

Supplemental Appendix for

# Climate Stress, Opportunity, and Environmental Violence

**Table A1:** Summary Statistics of all Variables

	Min	Median	Mean	Max	SD
<i>State violence (ACLED)<sub>it</sub></i>	0	0	0.004	27	0.101
<i>Rebel violence (ACLED)<sub>it</sub></i>	0	0	0.003	46	0.094
<i>Militia violence (ACLED)<sub>it</sub></i>	0	0	0.011	50	0.210
<i>State violence (GED)<sub>it</sub></i>	0	0	0.001	36	0.055
<i>Nonstate violence (GED)<sub>it</sub></i>	0	0	0.002	18	0.064
<i>State violence (PITF)<sub>it</sub></i>	0	0	0.0001	7	0.015
<i>Nonstate violence (GED)<sub>it</sub></i>	0	0	0.001	6	0.032
<i>Sahara transition zone<sub>it</sub></i>	0	0	0.065	1	0.247
<i>NDVI<sub>it-1</sub></i>	-0.140	0.275	0.353	0.894	0.251
<i>Log NT (sum)<sub>it</sub></i>	0	0	1.495	5.344	1,707
<i>Log population<sub>it</sub></i>	0	4.226	3.924	7.259	1.293
<i>Civil War Events<sub>(it)</sub></i>	0	0	0.004	32	0.138
<i>Civil War Events<sub>(it)</sub></i>	0	0	0.004	32	0.138
<i>Authoritarianism<sub>(it)</sub></i>	0	1	0.826	1	0.379
<i>Log precipitation<sub>it</sub></i>	0	2.542	2.524	7.710	2.009
<i>Mean Temperature<sub>it</sub></i>	-0.3	25.1	24.585	38.2	5.433

### Accounting for alternative explanations (full discussion)

One alternative explanation for the findings is that the presence of countries that never experienced any conflicts “inflates” the sample. By removing conflict-related incentives and actors, such countries may be systematically less likely to also experience violence against civilians, which increases the risk of type I errors, namely falsely accepting both hypotheses (e.g., Bagozzi, Koren, and Mukherjee 2017). Accordingly, we first evaluate our findings’ sensitivity to this concern by retaining only locations and times (i.e., grid-cell months) located within countries that experienced at least one civil war (defined as conflict with at least 25 casualties) event (Sundberg and Melander 2013) during our 2003-2018 period. Table A2, Supplemental Appendix, reports the same model specifications from Table 1 estimated on this civil-war-countries only sample. As this table illustrates, our results remain largely unchanged, suggesting robustness to this concern.

Another issue relates to the confounding impact of armed conflict on violence against civilians rates across conflict and non-conflict afflicted states. Our decision to focus on violence against civilians, specifically, rather than armed conflict broadly is motivated by the fact that armed actors have different environmental opportunities to engage in one over the other. To ensure our findings are robust to this decision, we add to our main models (Equation 1) controls for contemporaneous armed conflicts and one-month conflict lags, both from the GED, which measures armed conflict incidents involving states and rebels with at least one casualty occurring as part of a civil war with 25 or more deaths. These models are formalized in Equation 2:

$$y_{it} = \beta_0 + \beta_1 z_{it} + \beta_2 n_{it-1} + \beta_3 z_{it} \times n_{it-1} + \beta_4 \log l_{it} + \beta_5 \log p_{it} + \beta_6 y_{it-1} + \beta_7 c_{it} + \beta_8 c_{it-1} + \tau_t + m_t + \omega_j + \epsilon_i \quad (2)$$

Table A3, Supplemental Appendix, reports the estimates from the seven models corresponding to Equation 2, controlling for armed conflict intensification. Our results remain

largely unchanged in this table, except for nonstate PITF violence, where the *Sahara Transition Zone*<sub>it</sub> X *NDVI (mean)*<sub>it-1</sub> interaction, while still positive, now falls just short of the p<0.1 statistical significance threshold. This could be because PITF measures more violent nonstate actor massacres, which might be more likely to arise as part of civil war intensification.

