Economic Shocks and Civil Conflict: The Case of Large Floods

Ramesh Ghimire[†] and Susana Ferreira[††]

[†]Department of Agricultural and Applied Economics

University of Georgia, 305 Conner Hall, Cedar St.

Athens, GA 30602, USA

Email: ghimire@uga.edu

[††]Department of Agricultural and Applied Economics

University of Georgia, 313 Conner Hall, Cedar St.

Athens, GA 30602, USA

Email: sferreir@uga.edu

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Abstract: We investigate the impact of large floods on the risk of civil conflict in a sample of 125 countries between 1985 and 2009. We control for endogeneity of floods and the potential spatial and temporal dependency of civil conflict. We find that floods increase the probability of conflict incidence through a negative impact on short-run GDP growth.

1. Introduction

Natural hazards such as earthquakes, volcanic eruptions, tsunamis, hurricanes, floods, and droughts are common sources of economic shocks (IMF, 2012). They can cause substantial damages and become natural disasters with profound environmental, political, and social consequences (Nel and Righarts, 2008). Previous studies have found that natural disasters increase the risk of civil conflict (Bergholt and Lujala, 2012; Drury and Olson, 1998; Ghimire and Ferreira, 2012; Keefer 2009; Nel and Righarts, 2008). However except Bergholt and Lujala (2012), previous studies do not investigate the potential channels through which natural disasters can cause civil conflict, offering little insights for policy formulation.

In this paper, we investigate the impact of large, catastrophic floods on civil conflict, using GDP growth as a potential transmission channel and treating the occurrence of floods as an endogenous variable. Except Ghimire and Ferreira (2012), all previous studies treat the natural disasters as exogenous phenomena. However, the very definition of what constitutes a natural disaster in those studies is based on damages, and the damages are likely to be correlated with the same socioeconomic and institutional variables that determine the propensity to civil conflict. Countries with higher income and better institutions are less vulnerable to natural disasters (Cavallo and Noy, 2010; Ferreira *et al.*, 2011; Kahn, 2005). Ferreira and Ghimire (2012) find

that an increase in income and improvement in institutions are also associated with fewer floods. Further, the emergence of new conflict, or continuation of existing conflict could weaken disasters risk reduction efforts.

Identifying the potential transmission channels between floods and civil conflict is policy relevant for at least two reasons. First, floods are the most common natural disaster; between 1985 and 2009, floods accounted for 40 percent of all the natural disasters (CRED/OFDA, 2011). Brakenridge (2011) documents that floods are becoming larger and more frequent over the last 25 years. The IPCC (2001, 2007, 2012) predicts that climate change can lead to change in the frequency, intensity, spatial extent, duration, and timing of extreme weather and climate events and can result in unprecedented extreme weather and climate events such as floods, droughts, and heat waves. These events, interacting with exposed and vulnerable human and natural systems, can lead to disasters with profound environmental, political, and social consequences (Nel and Righarts, 2008). Second, civil conflict is one of the greatest tragedies in human civilization. It impacts negatively on economic development and political stability. It is estimated that civil conflicts have resulted deaths of 20 million people and caused 67 million people to become refugees since World War II (Doyle and Sambanis, 2003). In this regard, identifying the potential transmission channel is important to formulate policies to mitigate negative impacts of large, catastrophic floods on broad social outcomes.

2. Natural disasters, economic growth, and civil conflict

The economic effects of natural disasters vary widely depending on the country and the type of disaster. Countries with favorable socioeconomic characteristics and institutions appear to be less vulnerable to natural disasters (Cavallo and Noy, 2010; Ferreira and Ghimire, 2012; Ferreira *et al.*, 2011; Kahn, 2005; Noy, 2009). In some studies, natural disasters have been found to be a

positive force for economic growth particularly in developed economies.[1] In addition, the arrival

of resources for reconstruction may provide a short-run boost to the affected regions.

Disasters, however, tend to be disastrous in poor countries. For example, Haiti's economy

has shrunk more than eight percent since the 2011 earthquake (Surowiecki, 2011). In Pakistan,

the 2011 floods appear to have reduced GDP growth by about 2 percentage points in 2011

(Looney, 2012). Floods that hit Thailand in 2011 had cost US$ 45 billion worth of damages,

which is equivalent to 14 percent of her GDP (Xinhua, 2011). A typical hurricane that strikes in

the central American and Caribbean region causes a reduction in annual output growth of about

one percentage point (Strobl, 2008).

