Nunn and Qian (2014) find that increases in U.S. food aid can prolong civil conflict in recipient countries. In Africa, Gehring et al. (2022) report no average increase in outright conflict from Chinese or World Bank projects and identify some stability-enhancing effects, while Moscona (2025) shows that project management and appropriability importantly condition local violence. Disaggregated studies of resources and climate similarly demonstrate that local shocks can affect nearby conflict even when country aggregates mask those responses (N. Berman et al., 2017; Harari & La Ferrara, 2018).

Our departure from this literature is to distinguish project proximity from the distribution of project-induced gains. A single distance coefficient conflates at least two exposures: the gain experienced by the focal locality and the gain experienced by the locality's relevant comparison group. If own gains increase the opportunity cost of violence while stronger neighboring gains generate grievance or perceived exclusion, the net post-project conflict gradient can be non-monotonic even when both channels are systematic. Estimating own and comparison-group benefits separately therefore provides a sharper empirical mapping from development exposure to conflict than proximity alone.

2.3 Relative Deprivation, Horizontal Inequality, and Mobilization

Relative-deprivation theory holds that dissatisfaction depends partly on the gap between attainable or expected outcomes and realized outcomes, rather than solely on absolute hardship (Gurr, 1970). Evidence on reference-dependent well-being supports the importance of local comparison groups: conditional on own income, higher earnings among neighbors are associated with lower reported well-being (Luttmer, 2005). Applied to development projects, the implication is that visible improvement nearby can raise a locality's reference outcome. A community may therefore become relatively worse positioned even while its own

measured economic activity increases.

Conflict research adds a collective dimension to this mechanism. Horizontal inequalities across politically or ethnically meaningful groups can generate shared grievances and facilitate mobilization in ways that individual-level inequality need not. Montalvo and Reynal-Querol (2005) link ethnic polarization to civil conflict, Østby (2008) emphasizes horizontal social inequality, and Cederman et al. (2011) show that ethnonationalist conflict risk is related to groups' relative economic position. Esteban et al. (2012) connect ethnic structure and public-good stakes to conflict, while Lessmann (2016) documents a positive association between regional inequality and internal conflict. Alesina et al. (2016), using nighttime lights mapped to ethnic homelands, further demonstrate that economically meaningful inequality across ethnic groups is empirically substantial. Ray and Esteban (2017) synthesize these mechanisms as part of the broader economics of conflict.

This literature motivates two comparison sets that need not coincide. Geographic neighbors are salient because project effects, market interaction, commuting, and visible infrastructure are spatially bounded. Ethnic groups are salient because shared identity can make unequal allocation politically legible and reduce the organizational costs of collective action. A grid can lag behind nearby places without lagging behind other members of its ethnic group, or vice versa. Examining both reference groups therefore helps distinguish a spatial comparison mechanism from a group-based horizontal-inequality mechanism and provides a direct test of whether the empirical pattern depends on how the relevant benchmark is defined.

3 Data and Variable Construction

The project data come from AidData's China Global Development Dashboard and Geospatial Global Chinese Development Finance Dataset (Goodman et al., 2024). These sources geocode China's overseas development activities and record project location, financing or assistance type, implementation timing, implementing or financing actors, and project descriptions. We restrict the project universe to Africa and retain infrastructure and other investments with a clearly identifiable local physical footprint. Activities that cannot be meaningfully assigned to a specific site are excluded because the empirical design requires geographic distance to have a coherent interpretation as project exposure. This choice follows the logic of the subnational Chinese development-finance literature (Dreher et al., 2021a) and the broader geocoded-aid literature (Findley et al., 2011).

Local economic activity is measured with annual nighttime-light rasters. Nighttime luminosity is especially useful in this setting because consistently measured economic statistics are unavailable at the same fine spatial resolution across African countries, whereas satellite data provide a common spatial metric (Donaldson & Storeygard, 2016; Henderson et al., 2012). Because the panel spans changes in satellite platforms and sensors, untreated measurement shifts could be mistaken for economic change. We therefore use the harmonized annual nighttime-light series employed in the analysis and follow the intertemporal calibration approach of Li and Zhou (2017). Raster values are averaged within each 25-km grid cell. Estimation uses $\operatorname{asinh}(\text{light})$, which retains zero-light cells while compressing the strongly right-skewed upper tail.

Conflict outcomes are constructed from the Uppsala Conflict Data Program Georeferenced Event Dataset (UCDP GED; (Sundberg & Melander, 2013)). Event dates and geographic coordinates allow organized-violence events to be assigned directly to the same 25-km grid system used for project exposure and nighttime lights. Events are aggregated to annual grid-level counts, with grid-years containing no recorded event retained as zeros. The main outcome is the total number of conflict events. UCDP's event classification also permits separate analysis of state-based conflict, non-state conflict, and one-sided violence, which is useful for assessing whether relative-deprivation patterns are concentrated in organized contests involving the state or extend to other forms of violence.

The principal time-varying controls come from TerraClimate (Abatzoglou et al., 2018). We extract annual average temperature and precipitation for 2000–2024 and map them to the 25-km grid. To capture short-run deviations rather than persistent climatic differences, each variable is standardized relative to its corresponding mean and standard deviation. These anomalies enter the preferred conflict specifications because weather can affect both economic activity and violence (Harari & La Ferrara, 2018; Miguel et al., 2004). All project, light, conflict, and climate layers are transformed to a common spatial grid and calendar-year structure before estimation. The resulting common estimation panel contains 123,206 grid-year observations, summarized in Table 1.

4 Conceptual Framework

4.1 Localized Benefits and the Absolute-Development Channel

Consider a development project implemented at location p. Let B_{gt} denote the economic benefit received by grid g in year t. Construction demand, improved infrastructure, and service access make B_{gt} nonnegative in

the simplest case, but transport costs and project indivisibilities imply that the expected benefit declines with distance from the project. Spillovers may extend outward with delay, so the gradient can flatten over time without becoming spatially uniform. This motivates both distance rings and a smooth spatial-decay function in the empirical first stage.

Hypothesis 1 (Localized Development). Following project implementation, economic activity increases most strongly near the project site, and the estimated gain declines with distance.

Own benefit can affect violence through offsetting mechanisms. Higher local activity can increase legitimate earnings, raise the opportunity cost of joining armed groups, and strengthen incentives to provide information to the state (E. Berman et al., 2011; Miguel et al., 2004). Conversely, a valuable project can attract predation, generate appropriable rents, or induce strategic sabotage when armed actors expect the intervention to strengthen the state or rival constituencies (N. Berman et al., 2017; Crost et al., 2014; Nunn & Qian, 2014). We therefore do not impose a monotonic unconditional effect of project proximity on conflict. The absolute-benefit prediction is conditional on the comparison environment.

Hypothesis 2 (Absolute-Benefit Channel). Conditional on the benefit received by the relevant comparison set, a larger own development benefit is associated with less local conflict.

4.2 Reference Dependence and Spatial Relative Deprivation

Let NB_{gt} be the average benefit received by neighboring grids, which equals the weighted mean benefit of other grids in grid g's comparison neighborhood. A parsimonious representation of the nonviolent payoff is:

$$U_{gt} = u(B_{gt}) - \phi \cdot \max\{NB_{gt} - B_{gt},\, 0\} - K_{gt}, \qquad \phi > 0. \tag{1}$$

Here, $u(B_{gt})$ is increasing in own benefit and K_{gt} summarizes the economic, coercive, and organizational costs of violence. The second term captures reference dependence: when neighbors gain more, the focal grid experiences a surge in relative deprivation, defined as $RD_{gt} = \max\{NB_{gt} - B_{gt},\, 0\}$. A rise in own benefit increases the nonviolent payoff directly and, whenever the grid is behind, narrows the comparison gap. A rise in neighbor benefit has no deprivation effect when the focal grid remains ahead, but lowers the nonviolent payoff after the neighbor benchmark exceeds own benefit. This asymmetry motivates the positive-part measure used in the baseline specification.

The framework also clarifies the purpose of the signed-gap and decomposition tests. If conflict responds

smoothly to relative position on both sides of parity, the signed gap $NB_{gt} - B_{gt}$ should matter even without truncation. More generally, entering B_{gt} and NB_{gt} separately avoids imposing equal-and-opposite coefficients. A negative coefficient on own benefit together with a positive coefficient on neighbor benefit is the most transparent empirical pattern consistent with the absolute and comparison channels operating simultaneously.

