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## **Drought and Civil War in Sub-Saharan Africa**

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By **Mathieu Couttenier**, University of  
Paris 1 Panthéon-Sorbonne, CES and  
Sciences-Po

**Raphael Soubeyran**, INRA-LAMETA  
and IDEP Montpellier

## SUSTAINABLE DEVELOPMENT Series

Editor: Carlo Carraro

### Drought and Civil War in Sub-Saharan Africa

By Mathieu Couttenier, University of Paris 1 Panthéon-Sorbonne, CES and Sciences-Po

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#### Summary

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**Keywords:** Climate Change, Drought, Civil War

**JEL Classification:** O10 , O55, P0, Q0

*We are grateful to Pierre Courtois, Mathieu Parenti, Thierry Mayer for their constructive and helpful comments. Raphael Soubeyran acknowledges financial support from the ANR project "RISECO", ANR-08-JCJC-0074-01.*

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# Drought and Civil War in Sub-Saharan Africa\*

Mathieu Couttenier<sup>†</sup>

Raphael Soubeyran<sup>‡</sup>

## Abstract

In this paper, we show that drought has a positive effect on the incidence of civil war over the 1945-2005 period in Sub-Saharan Africa. We use the Palmer Drought Severity Index which is a richer measurement of drought than the measures used in the literature (rainfall and temperature) as it measures the accumulation of water in the soil in taking into account the temperature and the geological characteristics of the soil. We show that the risk of civil war increases by more than 42% from a “normal” climate to an “extremely drought” climate. Surprisingly, only 2.5% of this effect is channeled through economic growth.

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# 1 Introduction

*“Darfur is the first of many climate wars”* – Jan Egeland, former head of OCHA/UN, 2007.

Climate change will generate an increase in abnormal climatic events, such as droughts, floods and hurricanes (Intergovernmental Panel on Climate Change, 2007). Those climatic anomalies might have disastrous consequences for countries where fresh water is scarce and whose economy depends on local agriculture. Given that the poorest of African households derive between 60% and 100% of their income from agricultural activities (Davis et al., 2007) and that they often have no access to safe water,<sup>1</sup> Sub-Saharan Africa is one of the most adversely affected regions in the world by climate change. The civil war in Darfur is known as an ethnic conflict between Arabs and Black Africans but drought (and desertification) is now an agreed upon cause of the war as it increased disputes over arable land and water. Climatic anomalies increase resource competition and tensions which may escalate to civil war.

The first graph of Figure 1 shows the evolution of drought measured by the average Palmer Drought Severity Index (PDSI) in Sub-Saharan Africa (SSA) and the evolution of average PDSI for the rest of the World for the post World War II period (1945-2005). The graph suggests a break in the trend of the evolution of drought around 1980. The Sub-Saharan Africa climate is more volatile than the climate in the rest of the world over the period.<sup>2</sup> Moreover, the average PDSI value in Sub-Saharan Africa increases by more 13% from the 1945-1979 period to the 1980-2005 period whereas the average PDSI has increased only by 5% in the rest of the world. The second graph of Figure 1 shows the number of ongoing civil wars in SSA and in the rest of the world. One may draw a parallel between the increase in drought and the large number of

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<sup>1</sup>Many African people have no secure access to fresh water. Only 22% of Ethiopians, only 29% of Somalis and only 42% of Chadians have a secured access to fresh water.

<sup>2</sup>The standard deviation of PDSI is 1.4 and 0.67 for SSA and the rest of the world, respectively.

ongoing civil war in Sub-Saharan Africa during the 1980-2005 period.