Contrary to droughts, hurricanes, and earthquakes, some studies find a positive

macroeconomic impact of floods in long run, arguably through increased agricultural production

and productivity that spills over to the rest of the economy (Cuñado and Ferreira, 2011; Fomby

et al., 2011; Loayza *et al.*, 2009). However, in the short run large floods, like other natural

disasters hit the economy and result into a decline in GDP growth. As argued by Collier and

Hoeffler (1998, 2004), a low income, or economic growth decrease the opportunity costs of

young men to engage in civil conflict. The lower economic opportunities can result into

frustration and grievances, making it possible to recruit rebels at modest compensation levels.

Some socioeconomic characteristics such as high population density, youth bulges,

natural resource dependence, and ethnic tensions are thought to provide suitable environments to

breed conflict. Democratic institutions can reduce the risk of civil unrests (DeNardo, 1985;

Francisco, 1995; Hegre *et al.*, 2001). Other characteristics, such as rough terrain (Collier and

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[1] An argument often made for the limited macroeconomic impact of natural disasters in developed countries is that disasters may be speeding up a Schumpeterian "creative destruction" process: by destroying old infrastructures, such as factories, roads, airports, and bridges, the disasters allow new and more efficient infrastructures to be built, forcing the transition to a sleeker, more productive economy in the long run (Skidmore and Toya, 2002).

Hoeffler, 2004), and unrest in neighboring countries (Alcock, 1972) can also create a suitable environment for rebels to engage in civil conflict.

Although grievances may not be suffice to explain civil unrest, the grievances and competition for resources, combined with lack of representative institutions, economic redistribution mechanisms, and poor state capacity to deter violence, are likely explanation for civil unrest in the aftermath of large, catastrophic disasters (Gleditsch *et al.*, 2007).

3. Data

We compiled data on civil conflict, large floods, and a set of socioeconomic, political, and geophysical country characteristics and temporal-spatial controls for a total of 125 countries between 1985 and 2009 that are listed in the UPPSALA/PRIO civil conflict dataset.

3.1 Civil conflict data

We use civil conflict data from the annually updated UPPSALA/PRIO civil conflict dataset from the Uppsala Conflict Data Program (UCDP) (Gleditsch *et al.*, 2002; Themnér and Wallensteen, 2012). It defines civil conflict as "a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which one is the government of state, results in at least 25 battle-related deaths." The dataset is very selective, including only politically motivated violence. In addition, it has a relatively low inclusion criterion (25 battle-related deaths during a year). The dataset is event-based, recording conflict events for a given country in a year. We make it annual by aggregating multiple events within a country-year. We have used two indicators for civil conflict:

Onset of civil conflict: The onset variable is coded one when a new conflict emerges, there has been a total change in the opposite side, or when a conflict that has been inactive for more than

two calendar years and becomes active again, and zero otherwise. In total, our dataset includes 97 onsets out of 2576 observations (4%).

Incidence of civil conflict: The incidence variable is coded one if there are any types of conflict (new, or existing conflicts) in a country-year, and zero otherwise. We have a total of 491 incidences out of 2576 observations (19%).

3.2 Flood data

Flood data come from the Dartmouth Flood Observatory (DFO) (Brakenridge, 2011), a publicly accessible global archive of large flood events, housed at the University of Colorado (http://floodobservatory.colorado.edu/). For a flood event to be considered 'large' and recorded in the dataset, it has to fulfill at least one of the following criteria: significant damage to structures, or agriculture, long reported intervals (decades) since the last similar event, and/or fatalities (Brakenridge, 2011).

The DFO records the flood data on the basis of country-event. We converted them to country-year observations by adding the number of flood events, and physical impacts of all flood events (magnitude) within a year for a given country. We code flood frequency zero if there are no floods reported in a country-year. Otherwise, we set it equal to sum of reported events in a country-year.