Hypothesis 3 (Spatial Relative Deprivation). Conditional on own benefit, greater benefit among nearby grids—and hence a larger positive relative shortfall—is associated with more local conflict.

4.3 Ethnic Comparison and Collective Mobilization

Spatial proximity does not determine the only plausible reference group. Individuals may evaluate project allocation through ethnic or communal identities, particularly where political representation and public resources are organized along group lines. Let EB_{pet} denote the mean project-induced benefit of ethnic group e within project environment p, and let $EB_{p,-e,t}$ denote the corresponding benefit of other represented groups. Ethnic relative deprivation arises when the second quantity exceeds the first. The material gap can then become a group-level grievance rather than an isolated local disappointment.

Identity can make unequal treatment easier to interpret politically and can facilitate coordination. Shared networks, leadership, and narratives may lower the cost of translating grievance into collective action, while the state or rival groups provide identifiable targets (Cederman et al., 2011; Esteban et al., 2012; Montalvo & Reynal-Querol, 2005; Østby, 2008). This mechanism does not imply that every ethnic disparity produces violence. Rather, group organization, state capacity, prior conflict, and the political meaning of project allocation are scope conditions. The empirical implication is narrower: project-induced gaps aligned with ethnic boundaries may be especially relevant to organized conflict.

Hypothesis 4 (Group Salience and Organized Violence). Relative-deprivation associations should be stronger when comparison gaps align with socially salient ethnic groups and should be most visible in organized state-based or non-state conflict rather than one-sided violence.

5 Empirical Strategy

5.1 Unit of Analysis and Outcomes

The analysis is organized around 25-km grid cells observed annually. Geocoded Chinese project locations and implementation start years define project-centered spatial exposure. The primary economic outcome is annual nighttime luminosity, a spatially detailed proxy for local economic activity (Donaldson & Storeygard, 2016; Henderson et al., 2012). We use the inverse hyperbolic sine transformation, $\text{asinh}(\text{light})$, because it retains zero-light observations while reducing the influence of the pronounced right tail. Coefficients on this scale are interpreted as changes in transformed luminosity rather than mechanically as elasticities.

Conflict outcomes are annual geocoded event counts in each grid. The analysis considers the total count and, in the heterogeneity analysis, counts of state-based, non-state, and one-sided events. Temperature and precipitation anomalies are the preferred time-varying controls. We estimate conflict equations by Poisson pseudo-maximum likelihood (PPML), which accommodates zeros and consistently estimates a multiplicative conditional-mean model under correct specification of the conditional mean without requiring equality of the conditional variance and mean (Santos Silva & Tenreyro, 2006).

5.2 Project-Centered Spatial Difference-in-Differences

We first estimate how local economic activity and conflict change with distance from a project after implementation. For project site p, grid g, and year t, distance is partitioned into 0–25, 25–50, 50–75, 75–100, 100–150, 150–200, and 200–300 km rings. The 200–300 km band is the omitted spatial reference. This design is intended to recover a relative spatial profile around the same project rather than compare project locations with unrelated parts of the continent.

The baseline nighttime-light specification is

$$\text{asinh}(L_{pgt}) = \sum_{r} \beta_r \left[Post_{pt} \times \mathbf{1}\{d_{pg} \in r\} \right] + X'_{pgt}\theta + \alpha_{pg} + \lambda_{pt} + \varepsilon_{pgt}. \tag{2}$$

The summation covers the six inner rings. $Post_{pt}$ equals one from the implementation year onward, X_{pgt} contains the available weather anomalies, α_{pg} denotes site-by-grid fixed effects, and λ_{pt} denotes site-by-year fixed effects. The sample is restricted to event years -5 through $+5$. Site-by-grid fixed effects absorb time-invariant distance, geography, and baseline differences, while site-by-year fixed effects absorb shocks

common to all grids around a project site in a given year. Standard errors in this first stage are two-way clustered by original project and grid.

Under the identifying assumption that, absent implementation, outcomes in the inner rings would have evolved in parallel with the 200–300 km band, β_r measures the post-implementation change in ring r relative to the outer band.

For conflict, we estimate the analogous conditional-mean equation by PPML. Ring coefficients are converted to percentage changes as $100\,[\exp(\beta_r) - 1]$. This spatial conflict exercise is descriptive of the post-implementation gradient and is distinct from the later relative-deprivation regressions.

5.3 Dynamic Effects and Smooth Spatial Decay

To assess timing and the plausibility of parallel pre-trends, the static light specification is expanded into an event study. Indicators for event years $k = -5, \ldots, +5$ are interacted with each inner distance ring, with $k = -1$ omitted. The coefficients therefore compare each ring and event year with both its own pre-implementation baseline and the contemporaneous 200–300 km band:

$$\operatorname{asinh}(L_{pgt}) = \sum_{r} \sum_{\substack{k=-5 \\ k \neq -1}}^{5} \beta_{rk} \left[\mathbf{1}\{\tau_{pt} = k\} \times \mathbf{1}\{d_{pg} \in r\} \right] + X'_{pgt}\theta + \alpha_{pg} + \lambda_{pt} + \varepsilon_{pgt}. \tag{3}$$

We also replace the discrete ring indicators with a natural cubic spline in distance. The spline is defined over 0–300 km, with internal knots at 50, 100, and 200 km and boundary knots at 0 and 300 km. Only the spline basis interacted with $Post_{pt}$ enters because the site-by-grid fixed effects absorb the time-invariant distance profile. This smooth specification reduces dependence on arbitrary ring boundaries and provides a complementary description of spatial decay. The spline specification is

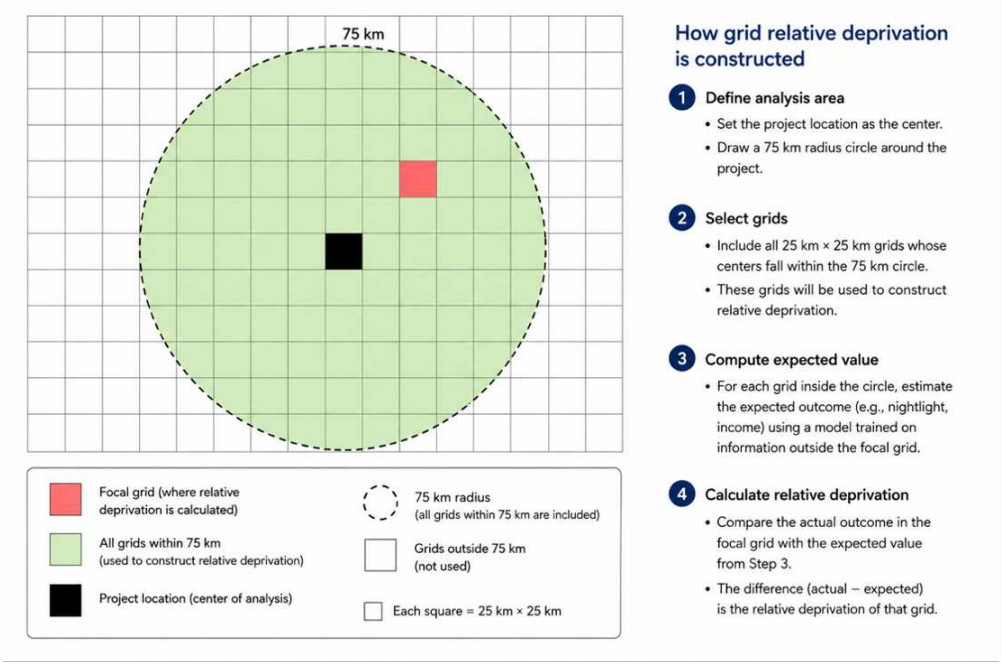
$$\operatorname{asinh}(L_{pgt}) = Post_{pt} \times \sum_{m} \eta_m B_m(d_{pg}) + X'_{pgt}\theta + \alpha_{pg} + \lambda_{pt} + \varepsilon_{pgt}. \tag{4}$$

For presentation and subsequent prediction, the fitted post-implementation spline is normalized by subtracting its mean fitted value over the observed 200–300 km reference band. The ring and spline approaches should therefore be read as complementary discrete and smooth representations of the same spatial contrast, not as specifications that are expected to produce identical coefficient scales.

5.4 Cross-Fitted Grid Benefit and Relative Deprivation

Own development benefit is a generated measure derived from the nighttime-light first stage. To reduce mechanical overfitting, original projects are assigned to five mutually exclusive folds. For fold k, the first-stage spatial model is estimated on the other four folds and its coefficients are applied only to projects in the held-out fold. All sites and observations belonging to a project remain in the same fold. The procedure implements project-level sample splitting in the spirit of cross-fitting (Chernozhukov et al., 2018): a project's predicted benefit is never generated from a first stage that was estimated using that same project.