Another possible alternative explanation is that violence against civilians within a climate harsh region intensifies during times of abundance not by actors acting locally, but rather by actors moving from neighboring areas. Our theoretical argument does not preclude this possibility and, indeed, if our theoretical claims are valid, it is possible that environmental opportunity could attract armed actors from neighboring regions. From an econometric perspective, the identification strategy employed in the estimation of all models in Table 1 (discussed previously) is the most recommended approach to evaluating our argument (Angrist and Pischke 2009). However, to evaluate the impact of such spatial political violence lags, we deploy geometrically weighted regression models in Table A4, Supplemental Appendix. Briefly, this method assigns a weight to all events occurring in nearby locations to cell *i* during a given month (*t*). This not only allows us to assess how much of conflict variability is explained by such spatial violence lags, but also to identify how much of the violence is being driven into high productivity cell months *from nearby locations*. This is directly in line with our argument, in illustrating whether our interacted relationship is strong enough to work – in effect – as a “magnet” for armed actors from nearby cells seeking to appropriate agricultural resources where they are most available. Our identification strategy is as follows:

$$y_{it} = \beta_0 + \beta_1 z_{it} + \beta_2 n_{it-1} + \beta_3 z_{it} \times n_{it-1} + \beta_4 \log l_{it} + \beta_5 \log p_{it} + \beta_6 y_{it-1} + \rho \lambda y_m + \tau_t + m_t + \omega_j + \epsilon_i \quad (3)$$

Equation 3 is essentially the same as equation 1 with one exception:  $\lambda$  is the spatial weights matrix and  $\rho$  the spatial lag's coefficient. We use a row standardized matrix where the “weight” is estimated using the number of neighboring cells that experienced violence, so if a grid cell has 5 neighbors, then the spatial weight between each neighbor pair is 0.2. Due to the computational demands of estimating such models, we were forced to remove all countries that did not include any Sahara Transition Zones, i.e., that were not part of the Sahel. To retain a fully balanced panel, as required in estimating such models, we only keep countries that existed in our sample throughout the entire period, which forced us to remove Sudan and South Sudan from our sample (due to the latter's independence in 2011). Note any impacts these changes may have on our results is *downwards*, that is, away from statistical significance. The focus on these Sahel countries provides an additional sensitivity analysis for our results, ensuring that we are comparing non-transition zone to Sahara Transition Zones only in countries that include both.

Table A4 reports the estimates for the same dependent variables used in Table 1. Despite losing two thirds of our sample and accounting for spatial political violence dependencies, the interaction *Sahara Transition Zone<sub>it</sub> X NDVI<sub>(it-1)</sub>*'s coefficient maintaining its positive sign across all models and its statistical significance in four cases: ACLED (state), ACLED (rebels), ACLED (militias) and PITF (nonstate). One interpretation of the results would be that – at this robustness threshold – only the more sensitive types of violence (as discussed above) are those by nonstate actors and those that involve relatively low intensity levels of violence, although it is important to bear in mind that the lack of significance might be caused by the loss of nearly 66% of our sample, which can induce a type II error.

Next, we assess the difference between autocracies and democracies, which we recognize in the main text might reveal different dynamics of violence. To this end, we first subset only

authoritarian countries for the years for which they were recorded as non-democratic in Bjørnskov and Martin Rode's (2020) extension of the Democracy and Dictatorship Revisited Dataset and estimate our seven models on this subsample, in Table A5. Next, we repeat this process, this time creating a subset of only democratic county-years, in Table A6. Examining these tables, we find that low level violence (ACLED) by state forces, rebels, and militias all covary with higher environmental variability in Sahara transition zones within autocracies, but only for rebels in democracies (columns 1-3). We also find that violence by rebels in civil wars (GED) statistically significantly increases in autocracies, but that this is not the case for state violence or for democracies (columns 4-5). Perhaps most interestingly, we find that the relationship between higher environmental security in Sahara Transition Zones and large-scale massacres (PITF) is only robust in democracies (columns 6-7). One potential explanation is that, because most democracies in Africa are quasi-democratic regimes or anocracies, this result may represent a case of "murder in the middle," where such regimes are at the highest risk of engaging in mass violence (e.g., Ulfelder 2012).