In addition to the number of floods, the DFO reports magnitude of each flood event as log (duration × severity × affected area). We code magnitude as zero if no floods were reported for a country-year. Otherwise, we compute total magnitude as the sum of the reported events' magnitude in a country-year.

Since we measure GDP growth in an annual basis, we need to adjust for the timing of flooding; a flood that hits economy in January will have a bigger impact on GDP in the same

year than a flood that hits in December (Bergholt and Lujala, 2012; Noy, 2009). We adjust for this taking into account the onset month (*OM*) and using the formula, $Flood = \frac{(13\text{-}OM)}{12}$. If a country has experienced several flood events during a year, the individual values are aggregated. The frequency of floods in our sample ranges from zero to 19 with nearly half flood event between 1985 and 2009 per country-year (standard deviation = 1.3). The magnitude ranges from zero to 161, with an average 3 per country-year (standard deviation = 8.3) (Table 1).

3.3 Other controls

We use GDP growth as the potential transmission channel between floods and civil conflict (WDI, 2010). In addition, as per previous literature, we control for a range of socioeconomic, institutional, and geophysical country characteristics. We use GDP per capita to account for the opportunity cost of rebels to engage in civil conflict (Hegre and Sambanis, 2006). Other socioeconomic controls are population density, youth population, oil rents, infant mortality as a proxy for economic inequality, and ethnic tensions. Data for population density and infant mortality come from WDI (2010), youth population from WDI (2010) and United Nations (2010), oil rents from the World Bank (2010), and ethnic tensions from PRS (2011).

To control for political institutions, we use polity2 and polity2 square from the Polity2 regime indicators prepared by Marshall and Jaggers (2011), with the variables ranging from +10 (strongly democratic) to -10 (strongly autocratic). The use of polity2 and polity2 square controls for the potential nonlinearity between income and institutions (Francisco, 1995; Hegre *et al.*, 2001). We control for regime instability as per Fearon and Laitin (2003) by creating a instability dummy with value one if there are three, or more change in polity2 regime indicator over the last 3 years.

Because of the panel nature of UPPSALA/PRIO civil conflict data, we control for temporal dependency in the onsets equation. We construct a 'brevity of peace' variable as per Hegre *et al.* (2001), Toset *et al.* (2000), Nel and Righarts (2008), and Urdal (2006). We control for spatial dependency with a 'conflict in neighboring country' variable, that equals one if there is conflict in a neighboring country-year and zero otherwise.

We control for geophysical characteristics, such as terrain ruggedness and country area as addition covariates. Terrain ruggedness data comes from from Nunn and Puga (2010) and country area data from WDI (2010).

We instrument for floods using precipitation data (monthly variation in precipitation in mm) collected from TCCCR (2011); and coastal proximity (percentage of country's land area within 100 km of ice-free coast) from Nunn and Puja (2012). Summary statistics of all the variables are provided in Table 1. The table shows that there are much variations in indicators for conflict and floods across countries.

4. Estimation strategy

We assume that floods are a negative shock to GDP growth, and that shock contributes to worsen socioeconomic conditions increasing the risk of civil conflict. Not only floods, but also GDP growth is likely to be endogenous. We correct for endogeneity of floods and GDP growth in our model using a three step estimation procedure. In the first stage, we estimate the reduced form equation for floods ($Flood_{it}$), in the second stage we estimate the reduced form equation for GDP growth ($GDPG_{it}$), and finally we estimate the structural equation for conflict risk ($Conflict_{it}$). The system of equations can be summarized as:

$$Flood_{it} = f(X_{it-1}, Z) \qquad (1)$$

$$GDPG_{it} = g(\,Flood_{it\,-\,1},\,\boldsymbol{X_{it\,-\,1}}\,)\tag{2}$$

$$Conflict_{it} = h(\,GDPG_{it},\,\boldsymbol{X_{it\,-\,1}}\,)\tag{3}$$

where *Flood* is an indicator for large floods (flood frequency, or magnitude adjusted by timing of flooding as described in the data section); *X* is a vector of controls that includes socioeconomic indicators – infant mortality rate, GDP per capita, youth population, population density, oil-rents (=1), ethnic tensions; political institutions – polity2, polity2 square, and instability (=1); geophysical characteristics – country area and terrain ruggedness; spatial-temporal controls – conflict in neighboring countries (=1), and brevity of peace; *Z* is a vector of instruments for floods that includes precipitation (monthly variation in precipitation) and costal proximity; *GDPG* is GDP growth; and *Conflict* is an indicator of civil conflict (either onset, or incidence).