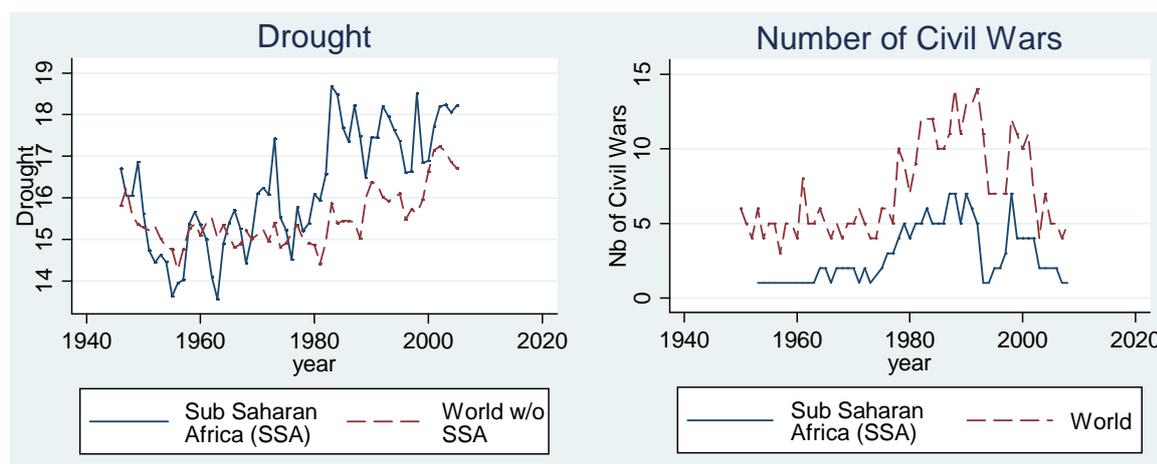


Figure 1: Drought and Number of Civil Wars since 1945

In this paper, we show that drought has a positive and robust effect on the incidence of civil war over the 1977-2005 period in Sub-Saharan Africa. We use the Palmer Drought Severity Index (PDSI) and find that the risk of civil war increases by more than 42% from a “normal” climate to an “extremely drought” climate. We then find that only 2.5% of this effect is channeled through economic growth.

Systematic studies linking climate and wars are few. The literature uses rainfall measures to assess the causal link between economic performance and civil war. The study by Miguel et al. (2004) covers the Sub-Saharan African countries for the period 1981-1999 and shows that rainfall positive variations decrease the likelihood of civil war through their positive impact on GDP. Bruckner (2009) uses a similar approach and show that civil war is more likely following an increase in population size. Ciccone (2010) provides a methodological contribution to this literature. He shows how to estimate the effect of transitory income shocks on the likelihood of civil war. Using the latest civil conflict data, he shows that civil conflicts are more likely following negative rainfall shocks and that instrumental variables estimates do not yield a robust link between transitory income shocks and civil war.

In this paper, we exploit a large dataset of a commonly used drought index in hydrology, named Palmer Drought Severity Index (Palmer, 1965). The PDSI is based on a supply and demand model of soil moisture and is calculated using precipitation and temperature data, as well as the local Available Water Content (AWC) of the soil. All the basic terms of the water balance equation can be determined, including evapotranspiration, soil recharge, runoff, and moisture loss from the surface layer. The PDSI is a richer measurement of drought than the level of precipitations as it measures the accumulation of water in the soil in taking into account the temperature and the geological characteristics of the soil.

The remainder of our paper is structured as follows. Section 2 describes data on the PDSI and the usual control variables and our estimation framework. Section 3 presents our results regarding the effect of drought on the incidence of civil war. Section 4 focuses on the economic growth channel. Section 5 concludes.

## **2 Data and Estimation Framework**

**The Palmer Drought Severity Index:** The PDSI has not been widely exploited in economics (at the exception of Landon-Lane et al. (2009) for the United States). The PDSI measures the moisture departure from a climatological normal. The PDSI is based on a supply and demand model of soil moisture and is calculated using precipitation and temperature data, as well as the local Available Water Content (AWC) of the soil. All the basic terms of the water balance equation can be determined, including evapotranspiration, soil recharge, runoff, and moisture loss from the surface layer. The PDSI is a weighted cumulative sum of monthly terms measured as differences with the monthly average for the month over the 1870-2005 period. This index captures departures from the average local climatic conditions. The PDSI data is a world time

series available over 1870-2005, geolocalised and available at a resolution of 2.5 degrees by 2.5 degrees. We choose the scale [0,30] for the values of the PDSI. Using this scale, a PDSI value of 15 refers to the “normal” climatic situation. As defined by Palmer, for a PDSI value above 25, climate is said “extremely drought” whereas for a PDSI value below 5 climate is said “extremely wet”. Our analysis is made at the country-year level. We aggregated the monthly geolocalised PDSI data by computing the country-year average. The distribution of this variable is a normal,<sup>3</sup> the average value is 15.376, which is close to the normal climatic situation and the standard deviation is 2.52, that is 16.4% of the average.

