**Appendix 2: Split sample analysis**

In this appendix we examine the potential for conditional effects of rainfall on social conflict in Africa. It may be that relatively poor countries, states that are small relative to the societies they govern, and economies that are highly dependent on agriculture, are more sensitive to variation in rainfall, and as such are more likely to see strong rainfall-social conflict links. Is the effect of rainfall on social conflict contingent on level of development, state size, or agricultural dependence? The evidence suggests that it is not.

Table A.I. reports results of pooled time-series cross-sectional negative binomial regression models of the impact of rainfall deviations on social conflict (see main text for discussion of model specification), splitting the sample into low income and high income groupings using median real GDP per capita (USD 1,645). The coefficients on *rainfall deviation2* are statistically significant and positive in both sub-samples, though the relationship is actually more statistically significant—and the coefficient estimate 30% larger—in the higher-income sample (p < 0.01 vs. p < 0.046). Higher income does not insulate a country from the curvilinear rainfall-conflict relationship; if anything, it slightly amplifies it.

Table A.I. Rainfall deviations and social conflict events, by income

|  |  |  |
| --- | --- | --- |
|  | Total events | Total events |
| Variables | GDP<median | GDP>=median |
|  |  |  |
| Lagged DV | 0.063\*\*\* | 0.041\*\*\* |
|  | (0.019) | (0.008) |
| Rainfall deviation | -0.004 | -0.007 |
|  | (0.049) | (0.042) |
| Rainfall deviation2 | 0.061\*\* | 0.079\*\*\* |
|  | (0.030) | (0.020) |
| Rainfall deviation, lagged | 0.025 | -0.048 |
|  | (0.062) | (0.044) |
| Rainfall deviation2, lagged | -0.032 | 0.050\* |
|  | (0.053) | (0.028) |
| Polity2 | 0.006 | -0.026\* |
|  | (0.018) | (0.016) |
| Polity22 | -0.004 | 0.001 |
|  | (0.004) | (0.004) |
| (log) Population | 0.219\*\* | 0.439\*\*\* |
|  | (0.090) | (0.083) |
| Population growth, % | -2.652 | -3.648 |
|  | (1.668) | (11.145) |
| Real GDP growth, % | -0.010\* | -0.016\*\* |
|  | (0.006) | (0.008) |
| Civil conflict incidence | 0.109 | 0.108 |
|  | (0.132) | (0.165) |
| Time trend | -0.069\*\*\* | -0.001 |
|  | (0.026) | (0.017) |
| Constant | 136.879\*\*\* | -0.176 |
|  | (51.226) | (34.671) |
| Period dummies | Yes | Yes |
| Observations | 382 | 383 |

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Similarly, the size of government does not appear to affect the rainfall-social conflict link. Table A.II splits the sample according to government share of GDP, which is an often-used proxy for the size of government (Rodrik, 1998; Easterly, 2001; data from Heston, Summers & Aten, 2009). In theory, larger governments might be more effective at placating social actors through patronage and redistribution in the midst of environmental shocks, while smaller states may generate more grievances, and have fewer resources to invest in mollifying social tensions. Larger, more resource-rich states, however, may incentivize social actors to press their grievances publicly during hard times, as the potential benefit of doing so (in the form of redistribution) is higher (see Easterly, 2001). However, the analysis once again indicates that the curvilinear rainfall-social conflict relationship holds across the split samples: the coefficient estimates are similar, as are levels of statistical significance. The signs on the first-order *rainfall deviation* variable are switched, however, indicating that social conflict may be more responsive to *positive* rainfall shocks in countries with larger governments and *negative* rainfall shocks in smaller-government countries.