The instruments used for floods are relevant as shown in the reduced form equations for floods (Table 2). We believe that they satisfy the exclusion restriction; precipitation and coastal proximity affect GDP growth through floods. We regressed GDP growth on monthly variation in precipitation with and without controls and found that precipitation was not a statistically significant determinant of either GDP growth, or conflict risk (onset and incidence). Further, coastal proximity does not directly affect either GDP growth, or civil conflict.

Civil conflict does not always follow immediately after the occurrence of natural disasters (De Boer and Sanders, 2004; De Boer and Sanders, 2005; Drury and Olson, 1998). We lagged the flood variables (frequency and magnitude) one period to accommodate the potential lagged effects. We also analyzed the robustness of the results to using alternative indicators for flood occurrence - magnitude of floods and using a linear probability model. In all the specifications, all explanatory variables are lagged one period to mitigate potential endogeneity bias. All the regressions include year dummies to control for year specific effects.

Econometric methods

We follow a three-step estimation procedure to estimate the model. In the first step we estimate equation (1) and then equation (2), both using a random effects model, and finally we estimate two versions of equation (3) (one for conflict onset and another one for conflict incidence) using a random effects logit model.

Instead of random effects, we could have used fixed effects to estimate the onset and incidence model, but Hausman tests favored in random effects (*p*=0.8729). Further, the use of fixed effects in non-linear models is generally inconsistent when the length of the panel is fixed and appears to be biased in finite samples (Greene, 2004; Wooldridge, 2002). Moreover, the use of fixed effects in our study drops a substantial number of observations from the sample; from 125 to 44 countries and from 2576 country-year pairs (observations) to only 959. It drops all the countries for which there is no variation in the dependent variable (e.g. because they did not experience any civil conflict, or they experienced civil conflict during the whole sample period). In this case, this country's contribution to the log-likelihood is zero and as such it has no effect on the estimation (Beck and Katz, 2001).

5. Results

After estimating the reduced form equation for floods (equation 1) (Table 2), we estimated 2 different versions of equations 2 and 3 depending on the dependent variables - conflict onset and conflict incidence. We summarize their average marginal effects (AMEs) in the last four columns of Table 2.

5. 1 Floods, GDP growth, and onset of civil conflict

In the reduced form equation for GDP growth (col. 3), the coefficient of the flood variable is negative and significant at a 5 percent level, implying that floods are a negative shock to GDP

growth, with one additional flood lowering GDP growth in the next period by about 2 percent. The variables population density, country area, terrain ruggedness, and conflict in neighboring countries are also statistically significant determinants of GDP growth.

In the conflict onsets equation (col. 4), GDP growth has a negative coefficient, indicating that it decreases the probability of conflict onset, but the result is weak statistically (the coefficient is not statistically significant at the conventional levels). In contrast, population density, oil rents, and conflict in neighboring countries are all positive and statistically significant at 10 percent level, or better. The marginal effects indicate that a one percent increase in population density increases the probability of conflict onset by about 1.5 percent. Countries with oil rents have a 4 percent greater probability of conflict onset than those without oil rents. Having civil unrest in neighboring countries positively and significantly increases the risk of conflict onset in adjacent countries by about 2.5 percent. The variables GDP per-capita, infant mortality, youth population, ethnic tensions, polity2, and country area all have the anticipated sign, but they are statistically insignificant.

5.2 Flood, GDP growth, and incidence of civil conflict

As shown in the reduced form equation for GDP growth (col. 5), the coefficient of the flood variable is negative and significant at a 5 percent level, implying that floods are a negative shock to GDP growth, with one additional flood lowering GDP growth by 2.3 percent for the average country in the next year. The variables population density, country area, terrain ruggedness, and conflict in neighboring countries are again statistically significant determinants of GDP growth.

In the incidence equation (col. 6), the coefficient on GDP growth is negative, implying that a decline in GDP growth increases the probability of conflict incidence, and this effect is statistically significant. A one percent decrease in GDP growth increases the probability of incidence of civil conflict by 3.7 percent.