**Other Usual Control Variables:** We use the last version from UCDP/PRIO civil war data.<sup>4</sup> This new version extends and seems to correct some coding errors of the previous one. We use the variable of civil war which is 1 for years with a number of deaths larger than 1000 and 0 otherwise. We also consider other determinants often used in the literature (Fearon and Laitin, 2003; Collier and Hoeffler, 2004). *GDP* and *Population* come from the World Bank. The *Percentage of Mountainous Terrain*, *Oil*, *U.K. and French colony* come from Fearon and Laitin (2003). *Oil* is a dummy which is 1 if the country has fuel exports exceeding one third of its exports revenue. *Polity 2* comes from the Polity IV project; its scale is the unit interval with higher values indicating stronger democratic institutions. *U.K. Colony and French Colony* are two time invariant dummies for U.K. and French colonies.

**Estimation Framework:** We will estimate the following equation which links civil war and drought:

$$War_{it} = \beta_0 + \beta_1 Drought_{it} + \beta_2 Z_{it} + Trends_{it} + \alpha_i + \mu_{it} \quad (1)$$

where  $i$  denotes the country and  $t$  denotes times.  $War_{it}$  will be either the incidence of civil war

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<sup>3</sup>According to the Chi square test.

<sup>4</sup><http://www.prio.no/CSCW/Datasets/Armed-Conflict/UCDP-PRIO/>

or civil war onset. The incidence of civil war index is a dummy variable which is 1 for years with a number of deaths larger than 1000 and 0 otherwise (peace). The civil war onset indicator is coded 1 for the first year of the civil war, 0 for each year of peace and set to missing from the second year of civil war to the last year of the civil war.

$Drought_{it}$  is the PDSI index,  $Z_{it}$  contains other explanatory variables and  $\mu_{it}$  is the error term. In most specifications we use country specific time trends ( $Trends_{it}$ ) and country fixed effects ( $\alpha_i$ ). Most of our estimates use the OLS procedure because using the probit estimates procedure with country fixed effects excludes countries which never experienced a civil war (and leads to consider 13 countries instead of 37). Thus, we choose to estimate all our regressions with the OLS procedure to keep a maximum of observations and control for country fixed effects (our database contains 37 countries among the 50 countries of Sub-Saharan Africa).<sup>5</sup>

### **3 Drought and the Incidence of Civil War**

Our baseline estimates link the value of drought and the incidence of civil war. Table 1 contains different specifications using OLS. Our preferred specification (column (1)) runs over the 1960-2005 period and 37 countries. The level of democracy (Polity 2), available since 1960 only, restricts our sample. Drought has a positive and significant effect on the incidence of civil war. All other usual control variables have the expected signs. The size of the population has a positive effect and the number of peace years has a negative effect on the incidence of civil war. In column (2) we run the regression using supplementary control variables. Drought is robust to these inclusions and all the other variables have still the expected signs. In column (3), we introduce country-specific time trends as in Miguel et al. (2004), and in column (4) we

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<sup>5</sup>The 37 countries are listed in the first column of Table 7.

introduce country fixed effects.<sup>6</sup> In column (5) we add both country-specific time trends and country fixed effects. The results are not affected, despite the coefficient of drought is reduced.