Table A.II. Rainfall deviations and social conflict events, by government size

|  |  |  |
| --- | --- | --- |
|  | Total events | Total events |
| Variables | government share of GDP< median | government share of GDP>= median |
|  |  |  |
| Lagged DV | 0.043\*\*\* | 0.049\*\*\* |
|  | (0.011) | (0.011) |
| Rainfall deviation | 0.001 | -0.027 |
|  | (0.041) | (0.048) |
| Rainfall deviation2 | 0.078\*\*\* | 0.068\*\*\* |
|  | (0.024) | (0.025) |
| Rainfall deviation, lagged | -0.010 | -0.058 |
|  | (0.048) | (0.058) |
| Rainfall deviation2, lagged | 0.029 | 0.034 |
|  | (0.032) | (0.044) |
| Polity2 | -0.027\* | -0.001 |
|  | (0.016) | (0.018) |
| Polity22 | -0.003 | 0.002 |
|  | (0.003) | (0.005) |
| (log) Population | 0.363\*\*\* | 0.276\*\*\* |
|  | (0.068) | (0.095) |
| Population growth, % | -3.620 | -3.078\*\* |
|  | (6.654) | (1.535) |
| (log) Real GDP per capita | -0.216\*\*\* | -0.078 |
|  | (0.082) | (0.106) |
| Real GDP growth, % | -0.013\* | -0.008 |
|  | (0.008) | (0.006) |
| Civil conflict incidence | 0.007 | 0.198\* |
|  | (0.136) | (0.104) |
| Time trend | -0.014 | -0.011 |
|  | (0.018) | (0.023) |
| Constant | 28.041 | 20.641 |
|  | (36.504) | (46.210) |
| Period dummies | Yes | Yes |
| Observations | 384 | 381 |

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table A.III investigates whether agricultural dependence mediates the curvilinear rainfall-social conflict relationship. In agriculturally dependent economies, defined as being above the median in agricultural value-added as a share of GDP (27.6%, data from 2010 *World Development Indicators*), the effect of rainfall deviations on social conflict is slightly stronger. The marginal effect of *rainfall deviation2* on social conflict is slightly larger than the magnitude of its effect in less agriculturally dependent countries. With all controls at their means, a two standard deviation increase in *rainfall deviation2* from mean increases the expected count of social conflict events by an average of 30% in agriculturally less-dependent countries, and 40% in more-dependent.

Table A.III. Rainfall deviations and social conflict events, by agricultural dependence

|  |  |  |
| --- | --- | --- |
|  | Total events | Total events |
| Variables | agricultural value added as share of GDP<median | agricultural value added as share of GDP>=median |
|  |  |  |
| Lagged DV | 0.050\*\*\* | 0.046\*\*\* |
|  | (0.011) | (0.014) |
| Rainfall deviation | -0.027 | 0.007 |
|  | (0.048) | (0.042) |
| Rainfall deviation2 | 0.065\*\* | 0.084\*\*\* |
|  | (0.027) | (0.026) |
| Rainfall deviation, lagged | -0.054 | 0.028 |
|  | (0.044) | (0.057) |
| Rainfall deviation2, lagged | 0.047 | -0.021 |
|  | (0.033) | (0.046) |
| Polity2 | -0.019 | -0.020 |
|  | (0.018) | (0.014) |
| Polity22 | -0.000 | -0.001 |
|  | (0.004) | (0.003) |
| (log) Population | 0.370\*\*\* | 0.272\*\*\* |
|  | (0.081) | (0.091) |
| Population growth, % | -16.028\* | -2.870\* |
|  | (8.197) | (1.660) |
| (log) Real GDP per capita | -0.110 | -0.161\* |
|  | (0.160) | (0.091) |
| Real GDP growth, % | -0.005 | -0.013\*\* |
|  | (0.006) | (0.006) |
| Civil conflict incidence | 0.112 | -0.029 |
|  | (0.154) | (0.148) |
| Constant | -0.019 | -0.025 |
|  | (0.020) | (0.025) |
| Period dummies | Yes | Yes |
| Observations | 366 | 399 |
|  |  |  |

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

These models indicate that the rainfall-social conflict link is slightly stronger in more- developed and agriculturally dependent countries, but higher levels of development and lessened dependence on agriculture do not insulate African countries from the rainfall-social conflict relationship. Deviations from normal rainfall levels are associated with increases in social conflict at both higher and lower levels of economic development, government size, and agricultural dependence. Whether this is an artifact of African countries not varying a great deal with respect to these characteristics, or whether economic and structural factors truly do not mediate this relationship, is left to future research. For more in-depth discussions of factors that might mediate the rainfall-conflict relationship, see Koubi et al. (2012) and Hendrix & Salehyan (2011).

**Additional references**

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