Results also show that a one percent increase in population density is associated with a 9.5 percent greater risk of conflict incidence. One unit improvement in ethnic tensions lowers the probability of conflict incidence by 2 percent. The variables GDP/capita, infant mortality, youth population, oil rents, instability, polity2, terrain ruggedness, and conflict in neighboring countries have the expected signs, but the results are weak statistically.

5.3 Robustness of results to alternative flood indicator

In Table 3, we use magnitude of floods as an alternative indicator of flood occurrence. As with flood frequency, we also adjusted for the timing of flood onset and instrumented for the flood magnitude variable using precipitation and coastal proximity. The results are similar to the baseline specifications; flood variable is statistically significant with a negative sign in the reduced form equations for GDP growth and GDP growth has a negative sign in both equations, but is statistically significant only in the incidence equation. The controls are significant as per the baseline specifications.

5.4 Robustness of results to linear probability model

Instead of using random effect logit model to estimate equation (3), we use random effects linear probability model (Table 4). The results still hold; the coefficient on GDP growth is negative for both estimates, but statistically significant to explain conflict incidence as in the baseline specification. The marginal effect shows that one percent decrease in GDP growth increases the probability of conflict incidence by about 4.5 percent.

Instead of using polity2 and polity2 square, we also use democracy dummy if the value of polity2 regime indicators is greater than 6 and zero otherwise and anocracies dummy if the value of polity2 is from -6 to -10 and zero otherwise. The results still hold (the results not shown here, but available on request).

6. Discussion and conclusion

Since one addition flood lowers GDP growth by about 2 percent and one percent reduction in GDP growth increases the probability of conflict incidence by about 4 percent, the combined effect, or the effect of one additional flood on conflict incidence is about a $2.3 \times 3.7 \approx 8.5$ percent larger probability of conflict incidence. With reference to our sample, the average country experienced approximately 0.54 flood event per year, which is associated with a 1.25 reduction in their GDP growth and results into $3.70 \times 1.25 \approx 4.63$ percent larger probability of conflict incidence. That is, the average country in our sample experienced a 4.63 percent larger risk of conflict incidence because of flooding.

The estimated impact of floods on GDP growth is large. However, case studies find that the estimated impacts could be much larger. For example, Pakistan experienced a 2 percentage point reduction in GDP growth after the 2010 massive inundations, which is equivalent to a 50 percent decline in GDP growth (Looney, 2012). Likewise, in Thailand, floods had cost US$ 45 billion worth of damages in 2011 (~14% of Thailand's GDP) and lowered the GDP growth by one percentage point, equivalent to 12 percent reduction in GDP growth in 2011 (Xinhua, 2011).

The slowdown in GDP growth could have huge socio, political impacts. Anecdotal evidence indicates that the Pakistani Taliban capitalized the frustration and grievance to strengthen their presence in the Northwest region, which was the most affected area by the flooding and also an epicenter of Pakistan's fight against al Qaeda and the Taliban (CBSNews, 2010; Righarts, 2010). However, there are few studies that analyze the impact of large, catastrophic disasters on broad social outcomes. Our work is a small effort to understand the potential impacts of large, catastrophic floods on GDP growth and on civil conflict.

Table 1: Descriptive statistics (unit of observation is country-year, 1985-2009)