Table 1: Drought and Civil War Incidence

	(1)	(2)	(3)	(4)	(5)
	Incidence	Incidence	Incidence	Incidence	Incidence
Drought (PDSI)	1.320*** (0.253)	1.446*** (0.282)	0.685** (0.291)	0.631** (0.273)	0.562** (0.281)
GDP Growth	-0.0645 (0.0444)	-0.0662 (0.0457)	-0.0608 (0.0425)	-0.0646 (0.0447)	-0.0476 (0.0426)
Log Population	0.0228*** (0.00483)	0.0193*** (0.00583)	0.0380*** (0.0120)	0.113*** (0.0316)	-0.553*** (0.185)
Peace Years	-0.00772*** (0.000580)	-0.00661*** (0.000601)	-0.00951*** (0.00154)	-0.00550*** (0.000969)	-0.00870*** (0.00182)
Polity 2	0.0224 (0.0226)	0.0657 (0.110)	0.0997 (0.106)	0.0699 (0.0998)	0.203 (0.143)
Polity 2 Sq.		-0.0628 (0.113)	-0.0999 (0.116)	-0.0926 (0.102)	-0.243 (0.151)
Log % Mountain		0.00685 (0.00426)	-0.00832 (0.00768)		
U.k Colony		-0.141*** (0.0351)	-0.299*** (0.0670)		
French Colony		-0.183*** (0.0333)	-0.357*** (0.0650)		
Oil		0.0375* (0.0216)	0.0566 (0.0391)		
Observations	1473	1426	1426	1426	1426
R-squared	0.255	0.294	0.461	0.454	0.514
Year :	1960 - 2005	1960 - 2005	1960 - 2005	1960 - 2005	1960 - 2005
Country Fixed Effect :	No	No	No	Yes	Yes
Country Specific					
Time Trends :	No	No	Yes	No	Yes

Note: Standard errors in parentheses with \*\*\*, \*\* and \* respectively denoting significance at the 1%, 5% and 10% levels.

Due to control variables missing data (Polity IV, Growth and Population for Africa before 1960), all the previous estimates do not use the full time range of available PDSI data (1870-2005). However, the time range we have considered (1960-2005) is larger than the usual range used in the literature (typically beginning around 1980). As civil war data is available since 1945, we can ask whether drought is an old or recent determinant of civil war. Since the control variables are not available since 1945, we estimate the link between drought and the incidence of civil war with country-specific time trends and country fixed effects only. Column (1) in table 2 shows the results for the whole 1945-2005 period. The effect of drought is no more significant

<sup>6</sup>All time invariant variables are dropped.

and the results presented in Table 1 suggest that the effect of drought on civil war is valid for recent decades only. Figure 1 suggests a change in the trend of the evolution of drought around the end of 70'. In columns (2) and (3), we run the regression for the 1945-1976 and 1977-2005 periods, respectively. This confirms that the effect of drought on civil war is significant for the last decades only. In column (4), we add control variables for the 1977-2005 period and the results are not affected.

Table 2: Drought and Civil War Incidence (1945-2005)

	(1) Incidence	(2) Incidence	(3) Incidence	(4) Incidence
Drought (PDSI)	0.301 (0.201)	0.154 (0.164)	0.750** (0.359)	0.836** (0.364)
GDP Growth				-0.0329 (0.0432)
Log Population				-0.550* (0.314)
Peace Years				-0.00456* (0.00276)
Polity 2				0.158 (0.237)
Polity 2 Sq.				-0.167 (0.228)
Observations	2257	1147	1073	992
R-squared	0.355	0.302	0.580	0.624
Year :	1945 - 2005	1945 - 1976	1977 - 2005	1977 - 2005
Country Fixed Effect :	Yes	Yes	Yes	Yes
Country Specific				
Time Trends :	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses with \*\*\*, \*\* and \* respectively denoting significance at the 1%, 5% and 10% levels.