Figure 1: Construction of Relative Deprivation



In the ring construction, the held-out coefficient associated with a project-grid distance ring becomes active in the implementation year and remains active thereafter. Multi-site projects receive site weights equal to the reciprocal of the number of mapped sites, and contributions from overlapping active projects are summed at the grid-year level. In the spline construction, each grid is linked to its nearest eligible project and receives the held-out, reference-band-normalized spline effect at that distance after implementation. Because the two constructions treat overlapping exposure differently, agreement across them is informative about robustness to the exposure function, while differences in coefficient magnitude are not themselves evidence of inconsistency.

Let B_{gt} denote the resulting cross-fitted own benefit of grid g in year t. For the baseline social-comparison

neighborhood, $\mathcal{N}_g$ contains all other grid centroids within 75 km of grid g. Neighbor benefit, denoted by NB_{gt}, is defined as the inverse-distance-weighted mean of the predicted benefits of these neighboring grids:

$$NB_{gt} = \frac{\sum_{j \in \mathcal{N}_g} d_{gj}^{-1} B_{jt}}{\sum_{j \in \mathcal{N}_g} d_{gj}^{-1}}. \tag{5}$$

Grid-level relative deprivation is defined as the positive part of the difference between neighboring benefit and own benefit $RD_{gt} = \max\{NB_{gt} - B_{gt}, 0\}$. Thus, $RD_{gt} = 0$ whenever the focal grid benefits at least as much as its surrounding comparison grids, and it becomes positive when the distance-weighted average benefit received by neighboring grids exceeds the focal grid's own predicted benefit. We calculate grid-level relative deprivation according to the procedure illustrated in Figure 1.

Robustness exercises replace the inverse-distance weights with equal weights, use the signed gap $NB_{gt} - B_{gt}$, decompose the gap into own and neighbor benefit, and vary the comparison radius from the baseline 75 km to 50 and 100 km.

5.5 Ethnic-Group Benefit and Relative Deprivation

The ethnic analysis introduces a socially salient comparison set alongside the geographic comparison. Grid centroids are assigned to localized ethnic-group polygons from the GeoEPR 2021 geography. Construction occurs at the project-by-ethnic-group-by-year level for grids within 300 km of a project. For project p, ethnic group e, and year t, ethnic own benefit is defined as the mean cross-fitted grid benefit among grids associated with group e in that project environment. This approach follows the horizontal-inequality logic that economic differences across groups, rather than individual dispersion alone, may be politically consequential (Alesina et al., 2016; Cederman et al., 2011).

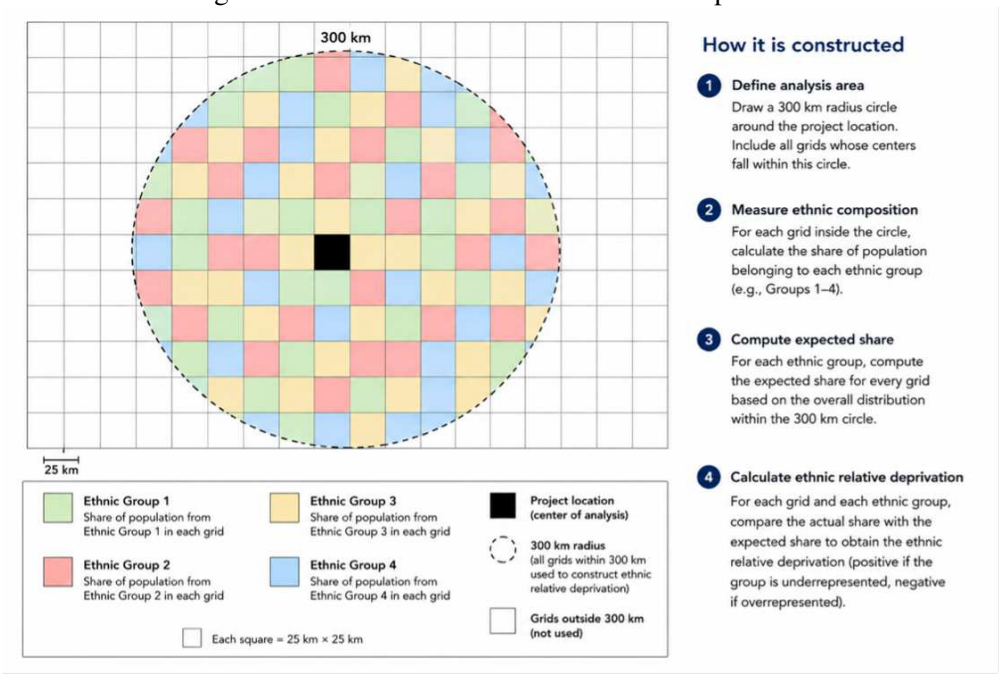
$$EB_{pet} = \frac{\sum_{g \in G_{pe}} B_{gt}}{N_{pet}}. \tag{6}$$

Here, G_{pe} denotes the set of grids associated with ethnic group e within project environment p, and N_{pet} is the number of corresponding grid observations used to construct the group-level benefit in year t. The comparison benefit of other groups, denoted by $EB_{p,-e,t}$, is the grid-count-weighted mean benefit among all grids belonging to ethnic groups $e' \neq e$ within the same project-year. Ethnic relative deprivation is

then defined as the positive shortfall between the benefit received by other represented groups and the focal ethnic group's own benefit $ERD_{pet} = \max\{EB_{p,-e,t} - EB_{pet}, 0\}$. The measure is defined only where at least two ethnic groups are represented within the same project environment. We calculate ethnic relative deprivation according to the procedure illustrated in Figure 2.

For estimation, the project-group-year measures are attached to ethnic-tagged grid-year observations using the grid's assigned project and ethnic group. Thus, the contextual regressors are constructed at the project $\times$ ethnic-group $\times$ year level, while the dependent variable remains the local grid-year conflict count. This distinction avoids interpreting a group-level contextual measure as a separately observed group-specific conflict outcome.

Figure 2: Construction of Ethnic Relative Deprivation



5.6 Conflict Specifications and Interpretation

The baseline grid-level conflict model is:

$$\mathbb{E}[\text{Conflict}_{gt} \mid Z_{gt}] = \exp\left[\beta_1 B_{gt} + \beta_2 RD_{gt} + X'_{gt}\theta + \alpha_g + \gamma_{ct}\right]. \tag{7}$$

where α_g are grid fixed effects and γ_{ct} are country-by-year fixed effects. The preferred columns include standardized temperature and precipitation anomalies. Standard errors are clustered by grid, allowing arbi-

trary serial correlation within grids. The ethnic-context specification replaces B_{gt} and RD_{gt} with EB_{pet} and ERD_{pet}, retains grid and country-by-year fixed effects, and clusters standard errors by project, as reported in Table 3. In both cases, $\exp(\beta\Delta) - 1$ is the proportional change in the expected conflict count associated with a Δ-unit increase in a regressor.

Identification differs across the two empirical stages, and we make that distinction explicit. In the first stage, the ring coefficients have a difference-in-differences interpretation under the assumption that, absent implementation, inner rings would have evolved in parallel with the 200–300 km reference band after conditioning on the fixed effects and controls. Because infrastructure can generate long-distance spillovers, the outer band need not be literally untreated; if it also benefits, the coefficients recover a relative spatial gradient and may understate the total project effect. In the second stage, own benefit and relative deprivation are generated from first-stage predictions. Project-level cross-fitting prevents a project from mechanically predicting itself, but the reported clustered standard errors condition on the generated predictions and the procedure is not a full orthogonal-score estimator. We therefore emphasize the sign, stability, and decomposition of the second-stage relationships across alternative constructions rather than interpreting them as structural causal parameters.

5.7 Robustness, Heterogeneity, and Sensitivity Analysis

The robustness analysis is designed around the main identifying and measurement choices. Table 4 examines four dimensions: excluding the upper 0.1% of conflict counts; replacing inverse-distance weights with equal weights; replacing the positive-part deprivation measure with the signed neighbor-minus-own benefit gap; and entering own and neighbor benefit separately. The final decomposition is especially informative because it does not impose the positive-part transformation: a negative own-benefit coefficient together with a positive neighbor-benefit coefficient is the unrestricted sign pattern implied by the absolute-benefit and comparison channels. Table 5 re-estimates the models separately for state-based, non-state, and one-sided violence. Table 6 varies the comparison radius from the 75-km baseline to 50 and 100 km while holding the sample and remaining modeling choices fixed. The Appendix leave-one-country-out exercise re-estimates the preferred model after omitting each country in turn to assess whether the estimates depend disproportionately on a single national setting.