Variable	No. of countries	No. of observations	Mean	Std. dev.	Min.	Max.
Indicators for floods						
Flood frequency	125	2576	0.545	1.392	0	19
Flood magnitude	125	2576	2.930	8.371	0	161.089
Indicator for civil conflict						
Conflict onset	125	2576	0.035	0.186	0	1
Conflict onset =1		97	1	0	1	1
Conflict onset =1		2479	0	0	0	0
Conflict incidence	125	2576	0.181	0.385	0	1
Conflict incidence=1		491	1	0	1	1
Conflict incidence=1		2085	0	0	0	0
Socioeconomic indicators						
GDP growth (%)	125	2576	3.719	5.603	-51.030	106.279
GDP/capita	125	2576	10969.88	12510.76	140.019	77108.22
Infant mortality	125	2576	41.584	37.134	2.1	167.2
Youth population (%)	125	2576	18.046	2.974	0.0481	26.105
Population density	125	2576	148.373	537.276	1.312	7125.143
Oil rents (=1)	125	2576	0.172	0.377	0	1
Ethnic tensions	125	2576	3.939	1.428	0	6
Political robustness index						
Instability (=1)	125	2576	0.111	0.314	0	1
Polity2	125	2576	3.267	6.921	-10	10
Geophysical characteristics						
Country area (km^2)	125	2576	992031	2185520	670	1.64E+07
Terrain ruggedness	125	2576	0.626	0.410	0.004	2.197
Spatial-temporal controls						
Brevity of peace	125	2576	0.236	0.391	0	1
Conflict in neighboring country (=1)	125	2576	0.484	0.499	0	1
Instruments for floods						
Coastal proximity	125	2576	40.639	36.544	0	100
Variation in precipitation, mm	125	2576	61.002	50.009	0.862	391.151

Table 2: Flood, GDP growth, and civil conflict (AMEs) (1985-2009)

VARIABLES	Reduced form for floods	Conflict onset		Conflict incidence	
		GDP growth	Onset	GDP growth	Incidence
	Equation (1)	Equation (2)	Equation (3)	Equation (2)	Equation (3)
Flood frequency		-2.175**		-2.313**	
		(0.993)		(1.018)	
GDP growth			-0.012		-0.037*
			(0.012)		(0.022)
Socioeconomic indicators					
Ln(GDP/capita)	0.326***	-0.413	-0.016	-0.430	-0.020
	(0.084)	(0.478)	(0 .016)	(0.430)	(0.038)
Ln(infant mortality)	0.366***	-0.272	0.003	-0.230	0.046
	(0.106)	(0.602)	(0.015)	(0.528)	(0.055)
Youth population	-0.038**	0.131	0.000	0.117	0.013
	(0.015)	(0.111)	(0 .003)	(0.108)	(0.014)
Ln(population density)	0.346***	1.036**	0.014*	1.073***	0.096***
	(0.065)	(0.408)	(0.011)	(0 .413)	(0.029)
Oil rents (=1)	-0.378**	0.301	0.041*	0.279	0.084
	(0.119)	(0.683)	(0.029)	(0.616)	(0.059)
Ethnic tensions	-0.038	0.224	-0.001	0 .241	-0.020*
	(0.022)	(0.182)	(0.004)	(0.193)	(0.011)
Political robustness index					
Instability (=1)	0.208**	0.221	-0.009	0.230	0.014
	(0.063)	(0.574)	(0.009)	(0.590)	(0.017)
Polity2	0.010	0.039	0.000	0.047	-0.000
	(0.007)	0.053	(0.000)	(0.054)	(0.001)
Geophysical characteristics					
Ln(country area)	0.546***	0.921**	0.007	0.974*	0.057***
	(0.053)	(0.463)	(0.006)	(0.497)	(0.021)
Terrain ruggedness	-0.074	-0.716*	-0.004	-0.736*	0.050
	(0.169)	(0.435)	(0.013)	(0.443)	(0.048)
Spatial-temporal controls					
Conflict in neighboring countries (=1)	-0.063	0.848**	0.024*	0.857***	0.037
	(0.057)	(0.359)	(0.019)	(0.323)	(0.030)
Brevity of peace	0.107	-0.114	-0.012		
	(0.084)	(0.499)	(0.016)		
Instruments for floods					
Ln(precipitation)	0.147***				
	(0.058)				
Costal proximity	0.005**				
	(0.002)				
Observations	2,576	2,576	2,576	2,576	2,576
Number of id	125	125	125	125	125
Log likelihood			-291.9566		-492.9400
Wald chi2	367.4600	339.8200	68.7400	399.1300	121.2400
Prob> chi2	0.0000	0.0000	0.0008	0.0000	0.0000

Note: Random effects model for reduced form equations (equations 1 & 2) and random effects logit model for structural equations (equation 3). Bootstrapped standard errors for second stage (equations 2) and third stage (equation 3) estimates in parentheses.*** p<0.01, ** p<0.05, * p<0.1

