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Economic shocks and civil conflict at the regional level

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HIGHLIGHTS

- We study the effects of economic shocks on civil conflict at the subnational level.
- Panel data from 5,689 regions from 53 African countries from 1992 to 2010 are used.
- Economic shocks are measured by nighttime light intensity.
- Lagged rainfall levels and drought intensity are used as instruments.
- Negative economic shocks increase the probability of regional civil conflict.

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ABSTRACT

We study the effects of economic shocks on civil conflict at the subnational level using a panel dataset of 5689 administrative regions from 53 African countries with yearly observations from 1992 to 2010. We find that economic shocks, measured by nighttime light intensity and instrumented by lagged rainfall levels and droughts, increase the probability of civil conflict.

1. Introduction

In an influential contribution, Miguel et al. (2004) study the effects of economic shocks on civil conflicts in Sub-Saharan Africa. They use rainfall patterns to instrument for economic shocks and exploit variation within countries over time to address endogeneity issues and omitted variable bias. They find that economic shocks increase the probability of civil conflicts. In this letter, we move beyond the country level and exploit variation within subnational regions over time to study the effect of economic shocks, instrumented by rainfall and drought, on civil conflicts at the regional level.

We construct a dataset of 5689 subnational administrative regions from 53 African countries with yearly observations from 1992 to 2010. We thereby rely on the Uppsala Conflict Data Program's Georeferenced Event Dataset (UCDP GED) to construct regional conflict indicators, and on satellite data on nighttime light intensity to measure regional economic activity. The use of nighttime light intensity as a measure of economic activity at the subnational level has been forcefully proposed by Henderson et al. (2012).[1] To instrument for economic activity, we use lagged levels

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[1] Early studies using nighttime light intensity as proxy for economic activity include Sutton and Costanza (2002), Doll et al. (2006), and Sutton et al. (2007). Michalopoulos and Papaioannou (2013, 2014) use nighttime light intensity to measure economic activity in a cross-section of African regions, and Hodler and Raschky (2014) in a panel of subnational administrative regions from all over the world.

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of rainfall inspired by Miguel et al. (2004) and Ciccone (2011), and lagged drought intensity inspired by Couttenier and Soubeyran (2014).

We find that lower levels of rainfall and droughts reduce regional economic activity as proxied by nighttime light intensity in the subsequent period, and, more importantly, that a drop in regional economic activity increases the risk of civil conflict in African regions in the subsequent year. A negative economic shock that corresponds to a reduction of nighttime light intensity by 10% increases the risk of civil conflict by around 3 percentage points, which corresponds to an increase in this risk from around 4.5% to around 7.5% in an average region. These results suggest that economic shocks have an important effect on the risk of regional conflict in African regions. Hence, the general pattern proposed by Miguel et al. (2004) holds at the more disaggregated level of subnational administrative regions.

There is a large literature on the determinants of civil conflict (see Blattman and Miguel, 2010, for a review). We contribute to two strands of this literature. First, we contribute to the strand on the causal effects of economic shocks on civil conflict discussed above. Second, we contribute to the emerging strand that uses data for subnational regions across Africa, which started with Buhaug and Rod (2006). Michalopoulos and Papaioannou (2011), and Besley and Reynal-Querol (2014) focus on how ethnic partitions and historical conflicts affect today's risk of civil conflict. Harari and La Ferrara (2013) study the relationship between weather shocks in the growing season of different crops and subsequent civil conflict using subnational regions that are rectangular cells (rather than administrative regions). We view their study and ours as complementary. They nicely document that weather shocks impact on civil conflict primarily through agriculture, and our two-stage least squares estimates with the chosen lag structure suggest that the income effect of weather shocks is crucial for their impact on civil conflict. Taken together, these two studies imply that weather shocks have a strong impact on civil conflict by changing incomes in the agricultural sectors.

The remainder of this paper is organized as follows: Section 2 presents the data, Section 3 the empirical specification, Section 4 our findings, and Section 5 briefly concludes.