Finally, one might argue that the results are suspect because conflict might affect environmental security or because the Sahara Transition Zones are not randomly assigned (e.g., because they are all located within the same geographic "band"). To ensure our results are robust to this concern, we re-estimated our seven models on a sample where we empirically matched Sahara Transition Zone cell months with non-Sahara transition zones with similar climatic traits based on monthly (log) precipitation and temperature levels, in Table A7. For matching, we used the more robust Coarsened Exact Matching (CEM) approach recommended by Iacus, King, and Porro (2012). Note that this sample is slightly smaller than the full sample used in the main analysis because cells that we could not find a match for were omitted. In conducting the matching exercise,

we find that the standard mean difference variance in the matched data is (well) below 0.25 (25%) which suggests a good balance in our panel. As Table A7 illustrates, our key results from the main paper fully hold in this matched sample, suggesting they are not driven by endogeneity and non-random assignment of our observations.

**Table A2:** Determinants of Violence against Civilians in Africa, Jan. 2003 - Dec. 2018, Civil War Countries Only.

	ACLED			GED		PITF	
	State	Rebel	Militia	State	Nonstate	State	Nonstate
<i>Sahara Transition Zone<sub>it</sub></i>	-0.002** (0.001)	-0.002** (0.001)	-0.003** (0.001)	0.001 (0.0004)	-0.001** (0.0005)	-0.0001 (0.0001)	-0.001*** (0.0003)
<i>NDVI<sub>i(t-1)</sub></i>	-0.003*** (0.001)	-0.0005 (0.001)	-0.005*** (0.001)	-0.002*** (0.0003)	-0.002*** (0.0004)	-0.0001 (0.0001)	-0.001*** (0.0002)
<i>Sahara Transition Zone<sub>it</sub> X NDVI<sub>i(t-1)</sub></i>	0.006*** (0.003)	0.009*** (0.003)	0.018*** (0.005)	0.001 (0.001)	0.004** (0.002)	0.001* (0.0005)	0.002* (0.001)
<i>DV<sub>i(t-1)</sub></i>	0.423*** (0.001)	0.352*** (0.001)	0.590*** (0.001)	0.262*** (0.001)	0.411*** (0.001)	0.197*** (0.001)	0.198*** (0.001)
<i>Log NT (sum)<sub>it</sub></i>	0.001*** (0.0001)	0.0004*** (0.0001)	0.003*** (0.0001)	0.0004*** (0.00003)	0.0003*** (0.00004)	0.0001*** (0.00001)	0.0002*** (0.00002)
<i>Log Population<sub>it</sub></i>	0.002*** (0.0001)	0.001*** (0.0001)	0.003*** (0.0002)	0.001*** (0.0001)	0.001*** (0.0001)	0.0001*** (0.00002)	0.0004*** (0.00004)
<i>Log <math>\tau_t</math></i>	0.003*** (0.0004)	0.003*** (0.0004)	0.007*** (0.001)	-0.0002** (0.0002)	0.002*** (0.0003)	0.0002** (0.0001)	0.001*** (0.0001)
<i>Constant</i>	-0.011*** (0.004)	-0.033*** (0.004)	-0.028** (0.008)	0.004** (0.002)	-0.024*** (0.003)	-0.001** (0.0005)	-0.006*** (0.002)
Observations	1,523,798			1,523,798		1,523,798	
R <sup>2</sup>	0.200	0.127	0.337	0.055	0.171	0.039	0.044
Adj. R <sup>2</sup>	0.200	0.127	0.337	0.055	0.171	0.039	0.044

Standard errors pooled oby grid cell in parentheses; logging was done in base 10; fixed effects by month and country were included in each model although none is reported. DV standards for ‘dependent variable.’