Table 3: Flood, GDP growth, and civil conflict with alternative indicators for floods (AMEs) (1985-2009)

VARIABLES	Conflict onset		Conflict incidence	
	GDP growth	Onset	GDP growth	Incidence
	Equation (2)	Equation (3)	Equation (2)	Equation (3)
Flood magnitude	**-0.309***		**-0.337***	
	(0.192)		**(0.187)**	
GDP growth		**-0.020**		**-0.045***
		(0.017)		**(0.031**
Socioeconomic indicators				
Ln(GDP/capita)	-0.766	-0.023	-0.806*	-0.029
	(0.473)	(0.020)	(0.457)	(0.047)
Ln(infant mortality)	-0.735	-0.003	-0.713	0.037
	(0.526)	(0.017)	(0.508)	(0.066)
Youth population (%)	0.169*	0.002	0.154	0.015
	(0.098)	(0.003)	(0.098)	(0.014)
Ln(population density)	0.911**	0.015*	0.951**	0.097***
	(0.464)	(0.010)	(0.453)	(0.027)
Oil rents (=1)	0.829	0.049*	0.837	0.097
	(0.700)	(0.031)	(0.688)	(0.072)
Ethnic tensions	0.228	0 .000	0.250	-0.017
	(0.183)	(0.004)	(0.179)	(0.013)
Political robustness				
Instability	0.146	-0.009	0.154	0.014
	(0.542)	(0.010)	(0.563)	(0.016)
Polity2	.0195	0.000	0.029	-0.000
	.0538	(0.000)	(0.055)	(0.001)
Geophysical characteristics				
Ln(country area)	0.731	0 .006	0.786	0.055**
	(0.519)	(0 .006)	(0.513)	(0.020)
Terrain ruggedness	-0.704	-0.008	-0.736	0.044
	(0.474)	(0.011)	(0.470)	(0.047)
Temporal-spatial controls				
Conflict in neighboring country (=1)	0.883**	0.0325*	0.891***	0.047
	(0.348)	(0.015)	(0.336)	(0.038)
Brevity of peace	-0.224	-0.015		
	(0.570)	(0.016)		
Observations	2,576	2,576	2,576	2,576
Number of id	125	125	125	125
Log likelihood		-292.4132		-493.1870
Wald chi2	336.1800	69.2800	387.0100	120.0700
Prob> chi2	0.0000	0.0000	0.0000	0.0000

Note: Random effects model for reduced form equations (equation 2) and random effects logit model for structural equations (equation 3). Bootstrapped Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 4: Flood, GDP growth, and civil conflict (baseline specification) with linear probability model (AMEs)

VARIABLES	Structural equations	
	Conflict onset	Conflict incidence
	Equation (3)	Equation (3)
GDP growth	**-0.0076**	**-0.0442****
	(0.0099)	**(0.0181)**
Socioeconomic indicators		
Ln(GDP/capita)	-0.0206	-0.0086
	(0.0194)	(0.0458)
Ln(infant mortality)	0.0042	0.0030
	(0.0248)	(0.0518)
Youth population (%)	-0.0029	0.0108
	(0.0032)	(0.0078)
Ln(population density)	0.0151*	0.0898***
	(0.0088)	(0.0229)
Oil rents (=1)	0.0569***	0.1020*
	(0.0210)	(0.0619)
Ethnic tensions	-0.0067	-0.0352***
	(0.0050)	(0.0100)
Political robustness		
Instability (=1)	-0.0224*	0.0169
	(0.0129)	(0.0263)
Polity2	0.0016	-0.0143***
	(0.0021)	(0.0043)
Geophysical characteristics		
Ln(country area, km^2)	0.0101*	0.0623***
	(0.0056)	(0.0170)
Terrain ruggedness	-0.0127	0.0542
	(0.0149)	(0.0556)
Temporal-spatial controls		
Conflict in neighboring country (=1)	0.0256*	0.0402
	(0.0144)	(0.0292)
Brevity of peace	0.0329	
	(0.0215)	
Observations	2,576	2,576
Number of id	125	125
Wald chi2	88.7400	121.8200
Prob > chi2	0.0000	0.0000

Note: Conflict onset and conflict incidence (equation 3) estimated employing linear probability model. Bootstrapped standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

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