We now provide quantifications for the effect of drought on probability of civil war. We simulate the effect of drought, everything else being constant. We quantify changes in the distribution of the probabilities of civil war incidence for the Sub-Saharan African countries using different scenarii. The probabilities are computed after a probit estimation using the same specification as Table 1 (column (2)).<sup>7</sup> Typically, we consider variations in the probabilities of civil war incidence for year 2004 when climate goes from a “normal” situation (PDSI=15) to

<sup>7</sup>The estimated coefficient for PDSI is 5.48 and it is significant at the 10% level (Table available upon request).

an “extremely dry” situation (PDSI=25). The variation of the average probability of civil war incidence is large. In Sub-Saharan Africa, a change of climate from “normal” to “extremely dry” increases the average probability of civil war incidence for year 2004 by approximately 42%. This probability is 7% for a “normal” climate and 12% for an “extremely dry” climate. We also make this comparison at the country level. We simulate three different probabilities of civil war for each country. First, we compute the predicted probability of civil war for each country in 2004. Second, we compute these probabilities in replacing all the PDSI values by 15, which refers to the “normal” climatic situation. Last, we compute the probabilities for PDSI values equal to 25 (“extremely dry” climate). The three predicted probabilities for each country are reported in Table 7 and Figure 2 shows the distribution for the Sub-Saharan African region for each of the three predictions (see Appendix). With a “normal” climatic situation (PDSI = 15 ) the probabilities of civil war are lower than 50% (per year).<sup>8</sup> Moving to an “extremely dry” climate (PDSI=25), the distribution become flatter with a shift to the right and a hole appears around 50%. A group of four countries (Angola, Liberia, Sudan, Uganda) has a very high estimated probability of civil war (around 60-70%) for the “extremely dry” climate situation.<sup>9</sup> Even if those four countries have a high probability of civil war with “normal” climatic conditions (PDSI=15), it increases by more than 30% when moving to a “extremely dry” climate (PDSI=25). Figure 3 shows the probabilities for the nine countries with the highest estimated probabilities of civil war for the year 2004 (see Appendix). Besides Uganda, Angola, Sudan, and Liberia, it is worth noticing that countries like Congo, Ethiopia, Mozambique and Zimbabwe could face the risk of civil war in case of drought, with predicted probabilities around

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<sup>8</sup>But Angola with a probability 51%.

<sup>9</sup>Uganda and Sudan were suffering from civil war in 2004 but Angola and Liberia were not. However, Angola experienced civil war from 1975 to 1995 and from 1998 to 2002 and Liberia had one year of civil war in 2003.

20% and up to a very high predicted probability of 40% for Ethiopia.<sup>10</sup>

These quantifications have to be interpreted cautiously as we have considered changes in drought without considering any changes in the other variables. However, this makes clear that drought has a strong effect on the risk of civil war.

## 4 The Economic Growth Channel

**Direct and Indirect effect:** Growth of gross domestic product is an important channel for the effect of drought on the incidence of civil war (see Miguel et al. (2004) and Ciccone (2010)). This is consistent with our previous estimates. We found no significant effect of GDP growth whereas it is usually significant in the literature when no measure of drought is included in the regressions. We now quantify the relative importance of GDP growth as a channel. We estimate the share of the effect of drought on the incidence of civil war that is channeled through GDP growth using the methodology of Papyrakis and Gerlagh (2007). Their methodology enables to estimate the direct effect and the indirect effect of an explanatory variable. We first estimate the link between drought and economic growth:

$$Growth_{it} = \gamma_0 + \gamma_1 Drought_{it} + \epsilon_{it} \quad (2)$$

Results are presented in table 5 (see Appendix). Drought has a negative and significant effect on growth. Substituting the estimated equation of equation (2) into equation (1), we obtain the

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<sup>10</sup>Congo experienced a civil war from 1997 to 1998, Ethiopia experienced civil war from 1975 to 1985 and from 1987 to 1991, Mozambique experienced a civil war from 1981 to 1991 and Zimbabwe experienced a civil war from 1976 to 1979.

overall effect of drought on the incidence of civil war:

$$Incidence_{it} = (\beta_0 + \beta_2\hat{\gamma}_0) + (\beta_1 + \beta_2\hat{\gamma}_1)Drought_{it} + \beta_2\hat{\epsilon}_{it} + \beta_3Z_{it} + \beta_4Trend_{it} + \alpha_i + \mu_{it} \quad (3)$$

where  $\beta_1$  represents the direct effect and  $\beta_2\hat{\gamma}_1$  the indirect effect of drought on the incidence of civil war. Table 6 shows the estimates of various specifications of equation (3). The estimated coefficient of the effect of drought on civil war incidence is only slightly larger than it was in our baseline estimates (Table 1). This reveals that the residual effect of growth on civil war incidence is non significant, i.e the effect of growth on the incidence of civil war is fully explained by drought. Our preferred specification corresponds to column (5) of Table 6 because it includes country fixed effects and country specific time trends (see Appendix).