6 Results

6.1 Uneven Spatial Effects of Project Implementation

Figure 3 presents the ring and spline estimates of post-implementation spatial change. Panel (a) shows a steep and economically ordered nighttime-light gradient. Relative to the 200–300 km reference band, the estimated increase is largest within 25 km, remains sizable at 25–50 km, falls sharply by 50–75 km, and approaches zero toward 200 km. The smooth specification in panel (c) delivers the same substantive result: project-related increases in local economic activity are concentrated near the project and decay with distance. The agreement between the discrete and smooth specifications supports Hypothesis 1 and provides the empirical basis for constructing spatially heterogeneous predicted benefits.

The conflict gradient in panels (b) and (d) is notably different from the growth gradient. The closest ring has a lower expected conflict count than the outer reference band, while coefficients across the remaining rings are non-monotonic and often imprecisely estimated. The smooth curve also changes sign over distance and is surrounded by relatively wide confidence intervals. Thus, the direct spatial response offers little evidence for a single monotonic effect of project proximity on violence. This contrast is precisely what motivates separating own development gains from relative position in the second-stage analysis.

6.2 Dynamic Growth Effects

Figure 4 reports the event-study estimates for nighttime light. Across distance rings, pre-implementation coefficients for event years -5 through -2 are generally small and their confidence intervals include zero, providing no evidence of a strong differential pre-trend relative to the omitted event year and the outer reference band. After implementation, the estimates rise progressively. The increase is largest and most precisely estimated within 50 km, while positive effects emerge with delay in the 50–100 km rings and, in later post-treatment years, in the 100–200 km rings. The dynamic ordering reinforces the static result: project-associated economic activity grows persistently after implementation, with both the magnitude and speed of the response declining with distance.

6.3 Spatial Distribution and Descriptive Evidence

Figure 5 maps conflict, predicted own development benefit, and relative deprivation. Conflict is spatially concentrated, while both first-stage benefit surfaces form localized clusters around project locations. Relative

deprivation is more discontinuous because it identifies grids whose predicted gains lag behind those of nearby comparison cells. The ring and spline constructions differ in smoothness and scale but highlight many of the same broad regions of uneven project-related development. These maps are descriptive; the regression specifications rely on within-grid variation and country-by-year comparisons rather than cross-sectional co-location alone.

Table 1 summarizes the common grid-year sample of 123,206 observations. Nighttime light is strongly right-skewed in levels (mean 1.447, standard deviation 5.246, maximum 62.339), while the asinh transformation reduces dispersion substantially. Conflict is sparse and highly skewed: the total count has a mean of 0.387, a standard deviation of 3.423, and a maximum of 692. State-based, one-sided, and non-state conflict have means of 0.174, 0.171, and 0.043, respectively. The mass at zero and long upper tail make PPML preferable to log-linear specifications that would require ad hoc treatment of zeros. Ring-based generated benefits have longer upper tails than spline-based measures, while the small negative minima of spline predictions reflect the normalized prediction scale rather than negative observed luminosity.

6.4 Grid-Level Relative Deprivation and Conflict

Table 2 reports the baseline grid-level PPML estimates. In the preferred ring specification with weather controls, the own-benefit coefficient is -0.2264 (standard error 0.1157), statistically significant at the 10% level, while the relative-deprivation coefficient is 3.4394 (1.1013), significant at the 1% level. The preferred spline specification yields the same signs: own benefit is -0.2654 (0.2544) and imprecisely estimated, whereas relative deprivation is 3.5677 (1.6538), significant at the 5% level. The most stable feature of Table 2 is therefore the positive deprivation coefficient across both exposure constructions; the negative own-benefit relationship is more precisely estimated under the ring design.

To convey magnitude on the scale of the generated regressors, we combine the preferred coefficients with the standard deviations in Table 1 and the disclosed spline rescaling. A one-standard-deviation increase in ring own benefit is associated with approximately a 6.4% decline in the expected conflict count, while a one-standard-deviation increase in ring relative deprivation is associated with about a 12.0% increase. The corresponding spline calculations are approximately -4.0% for own benefit and $+5.1\%$ for relative deprivation. These calculations are descriptive transformations of the PPML coefficients; in particular, the spline own-benefit estimate is not statistically distinguishable from zero in the preferred specification.

6.5 Ethnic Relative Deprivation

Table 3 shifts the comparison set from neighboring grids to ethnic groups within project environments. Ethnic own benefit is statistically indistinguishable from zero throughout the baseline specifications. Under the ring cross-fit, ethnic relative deprivation is positive and precisely estimated: the coefficient is 5.8392 when entered alone, 5.8096 when estimated jointly with own benefit, and 5.7724 (2.1569) in the preferred specification, with all three significant at the 1% level. Under the spline cross-fit, the preferred coefficient is 2.3555 (1.6620) and is not statistically significant. The ethnic evidence therefore supports the relative-deprivation mechanism under the ring exposure function but is less robust to the smooth spline construction than the grid-level evidence.

6.6 Robustness and Mechanism

Table 4 tests whether the baseline pattern depends on extreme conflict observations, the choice of spatial weights, or the positive-part transformation. In the grid panel, relative deprivation remains positive after trimming the top 0.1% of conflict observations (4.597 ring; 5.136 spline) and under equal 75-km weights (3.920; 4.911), with all four coefficients statistically significant. The signed-gap coefficients are also positive and significant (1.093 ring; 3.095 spline). In the ethnic panel, trimming produces positive significant estimates under both constructions (6.209; 3.125), while equal weighting remains significant for the ring specification but not the spline. Ethnic signed-gap estimates are positive and significant under both constructions (2.123; 3.597).

Columns (7) and (8) provide the most transparent unrestricted decomposition. At the grid level, own benefit is negative and statistically significant under both constructions (-0.976 ring; -1.004 spline), while neighboring-grid benefit is positive and significant (1.093; 1.354). Holding nearby gains fixed, stronger own gains are associated with less conflict; holding own gains fixed, stronger neighboring gains are associated with more conflict. The ethnic decomposition is directionally similar: own-group benefit is negative under both constructions and statistically significant in the ring specification, while neighboring-group benefit is positive and significant in both. Because the signed-gap coefficient and the neighbor-benefit coefficient need not rely on truncating the deprivation measure at zero, these results provide particularly useful support for a relative-position interpretation.

6.7 Conflict-Type Heterogeneity

Table 5 shows that the positive deprivation relationship is concentrated most clearly in state-based violence. Grid relative deprivation is positive and significant for state-based conflict under both ring and spline constructions (8.1890 and 5.7104). Ethnic relative deprivation is also positive in both state-based specifications (12.228 and 4.205), with the spline estimate significant at the 10% level. For non-state conflict, the deprivation coefficient is positive and significant in the ring models (6.3061 at the grid level; 5.670 for ethnic comparisons) but not in the spline models. For one-sided violence, deprivation is not statistically distinguishable from zero under either construction or comparison set. This pattern is consistent with the idea that relative project gains are most consequential when violence is organized around contests involving the state, although the conflict-type results should be interpreted as heterogeneity rather than a separate causal test of mechanism.

6.8 Comparison-Radius Sensitivity and Country Influence

Table 6 varies the social-comparison radius while holding the 123,206-observation sample fixed. Under ring decay, relative deprivation remains positive and significant at 50, 75, and 100 km, with coefficients of 3.3249, 3.4394, and 2.5882; own benefit remains negative and significant at conventional levels in all three columns (-0.2478, -0.2264, and -0.2394). Under the spline construction, relative deprivation is positive but imprecisely estimated at 50 km (2.4210) and positive and significant at 75 and 100 km (3.5677 and 3.7152). Spline own-benefit estimates remain negative but statistically insignificant. The radius exercise therefore indicates that the grid-level relative-deprivation result is not specific to a single neighborhood definition, particularly under the ring construction.

The leave-one-country-out exercise addresses a different concern: whether the baseline relationship is driven by one conflict-intensive or project-intensive national setting. Re-estimating the preferred coefficient pair after omitting each country in turn leaves the qualitative pattern intact. This diagnostic does not remove all forms of cross-country heterogeneity, but it shows that the headline grid result is not attributable to a single country.