2. Data

The Center for International Earth Science Information Network (CIESIN) at Columbia University and its project partners provide information on subnational administrative regions and their boundaries. Our units of observation are administrative regions at the second subnational level. Our sample consists of 5689 regions from the 53 African countries for which CIESIN provides the corresponding regional boundaries.[2]

Our dependent variables are based on the UCDP GED, which is an event-based and georeferenced dataset on organized violence in Africa between 1989 and 2010. For each individual event of violence there is information on the place of the event (with coordinates), the date of the event, the actors participating in the event, and the estimates of fatalities.[3] Most country-level studies of civil conflict, including Miguel et al. (2004), use as dependent variable a dummy variable that classifies a country–year as having a civil conflict when there are more than 25 conflict-related deaths. Given that there are 107 subnational regions in an average country in our sample, we use two different dummy variables: $Conflict01_{it}$ and $Conflict25_{it}$, which are equal to one if there are more than one or more than 25 conflict-related deaths, respectively, in region i in year t.

Our measure of economic activity is based on satellite data on the intensity of nighttime lights. Weather satellites from the US Air Force circle the earth 14 times per day and measure light intensity. The National Oceanic and Atmospheric Administration (NOAA) uses observations from evenings during the dark half of the lunar cycle in seasons when the sun sets early, but removes observations that could be affected by, e.g., cloud coverage, fires or other ephemeral lights. It then provides annual data for the time period from 1992 to 2010 for output pixels that correspond to less than one square kilometer. The data comes on a scale from 0 to 63, with higher values implying more intense nighttime light. Henderson et al. (2012) find a high correlation between changes in nighttime light intensity and GDP at the country level, and Hodler and Raschky (2014) document a similar relationship at the level of subnational administrative regions. A main advantage of nighttime light intensity is its availability at the regional level, which is particularly useful in the African context where regional GDP estimates are typically poor or unavailable. The variable $Light_{it}$ corresponds to the logarithm of the average nighttime light intensity of the pixels in region i in year t.[4]

Following Miguel et al. (2004) and Ciccone (2011), our first instrumental variable is the lagged level of rainfall (in logs).[5] The Climatic Research Unit provides monthly precipitation data on a 0.5×0.5 degree grid.[6] The variable $Rain_{it}$ corresponds to the logarithm of average precipitation in region i in year t.

Our second instrumental variable is based on the Palmer Drought Severity Index (PDSI), which combines precipitation, temperature and local soil characteristics. Dai et al. (2004) provide monthly PDSI on a 2.5×2.5 degree grid, with negative values implying dry areas. Couttenier and Soubeyran (2014) show that the association between PDSI and conflict is stronger than the one between rainfall and conflict at the country level, and that low PDSI is associated with low crop yields. The variable $Drought_{it}$ is equal to the average PDSI in region i in year t.

Table 1 provides summary statistics for our five main variables.

3. Empirical specification

To estimate the effect of nighttime light intensity on conflict, we start with the following specification:

$$Conflict_{it} = \alpha_i + \beta_i t + \gamma_t + \delta Light_{it-1} + \epsilon_{it}, \quad (1)$$

where $Conflict_{it}$ is either $Conflict01_{it}$ or $Conflict25_{it}$. The regional dummy variables α_i and the region-specific time trends $\beta_i t$ control for time-invariant regional characteristics, such as size and geography, and for different trends across regions during our

[2] The following 53 countries are in our sample: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo (DRC), Congo (RC), Cote d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Western Sahara, Zambia, and Zimbabwe.

[3] We employ the UCDP GED rather than the Armed Conflict Location and Event Dataset (ACLED) mainly because the latter only starts in 1997. Moreover, Eck (2012) raises some doubts about the quality of the georeferences in ACLED.

[4] To avoid losing observations with a reported nighttime light intensity of zero, we follow Michalopoulos and Papaioannou (2013, 2014), and Hodler and Raschky (2014) in adding 0.01 to the average nighttime light intensity before taking the logarithm. We do the same when taking the logarithm of average precipitation. Note that our results remain qualitatively and quantitatively similar when excluding all regions in which reported nighttime light intensity is zero throughout the sample period. (Results are available upon request.)

[5] Miguel et al. (2004) use lagged year-to-year changes in rainfall, but Ciccone (2011) argues that using the logarithm of lagged levels of rainfall is more appropriate.

[6] One degree corresponds on average to approximately 110 km.