\*\*\*p<0.01; \*\*p<0.05; \*p<0.1.

**Table A3:** Determinants of Violence against Civilians in Africa, Jan. 2003 – Dec. 2018, Civil War.

	ACLED			GED		PITF	
	State	Rebel	Militia	State	Nonstate	State	Nonstate
<i>Sahara Transition Zone<sub>it</sub></i>	-0.001* (0.001)	-0.001** (0.001)	-0.002* (0.001)	0.001** (0.0004)	-0.0005 (0.0004)	-0.0001 (0.0001)	-0.001*** (0.0002)
<i>NDVI<sub>i(t-1)</sub></i>	-0.003*** (0.001)	-0.001 (0.0005)	-0.004*** (0.001)	-0.002*** (0.0003)	-0.002*** (0.0003)	-0.0001 (0.0001)	-0.001*** (0.0002)
<i>Sahara Transition Zone<sub>it</sub> X NDVI<sub>i(t-1)</sub></i>	0.004* (0.003)	0.007*** (0.002)	0.016*** (0.005)	0.001 (0.001)	0.003* (0.002)	0.001* (0.0004)	0.001 (0.001)
<i>DV<sub>i(t-1)</sub></i>	0.418*** (0.001)	0.316*** (0.001)	0.542*** (0.001)	0.221*** (0.001)	0.381*** (0.001)	0.185*** (0.001)	0.159*** (0.001)
<i>Civil War Events<sub>(it)</sub></i>	0.074*** (0.001)	0.125*** (0.001)	0.157*** (0.001)	0.036*** (0.0004)	0.070*** (0.0004)	0.013*** (0.0001)	0.039*** (0.0002)
<i>Civil War Events<sub>(it-1)</sub></i>	0.025*** (0.001)	0.001** (0.001)	0.036*** (0.001)	0.003*** (0.0003)	0.004*** (0.0003)	-0.003*** (0.0001)	0.009*** (0.0002)
<i>Log NT (sum)<sub>it</sub></i>	0.001*** (0.0001)	0.0001*** (0.0001)	0.002*** (0.0001)	0.0003*** (0.00003)	0.0001*** (0.00004)	0.00003*** (0.00001)	0.0001*** (0.00002)
<i>Log Population<sub>it</sub></i>	0.001*** (0.0001)	0.001*** (0.0001)	0.002*** (0.0002)	0.0004*** (0.0001)	0.001*** (0.0001)	0.0001*** (0.00001)	0.0002*** (0.00003)
<i>Log <math>\tau_t</math></i>	0.001*** (0.0003)	0.003*** (0.0003)	0.005*** (0.001)	-0.0005** (0.0002)	0.002*** (0.0002)	0.0001** (0.0001)	0.001*** (0.0001)
<i>Constant</i>	-0.001 (0.004)	-0.023*** (0.004)	-0.018** (0.007)	0.007*** (0.002)	-0.018*** (0.002)	-0.001 (0.001)	-0.004*** (0.001)
Observations	1,947,324			1,947,324		1,947,324	
R <sup>2</sup>	0.200	0.127	0.337	0.055	0.171	0.039	0.044
Adj. R <sup>2</sup>	0.200	0.127	0.337	0.055	0.171	0.039	0.044

Standard errors pooled by grid cell in parentheses; logging was done in base 10; fixed effects by month and country were included in each model although none is reported. DV standards for ‘dependent variable.’

\*\*\*p<0.01; \*\*p<0.05; \*p<0.1.