6.9 Summary of the Evidence

Taken together, the evidence is internally consistent with the paper's distributional mechanism. The first stage shows localized and persistent post-implementation growth in nighttime light, while the raw conflict gradient around projects is non-monotonic. In the second stage, grid-level own benefit is negatively associated with conflict under the ring construction and relative deprivation is positively associated with conflict under both ring and spline constructions. The deprivation relationship survives trimming, alternative weighting, signed-gap specifications, own-versus-neighbor decomposition, and alternative comparison radii, and it is strongest for state-based violence. Ethnic relative deprivation is strongly positive in the ring baseline and in several robustness specifications, but the baseline spline estimate is imprecise. The most defensible conclusion is therefore not that uneven development mechanically causes conflict, but that relative position is a systematic and empirically relevant correlate of violence once project-induced own gains are separated from gains in the surrounding comparison environment.

7 Discussion and Policy Implications

The results sharpen the interpretation of development projects in two ways. First, average local growth can coexist with meaningful redistribution across nearby space. This is consistent with a broader spatial-development literature in which infrastructure changes market access and the location of activity rather than raising every place proportionally (Faber, 2014; Storeygard, 2016). Second, the conflict results suggest that this spatial incidence can matter politically: the same intervention may improve absolute conditions in a locality while worsening its position relative to visible neighbors. That combination helps reconcile why development interventions can appear growth-enhancing on average yet generate heterogeneous political responses.

Our results have a direct implication for project evaluation. Monitoring systems should assess functional project regions rather than administrative averages alone. For major transport, energy, industrial, or urban-development investments, donors and governments can report expected and realized gains across distance bands, labor-market areas, service catchments, and socially salient groups. The objective is not to require mechanically equal gains—agglomeration and network effects make spatial concentration economically natural—but to distinguish productive concentration from persistent exclusion and to identify places that systematically lag behind plausible comparison communities.

Project design can also use complementary investments to broaden access to a growth pole. Feeder infrastructure, local procurement, training, service provision, and transparent benefit-sharing may allow nearby lagging areas to participate in opportunities created by a flagship project. This logic is consistent with place-sensitive approaches to regional development, which emphasize heterogeneous local capabilities and spatial spillovers rather than uniform policy packages (Barca et al., 2012). It also speaks to the broader concern that places experiencing weaker gains can become politically discontented even when national or regional averages improve (Rodríguez-Pose, 2018).

Finally, distributional monitoring should be connected to local accountability and conflict prevention. Where project benefits are visible and uneven, transparent eligibility rules, publication of implementation milestones, accessible grievance mechanisms, and consultation with affected communities can reduce uncertainty about allocation and provide nonviolent channels for contesting distributional outcomes. These recommendations are precautionary rather than deterministic: the estimates do not imply that every local disparity will produce violence. They instead suggest that relative as well as absolute outcomes should be treated as explicit dimensions of project evaluation, especially where major investments visibly reshape the local economic geography.

8 Conclusion

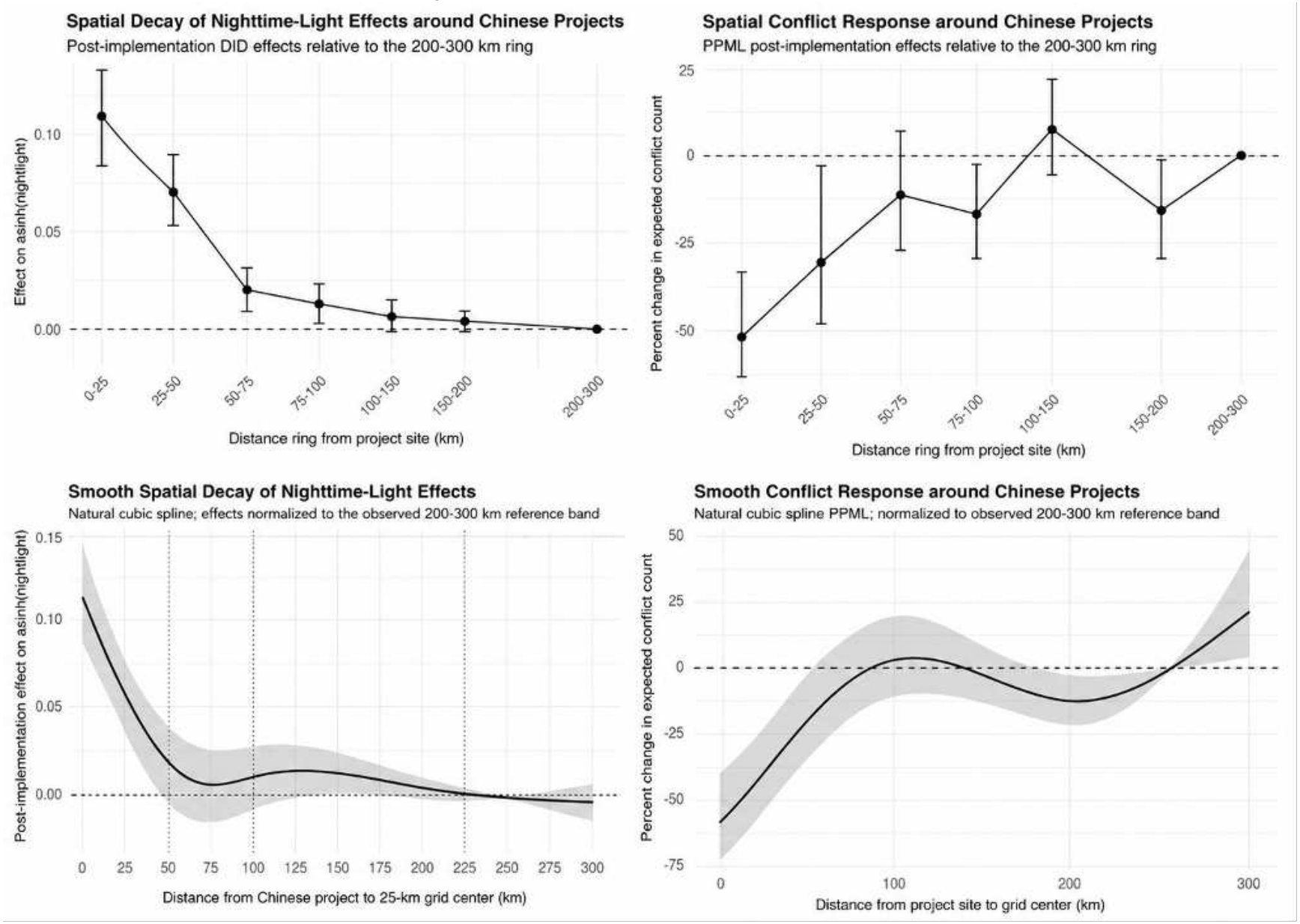
This paper asks whether development can improve local economic activity while creating relative disparities that are relevant for conflict. Chinese project implementation is followed by a clear spatial gradient in nighttime light: gains are largest near project sites, persist after implementation, and decay with distance. The direct conflict gradient, however, is non-monotonic. Once predicted project-induced gains are decomposed, stronger own benefit is associated with less conflict while stronger gains among comparison locations are associated with more conflict. The relative-deprivation relationship is most stable at the grid level and is especially pronounced for state-based violence; ethnic comparisons provide supportive but more specification-sensitive evidence.

The contribution is to place distributional geography between project exposure and local political outcomes. A proximity measure alone can combine beneficial own gains with an unfavorable movement in relative position, obscuring channels that operate in opposite directions. By estimating the spatial growth response, cross-fitting predicted benefits, and constructing explicit geographic and ethnic comparison mea-

sures, the paper provides a framework for studying how the incidence of development—who gains relative to whom—can matter alongside average project effects.