**Table A4:** Determinants of Violence against Civilians in Africa, Jan. 2003 – Dec. 2018, Spatial Lag Models.

	ACLED			GED		PITF	
	State	Rebels	Militia	State	Nonstate	State	Nonstate
<i>Sahara Transition Zone</i> <sub>it</sub>	-2.25e-3*** (8.00e-4)	-3.16e-3*** (7.50e-4)	-3.75e-3*** (1.43e-3)	7.64e-4* (4.02e-4)	-1.35e-3*** (5.03e-4)	-9.41e-5 (1.36e-4)	-1.80e-3*** (3.63e-4)
<i>NDVI (mean)</i> <sub>i(t-1)</sub>	-4.65e-3*** (9.45e-4)	-5.02e-3*** (8.86e-4)	-7.01e-3*** (1.69e-3)	-9.91e-4** (4.75e-4)	-5.74e-3*** (5.94e-4)	-1.07e-4 (1.61e-4)	-3.43e-3*** (4.29e-4)
<i>Sahara Transition Zone</i> <sub>it</sub> X <i>NDVI</i> <sub>(it-1)</sub>	5.01e-3 (3.07e-3)	6.38e-3** (2.88e-3)	1.54e-2*** (5.49e-3)	7.84e-4 (1.54e-3)	2.03e-3 (1.93e-3)	6.11e-4 (5.23e-4)	2.77e-3** (1.39e-3)
<i>DV</i> <sub>i(t-1)</sub>	3.37e-1*** (1.15e-3)	4.24e-1*** (1.10e-3)	5.07e-1*** (1.04e-3)	1.50e-1*** (1.20e-3)	4.34e-1*** (1.09e-3)	5.02e-2*** (1.22e-3)	2.03e-1*** (1.18e-3)
<i>Log NT (sum)</i> <sub>it</sub>	2.60e-3*** (1.16e-4)	1.08e-3*** (1.09e-4)	5.57e-3*** (2.07e-4)	7.73e-4*** (5.82e-5)	5.63e-4*** (7.27e-5)	1.60e-4*** (1.97e-5)	6.25e-4*** (5.25e-5)
<i>Log Population</i> <sub>it</sub>	1.96e-3*** (2.05e-4)	1.92e-3*** (1.93e-4)	2.86e-3*** (3.67e-4)	3.88e-4*** (1.03e-4)	1.06e-3*** (1.29e-4)	1.02e-4*** (3.50e-5)	8.05e-4*** (9.31e-5)
<i>Log m<sub>t</sub></i>	2.78e-3*** (6.53e-4)	5.24e-3*** (6.13e-4)	4.44e-3*** (1.17e-3)	-3.58e-4 (3.28e-4)	2.31e-3*** (4.11e-4)	2.80e-4** (1.11e-4)	2.63e-3*** (2.96e-4)
<i>DV</i> <sub>jt</sub>	0.05*** (0.02e-1)	0.10*** (0.02e-1)	0.07*** (0.02e-1)	0.11*** (0.02e-1)	0.09*** (0.02e-1)	0.01 (NA)	0.05*** (0.02e-1)
<i>Constant</i>	-2.20e-2*** (3.76e-3)	-3.40e-2*** (3.53e-3)	-3.40e-2*** (6.73e-3)	7.27e-4 (1.89e-3)	-1.48e-2*** (2.36e-3)	-1.99e-3** (6.41e-4)	-1.65e-2*** (1.71e-3)
Observations	688,905			688,905		688,905	

Standard errors in parentheses; logging was done in base 10; fixed effects by month and country were included in each model although none is reported. DV standards for ‘dependent variable.’

\*\*\*p<0.01; \*\*p<0.05; \*p<0.1.