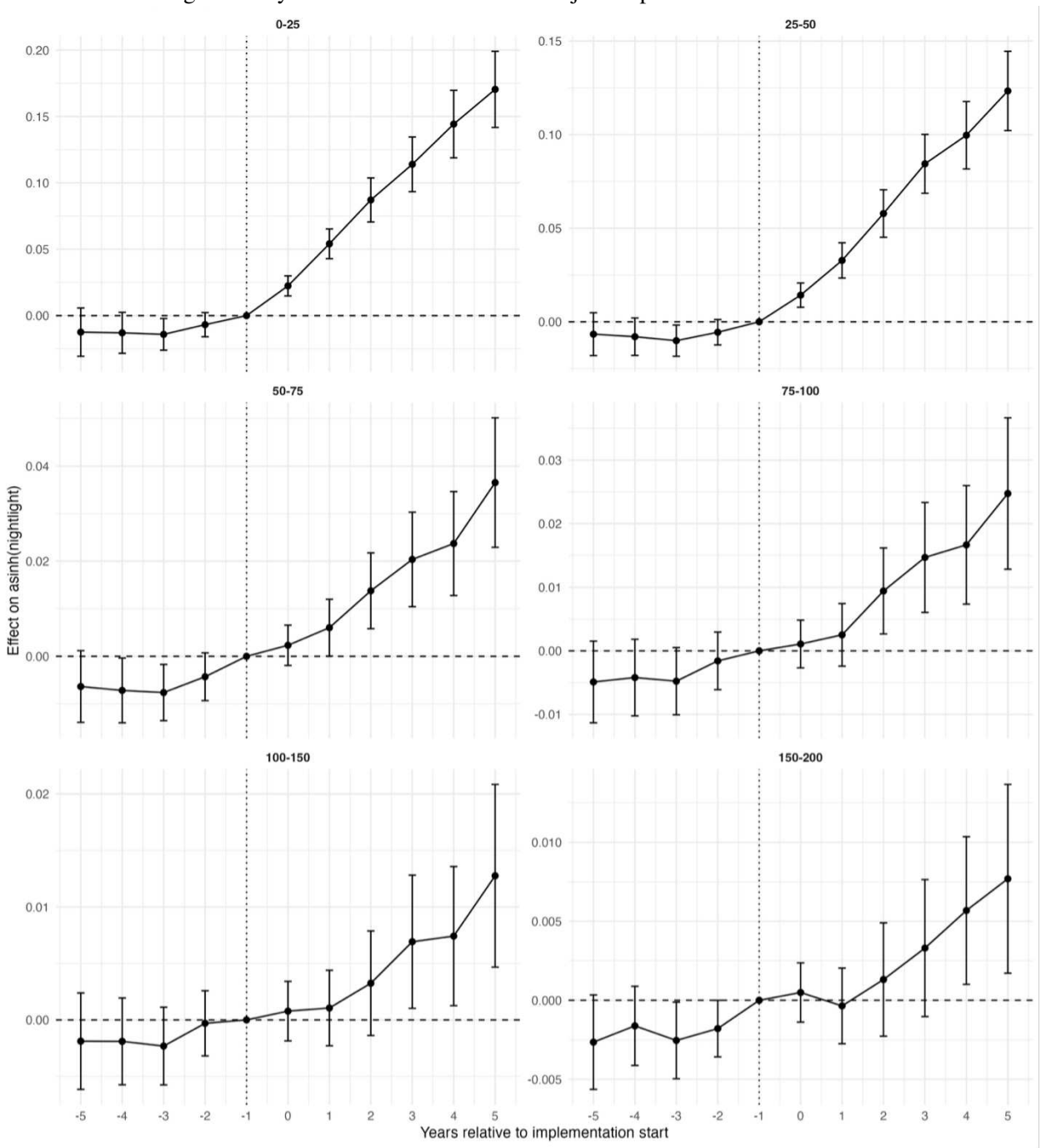
The empirical interpretation remains deliberately bounded. Under the parallel-trends assumption, the project-centered first stage identifies a relative spatial growth response. The second-stage estimates do not by themselves establish that relative deprivation is exogenous to all time-varying local determinants of violence, but their stability across alternative constructions, decompositions, and comparison sets makes the reference-group mechanism difficult to dismiss as a feature of one particular specification. More broadly, the results suggest that evaluations of large development investments should treat the spatial distribution of gains as an outcome of first-order economic and political importance.

Figure 3: Uneven Distribution of Growth and Conflict



Notes: Panels (a) and (b) report ring-specific post-implementation effects relative to the omitted 200–300 km reference ring. Vertical bars denote 95% confidence intervals. Panels (c) and (d) report the corresponding smooth spatial effects estimated using natural cubic splines and normalized relative to the observed 200–300 km reference band; shaded areas denote 95% confidence intervals.

Figure 4: Dynamic Effects of Chinese Project Implementation on Growth



Notes: The figure reports event-study estimates by distance ring, relative to the 200–300 km reference ring. Event time $t = -1$ is omitted. Vertical bars indicate 95% confidence intervals.

Figure 5: Spatial Distribution of Conflict and Uneven Development Across Africa

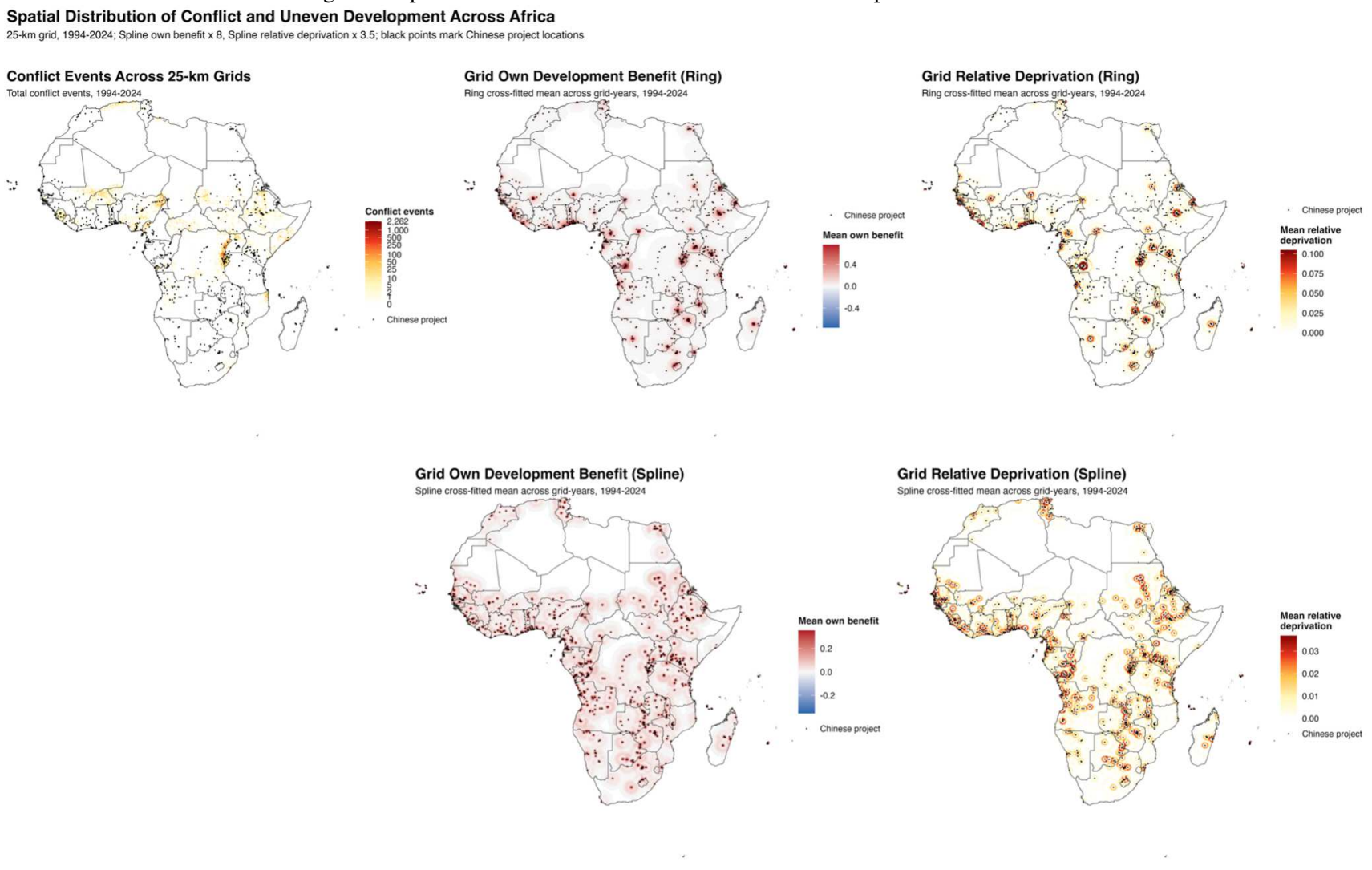


Table 1: Descriptive Statistics

Variable	N	Mean	Std. Dev.	Min	Max
Nighttime light	123,206	1.447	5.246	0.000	62.339
Nighttime light (asinh)	123,206	0.442	0.920	0.000	4.826
PPML conflict count: all conflict	123,206	0.387	3.423	0.000	692.000
PPML conflict count: state-based	123,206	0.174	1.809	0.000	236.000
PPML conflict count: one-sided	123,206	0.171	2.512	0.000	692.000
PPML conflict count: non-state	123,206	0.043	0.493	0.000	47.000
Predicted own benefit (ring cross-fit)	123,206	0.074	0.294	0.000	7.511
Predicted neighboring-grid benefit (ring cross-fit)	123,206	0.069	0.223	0.000	3.931
Relative deprivation (ring cross-fit)	123,206	0.009	0.033	0.000	0.822
Predicted own benefit (spline cross-fit)	123,206	0.007	0.019	-0.005	0.126
Predicted neighboring-grid benefit (spline cross-fit)	123,206	0.007	0.012	-0.003	0.085
Relative deprivation (spline cross-fit)	123,206	0.002	0.004	0.000	0.068