**Table A5:** Determinants of Violence against Civilians in Africa, Jan. 2003 – Dec. 2018, Authoritarian States Only.

	ACLED			GED		PITF	
	State	Rebels	Militia	State	Nonstate	State	Nonstate
<i>Sahara Transition Zone<sub>it</sub></i>	-0.001 (0.001)	-0.002*** (0.001)	-0.002 (0.002)	0.002*** (0.0005)	-0.001*** (0.001)	0.00004 (0.0001)	-0.001** (0.0003)
<i>NDVI<sub>it-1</sub></i>	-0.003*** (0.001)	-0.0002 (0.001)	-0.004*** (0.001)	-0.002*** (0.0003)	-0.002*** (0.0004)	-0.0001 (0.0001)	-0.001*** (0.0002)
<i>Sahara Transition Zone<sub>it</sub> × NDVI<sub>it-1</sub></i>	0.006* (0.003)	0.010*** (0.003)	0.024*** (0.006)	0.001 (0.002)	0.006*** (0.002)	0.001 (0.0005)	0.001 (0.001)
<i>DV<sub>it-1</sub></i>	0.451*** (0.001)	0.357*** (0.001)	0.592*** (0.001)	0.236*** (0.001)	0.402*** (0.001)	0.217*** (0.001)	0.216*** (0.001)
<i>Log NT (sum)<sub>it</sub></i>	0.001*** (0.0001)	0.0003*** (0.0001)	0.002*** (0.0001)	0.0004*** (0.00004)	0.0002*** (0.00004)	0.0001*** (0.00001)	0.0002*** (0.00002)
<i>Log Population<sub>it</sub></i>	0.002*** (0.0001)	0.001*** (0.0001)	0.003*** (0.0002)	0.001*** (0.0001)	0.001*** (0.0001)	0.0001*** (0.00002)	0.0003*** (0.00003)
<i>Log τ<sub>t</sub></i>	0.001*** (0.0004)	0.003*** (0.0004)	0.005*** (0.001)	-0.0003 (0.0002)	0.002*** (0.0002)	0.0001* (0.0001)	0.001*** (0.0001)
<i>Constant</i>	0.005 (0.005)	-0.020*** (0.005)	-0.011 (0.009)	0.009*** (0.003)	-0.015*** (0.003)	-0.0004 (0.001)	-0.003 (0.002)
Observations	1,609,515	1,609,515	1,609,515	1,609,515	1,609,515	1,609,515	1,609,515
R <sup>2</sup>	0.210	0.130	0.372	0.058	0.163	0.047	0.049
Adjusted R <sup>2</sup>	0.210	0.130	0.372	0.058	0.163	0.047	0.049

Standard errors pooled by grid cell in parentheses; logging was done in base 10; fixed effects by month and country were included in each model although none is reported. DV standards for ‘dependent variable.’

\*\*\*p<0.01; \*\*p<0.05; \*p<0.1.

**Table A6:** Determinants of Violence against Civilians in Africa, Jan. 2003 – Dec. 2018, Democratic States Only.

	ACLED			GED		PITF	
	State	Rebels	Militia	State	Nonstate	State	Nonstate
<i>Sahara Transition Zone<sub>it</sub></i>	-0.001 (0.001)	-0.0004 (0.001)	-0.003 (0.002)	-0.0002 (0.0005)	0.001 (0.001)	-0.0004** (0.0001)	-0.001*** (0.001)
<i>NDVI<sub>it-1</sub></i>	-0.00002 (0.001)	-0.004*** (0.001)	0.001 (0.002)	0.0004 (0.0005)	-0.004*** (0.001)	0.0001 (0.0002)	-0.003*** (0.001)
<i>Sahara Transition Zone<sub>it</sub> × NDVI<sub>it-1</sub></i>	-0.005** (0.002)	0.007** (0.003)	-0.022*** (0.008)	-0.002 (0.002)	-0.003 (0.003)	0.001* (0.001)	0.005** (0.002)
<i>DV<sub>it-1</sub></i>	0.061*** (0.002)	0.287*** (0.002)	0.255*** (0.002)	0.146*** (0.002)	0.457*** (0.002)	-0.001 (0.002)	0.142*** (0.002)
<i>Log NT (sum)<sub>it</sub></i>	0.001*** (0.0001)	0.0004*** (0.0001)	0.002*** (0.0002)	0.0003*** (0.0001)	0.0002** (0.0001)	0.00001 (0.00002)	0.0001 (0.0001)
<i>Log Population<sub>it</sub></i>	0.001*** (0.0001)	0.001*** (0.0002)	0.005*** (0.0004)	0.0005*** (0.0001)	0.001*** (0.0002)	0.0001** (0.00003)	0.001*** (0.0001)
<i>Log τ<sub>t</sub></i>	0.001 (0.0004)	0.002*** (0.001)	0.003** (0.001)	-0.0004 (0.0003)	0.001 (0.001)	0.0001 (0.0001)	0.001* (0.0004)
<i>Constant</i>	-0.017*** (0.005)	-0.042*** (0.006)	-0.034** (0.015)	-0.006 (0.004)	-0.033*** (0.006)	-0.0001 (0.001)	-0.009** (0.004)
Observations	337,809	337,809	337,809	337,809	337,809	337,809	337,809
R <sup>2</sup>	0.007	0.087	0.082	0.022	0.216	0.001	0.033
Adjusted R <sup>2</sup>	0.007	0.087	0.082	0.022	0.216	0.001	0.033