Notes: Statistics are based on the 123,206 grid-year observations in the common estimation sample. Nighttime light is reported in levels and inverse-hyperbolic-sine (asinh) form; conflict outcomes are annual event counts. Temperature and precipitation anomalies are standardized measures. Benefit and relative-deprivation variables are five-fold cross-fitted predictions from the ring and spline first-stage specifications. Extreme upper tails in conflict counts and ring-based predictions are retained. Small negative minima in spline-predicted benefits are retained because they arise from the normalized prediction scale.

Table 2: Relative Deprivation and Conflict: Baseline PPML Estimates

	Dependent variable: Conflict count							
	Ring-decay cross-fit				Cubic spline cross-fit			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Own development benefit	-0.3045^{***}		-0.2287^{*}	-0.2264^{*}	-0.4228^{*}		-0.2475	-0.2654
	(0.1116)		(0.1194)	(0.1157)	(0.2352)		(0.2615)	(0.2544)
Relative deprivation		4.2675^{***}	3.4110^{***}	3.4394^{***}		4.9663^{***}	3.6323^{**}	3.5677^{**}
		(1.0685)	(1.1016)	(1.1013)		(1.6355)	(1.6510)	(1.6538)
Weather controls	No	No	No	Yes	No	No	No	Yes
Grid FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country $\times$ year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	123,206	123,206	123,206	123,206	123,206	123,206	123,206	123,206
Pseudo R^2	0.5895	0.5897	0.5900	0.5904	0.5893	0.5894	0.5895	0.5899

Notes: The table reports PPML estimates at the 25-km grid-by-year level. Columns (1)–(4) use five-fold cross-fitted ring-decay measures and columns (5)–(8) use five-fold cross-fitted natural-cubic-spline measures. All specifications use the common estimation sample, include grid fixed effects and country-by-year fixed effects, and cluster standard errors by grid. Weather controls are standardized temperature and precipitation anomalies. For the spline columns, own development benefit and relative deprivation are multiplied by 8.0 and 3.5, respectively; the rescaling changes coefficient units but not fitted values, statistical significance, or substantive comparisons. Standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

Table 3: Ethnic Relative Deprivation and Conflict: Baseline PPML Estimates

	Dependent variable: Conflict count							
	Ring-decay cross-fit				Cubic spline cross-fit			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ethnic own benefit	0.0915		0.0535	0.0489	0.1187		0.2410	0.2327
	(0.2327)		(0.2210)	(0.2124)	(0.1776)		(0.2035)	(0.1969)
Ethnic relative deprivation		5.8392***	5.8096***	5.7724***		1.0863	2.3359	2.3555
		(2.2035)	(2.1840)	(2.1569)		(1.5650)	(1.6773)	(1.6620)
Weather controls	No	No	No	Yes	No	No	No	Yes
Grid FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	76,612	76,612	76,612	76,612	76,612	76,612	76,612	76,612
Pseudo R^2	0.5321	0.5332	0.5332	0.5335	0.5321	0.5321	0.5324	0.5327

Notes: The table reports PPML estimates for ethnic-tagged 25-km grid-by-year observations. All specifications are unweighted, use the same common ethnic estimation sample, include grid fixed effects and country-by-year fixed effects, and cluster standard errors by project ID. Weather controls are standardized temperature and precipitation anomalies. Standard errors are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

Table 4: Robustness and Mechanism: Grid and Ethnic Relative Deprivation and Local Conflict

	Trim top 0.1% conflict		Equal-weight 75 km		Signed benefit gap		Own + neighbor benefit	
	(1) Ring	(2) Spline	(3) Ring	(4) Spline	(5) Ring	(6) Spline	(7) Ring	(8) Spline
Panel A. Grid-level relative deprivation								
Own development benefit	-0.227^{**}	-0.124	-0.299^{**}	-0.354	0.117	0.350	-0.976^{***}	-1.004^{***}
	(0.109)	(0.187)	(0.122)	(0.252)	(0.206)	(0.487)	(0.215)	(0.268)
Relative deprivation	4.597^{***}	5.136^{***}	3.920^{***}	4.911^{***}				
	(0.867)	(1.506)	(0.970)	(1.628)				
Signed benefit gap					1.093^{***}	3.095^{**}		
					(0.339)	(1.316)		
Neighbor-grid benefit							1.093^{***}	1.354^{**}
							(0.339)	(0.576)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Grid FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	122,990	122,990	123,206	123,206	123,206	123,206	123,206	123,206
Pseudo R^2	0.508	0.507	0.598	0.597	0.597	0.597	0.597	0.597
Panel B. Ethnic-group relative deprivation								
Own development benefit	-0.057	0.134	0.051	0.252	0.933	1.270^{***}	-1.191^{*}	-0.375
	(0.166)	(0.146)	(0.212)	(0.199)	(0.587)	(0.364)	(0.702)	(0.236)
Relative deprivation	6.209^{***}	3.125^{**}	5.334^{***}	2.548				
	(1.907)	(1.492)	(2.038)	(1.659)				
Signed benefit gap					2.123^{*}	3.597^{***}		
					(1.219)	(1.031)		
Neighbor-group benefit							2.123^{*}	1.645^{***}
							(1.219)	(0.471)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Grid FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	76,535	76,535	76,612	76,612	76,612	76,612	76,612	76,612
Pseudo R^2	0.466	0.465	0.534	0.533	0.533	0.534	0.533	0.534

Notes: The dependent variable is the local annual conflict count and all specifications are estimated by PPML. Models include temperature and precipitation anomalies, grid fixed effects, and country-by-year fixed effects. Columns (1)–(8) cluster standard errors by grid in Panel A and by project in Panel B. Columns (1)–(2) exclude the top 0.1% of conflict observations; columns (3)–(4) use equal weights within the 75-km comparison radius; columns (5)–(6) use the signed benefit gap; and columns (7)–(8) enter own and neighboring benefits separately. Ring and spline specifications use identical observations within each paired comparison. Standard errors are in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Table 5: Conflict-Type Heterogeneity of Relative Deprivation and Conflict

	State-based conflict		Non-state conflict		One-sided conflict	
	(1) Ring	(2) Spline	(3) Ring	(4) Spline	(5) Ring	(6) Spline
Panel A. Grid-level cross-fitted benefit and relative deprivation						
Own benefit	0.0951	−0.3002	−0.3657	−0.7405**	−0.3636***	−0.2561
	(0.2420)	(0.3806)	(0.3767)	(0.3488)	(0.1146)	(0.2817)
Relative deprivation	8.1890***	5.7104***	6.3061***	−0.4224	0.8584	0.8145
	(1.6332)	(2.1985)	(2.2909)	(2.7690)	(1.2013)	(2.0360)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Grid FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × year FE	Yes	Yes	Yes	Yes	Yes	Yes
SE clustering	Grid	Grid	Grid	Grid	Grid	Grid
Observations	67,994	67,994	29,931	29,931	74,881	74,881
Pseudo R^2	0.5600	0.5596	0.3814	0.3812	0.5638	0.5628
Panel B. Ethnic-group cross-fitted benefit and relative deprivation						
Own benefit	0.341	0.329	0.016	−0.478**	−0.161	0.263
	(0.397)	(0.300)	(0.267)	(0.196)	(0.234)	(0.227)
Relative deprivation	12.228***	4.205*	5.670**	−1.685	2.381	0.800
	(3.104)	(2.304)	(2.419)	(2.230)	(2.605)	(2.294)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Grid FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × year FE	Yes	Yes	Yes	Yes	Yes	Yes
SE clustering	Project	Project	Project	Project	Project	Project
Observations	45,203	45,203	16,183	16,183	44,900	44,900
Pseudo R^2	0.503	0.500	0.381	0.381	0.480	0.480

Notes: The dependent variables are annual counts of state-based, non-state, and one-sided conflict. All specifications are estimated by PPML and include cross-fitted own development benefit and relative deprivation, temperature and precipitation anomaly controls, grid fixed effects, and country-by-year fixed effects. Ring and spline specifications use the same observations within each conflict type. Samples can differ across conflict types because PPML drops outcome-specific all-zero or perfectly predicted fixed-effect groups. Standard errors are clustered by grid in Panel A and by project in Panel B. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Table 6: Sensitivity of Conflict Effects to Social-Comparison Radius

	Ring-decay cross-fit			Cubic spline cross-fit		
	(1)	(2)	(3)	(4)	(5)	(6)
Variable	50 km	75 km	100 km	50 km	75 km	100 km
Own benefit	-0.2478^{**}	-0.2264^{*}	-0.2394^{**}	-0.3351	-0.2654	-0.2521
	(0.1118)	(0.1157)	(0.1165)	(0.2509)	(0.2544)	(0.2606)
Relative deprivation	3.3249^{***}	3.4394^{***}	2.5882^{**}	2.4210	3.5677^{**}	3.7152^{**}
	(0.9661)	(1.1013)	(1.0254)	(1.5067)	(1.6538)	(1.7355)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Grid FE	Yes	Yes	Yes	Yes	Yes	Yes
Country $\times$ year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	123,206	123,206	123,206	123,206	123,206	123,206
Pseudo R^2	0.5903	0.5904	0.5902	0.5898	0.5899	0.5899

Notes: The dependent variable is the annual conflict count. Columns (1)–(3) use five-fold cross-fitted ring-decay measures and columns (4)–(6) use five-fold cross-fitted natural-cubic-spline measures. The social-comparison radius is 50, 75, or 100 km; 75 km is the baseline. All models are estimated by PPML with grid fixed effects, country-by-year fixed effects, and temperature and precipitation anomaly controls. Standard errors clustered by grid are in parentheses. The estimation sample is held fixed at 123,206 observations across all six specifications. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

References

Abatzoglou, J. T., Dobrowski, S. Z., Parks, S. A., & Hegewisch, K. C. (2018). TerraClimate, a high-resolution global dataset of monthly climate and climatic water balance from 1958–2015. *Scientific Data*, *5*, 170191.

Alesina, A., Michalopoulos, S., & Papaioannou, E. (2016). Ethnic inequality. *Journal of Political Economy*, *124*(2), 428–488.

Barca, F., McCann, P., & Rodríguez-Pose, A. (2012). The case for regional development intervention: Place-based versus place-neutral approaches. *Journal of Regional Science*, *52*(1), 134–152.

Berman, E., Shapiro, J. N., & Felter, J. H. (2011). Can hearts and minds be bought? the economics of counterinsurgency in iraq. *Journal of Political Economy*, *119*(4), 766–819.

Berman, N., Couttenier, M., Rohner, D., & Thoenig, M. (2017). This mine is mine! how minerals fuel conflicts in africa. *American Economic Review*, *107*(6), 1564–1610.

Bluhm, R., Dreher, A., Fuchs, A., Parks, B. C., Strange, A. M., & Tierney, M. J. (2025). Connective financing: Chinese infrastructure projects and the diffusion of economic activity in developing countries. *Journal of Urban Economics*, *145*, 103730.

Cederman, L.-E., Weidmann, N. B., & Gleditsch, K. S. (2011). Horizontal inequalities and ethnonationalist civil war: A global comparison. *American Political Science Review*, *105*(3), 478–495.

Chernozhukov, V., Chetverikov, D., Demirer, M., Duflo, E., Hansen, C., Newey, W., & Robins, J. (2018). Double/debiased machine learning for treatment and structural parameters. *The Econometrics Journal*, *21*(1), C1–C68.

Crost, B., Felter, J., & Johnston, P. (2014). Aid under fire: Development projects and civil conflict. *American Economic Review*, *104*(6), 1833–1856.

Donaldson, D., & Storeygard, A. (2016). The view from above: Applications of satellite data in economics. *Journal of Economic Perspectives*, *30*(4), 171–198.

Dreher, A., Fuchs, A., Hodler, R., Parks, B. C., Raschky, P. A., & Tierney, M. J. (2021a). Is favoritism a threat to chinese aid effectiveness? a subnational analysis of chinese development projects. *World Development*, *139*, 105291.

Dreher, A., Fuchs, A., Parks, B., Strange, A., & Tierney, M. J. (2021b). Aid, china, and growth: Evidence from a new global development finance dataset. *American Economic Journal: Economic Policy*, *13*(2), 135–174.

Dube, O., & Vargas, J. F. (2013). Commodity price shocks and civil conflict: Evidence from colombia. *The Review of Economic Studies*, *80*(4), 1384–1421.

Esteban, J., Mayoral, L., & Ray, D. (2012). Ethnicity and conflict: An empirical study. *American Economic Review*, *102*(4), 1310–1342.

Faber, B. (2014). Trade integration, market size, and industrialization: Evidence from china's national trunk highway system. *The Review of Economic Studies*, *81*(3), 1046–1070.

Findley, M. G., Powell, J., Strandow, D., & Tanner, J. (2011). The localized geography of foreign aid: A new dataset and application to violent armed conflict. *World Development*, *39*(11), 1995–2009.

Gehring, K., Kaplan, L. C., & Wong, M. H. L. (2022). China and the world bank—how contrasting development approaches affect the stability of african states. *Journal of Development Economics*, *158*, 102902.

Goodman, S., Zhang, S., Malik, A. A., Parks, B. C., & Hall, J. (2024). AidData's geospatial global chinese development finance dataset. *Scientific Data*, *11*, 529.

Gurr, T. R. (1970). *Why men rebel*. Princeton University Press.

Harari, M., & La Ferrara, E. (2018). Conflict, climate, and cells: A disaggregated analysis. *The Review of Economics and Statistics*, *100*(4), 594–608.

Henderson, J. V., Storeygard, A., & Weil, D. N. (2012). Measuring economic growth from outer space. *American Economic Review*, *102*(2), 994–1028.

Isaksson, A.-S., & Kotsadam, A. (2018). Chinese aid and local corruption. *Journal of Public Economics*, *159*, 146–159.

Lessmann, C. (2016). Regional inequality and internal conflict. *German Economic Review*, *17*(2), 157–191.

Li, X., & Zhou, Y. (2017). A stepwise calibration of global DMSP/OLS stable nighttime light data (1992–2013). *Remote Sensing*, *9*(6), 637.

Luttmer, E. F. P. (2005). Neighbors as negatives: Relative earnings and well-being. *The Quarterly Journal of Economics*, *120*(3), 963–1002.

Miguel, E., Satyanath, S., & Sergenti, E. (2004). Economic shocks and civil conflict: An instrumental variables approach. *Journal of Political Economy*, *112*(4), 725–753.

Montalvo, J. G., & Reynal-Querol, M. (2005). Ethnic polarization, potential conflict, and civil wars. *American Economic Review*, *95*(3), 796–816.

Moscona, J. (2025). The management of aid and conflict in africa. *American Economic Journal: Economic Policy*, *17*(4), 228–259.

Nunn, N., & Qian, N. (2014). US food aid and civil conflict. *American Economic Review*, *104*(6), 1630–1666.

Østby, G. (2008). Polarization, horizontal inequalities and violent civil conflict. *Journal of Peace Research*, *45*(2), 143–162.

Ray, D., & Esteban, J. (2017). Conflict and development. *Annual Review of Economics*, *9*, 263–293.

Rodríguez-Pose, A. (2018). The revenge of the places that don't matter (and what to do about it). *Cambridge Journal of Regions, Economy and Society*, *11*(1), 189–209.

Santos Silva, J. M. C., & Tenreyro, S. (2006). The log of gravity. *The Review of Economics and Statistics*, *88*(4), 641–658.

Storeygard, A. (2016). Farther on down the road: Transport costs, trade and urban growth in sub-saharan africa. *The Review of Economic Studies*, *83*(3), 1263–1295.

Sundberg, R., & Melander, E. (2013). Introducing the UCDP georeferenced event dataset. *Journal of Peace Research*, *50*(4), 523–532.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- mainappendix.pdf