Standard errors pooled by grid cell in parentheses; logging was done in base 10; fixed effects by month and country were included in each model although none is reported. DV standards for ‘dependent variable.’

\*\*\*p<0.01; \*\*p<0.05; \*p<0.1.

**Table A7:** Determinants of Violence against Civilians in Africa, Jan. 2003 – Dec. 2018, Matched Sample.

	ACLED			GED		PITF	
	State	Rebels	Militia	State	Nonstate	State	Nonstate
<i>Sahara Transition Zone<sub>it</sub></i>	-0.002** (0.001)	-0.002*** (0.001)	-0.003** (0.001)	0.001 (0.0004)	-0.001** (0.0004)	-0.0001 (0.0001)	-0.001*** (0.0002)
<i>NDVI<sub>it-1</sub></i>	-0.002*** (0.001)	-0.001 (0.001)	-0.004*** (0.001)	-0.002*** (0.0003)	-0.002*** (0.0003)	-0.0001* (0.0001)	-0.001*** (0.0002)
<i>Sahara Transition Zone<sub>it</sub> × NDVI<sub>it-1</sub></i>	0.005** (0.003)	0.009*** (0.003)	0.018*** (0.005)	0.001 (0.002)	0.004** (0.002)	0.001** (0.0004)	0.002* (0.001)
<i>DV<sub>it-1</sub></i>	0.444*** (0.001)	0.354*** (0.001)	0.582*** (0.001)	0.229*** (0.001)	0.417*** (0.001)	0.203*** (0.001)	0.200*** (0.001)
<i>Log NT (sum)<sub>it</sub></i>	0.001*** (0.0001)	0.0003*** (0.0001)	0.002*** (0.0001)	0.0004*** (0.00003)	0.0002*** (0.00004)	0.00005*** (0.00001)	0.0002*** (0.00002)
<i>Log Population<sub>it</sub></i>	0.002*** (0.0001)	0.001*** (0.0001)	0.003*** (0.0002)	0.001*** (0.0001)	0.001*** (0.0001)	0.0001*** (0.00001)	0.0003*** (0.00003)
<i>Log τ<sub>t</sub></i>	0.001** (0.0004)	0.003*** (0.0004)	0.005*** (0.001)	-0.0005** (0.0002)	0.002*** (0.0002)	0.0001** (0.0001)	0.001*** (0.0001)
<i>Constant</i>	-0.003 (0.004)	-0.027*** (0.004)	-0.022*** (0.007)	0.006** (0.002)	-0.020*** (0.003)	-0.001 (0.001)	-0.005*** (0.001)
Observations	1,803,053	1,803,053	1,803,053	1,803,053	1,803,053	1,803,053	1,803,053
R <sup>2</sup>	0.202	0.128	0.348	0.054	0.176	0.047	0.045
Adjusted R <sup>2</sup>	0.202	0.128	0.348	0.054	0.176	0.047	0.045

Standard errors pooled by grid cell in parentheses; logging was done in base 10; fixed effects by month and country were included in each model although none is reported. DV standards for ‘dependent variable.’ Variables used for matching were *Log precipitation<sub>it</sub>* and *Mean Temperature<sub>it</sub>*.

\*\*\*p<0.01; \*\*p<0.05; \*p<0.1.

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