We now quantify the relative importance of the direct and the indirect effect of drought on the incidence of civil war. Table 3 summarizes our results. The estimated effect of drought on the incidence of civil war  $\hat{\gamma}_1 = -0.329$  comes from Table 5. The residual effect of growth on the incidence of civil war,  $\hat{\beta}_2 = -0.0418$  and the total estimated effect of drought on the incidence of the civil war ( $\hat{\beta}_1 + \hat{\beta}_2\hat{\gamma}_1 = 0.576$ ), come from Table 6 (column (5)). The indirect effect of drought on civil war, i.e. the effect of drought that is channeled through growth, is then  $\hat{\beta}_2\hat{\gamma}_1 = 0.014$  and the direct effect is  $\hat{\beta}_1 = 0.562$ . The economic growth channel represents only 2.5% ( $\hat{\beta}_2\hat{\gamma}_1/(\hat{\beta}_1 + \hat{\beta}_2\hat{\gamma}_1)$ ) of the total effect of drought on the incidence of civil war.

**Outbreak of Civil War, Growth and Drought:** The direct effect of drought may be thought to be artificial and due to GDP measurement problems. Authors have questioned the validity of poor country GDP data (Deaton, 2005; Young, 2009) and these concerns are much more salient

Table 3: Relative Contribution of the Growth Channel

Transmission Channel	$\hat{\beta}_2$	$\hat{\gamma}_1$	Contribution to $\hat{\beta}_1 + \hat{\beta}_2\hat{\gamma}_1$	Relative Contribution (%)
Drought			0.562	97.5
Growth	-0.0418	-0.329	0.014	2.5
Total			0.576	100

Note:  $\hat{\beta}_2$  comes from column (5) of table 1,  $\hat{\beta}_1$  comes from table 5  
and  $\hat{\beta}_1 + \hat{\beta}_2\hat{\gamma}_1$  comes from column (5) of table 6

during civil war episodes. Given that African countries remain highly dependent on agriculture for both employment and economic production, with agriculture accounting for more than 50% of gross domestic product (World Bank 2009), one can think that the effect of drought on civil war is mainly channeled through economic growth. In order to provide a first insight, we estimate the link between drought and the outbreak of civil war (onset). This index is less sensitive to GDP measurement problems for civil war episodes than the civil war incidence index because it only takes the first year of civil war into account and the other years of civil war are set to missing values. Table 4 summarizes our estimates of the link between drought and civil war onset. This table shows that the direct effect of drought remains significant over the 1977-2005 period (column (3)) even when control variables are included (column (4)) and it remains non significant over the 1945-1976 period (columns (2)). Finally, one cannot exclude the possibility of a real direct effect of drought on the risk of civil war.

Table 4: Drought and Civil War Onset

	(1) Onset	(2) Onset	(3) Onset	(4) Onset
Drought (PDSI)	0.172 (0.125)	0.0519 (0.131)	0.436** (0.210)	0.423* (0.240)
GDP Growth				-0.0394 (0.0310)
Log Population				-0.214** (0.109)
Peace Years				0.00349 (0.00241)
Polity 2				0.116 (0.172)
Polity 2 Sq.				-0.126 (0.165)
Observations	2152	1130	987	906
R-squared	0.080	0.080	0.160	0.218
Year :	1945 - 2005	1945 - 1976	1977 - 2005	1977 - 2005
Country Fixed Effect :	Yes	Yes	Yes	Yes
Country Specific				
Time Trends :	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses with \*\*\*, \*\* and \* respectively denoting significance at the 1%, 5% and 10% levels.

## 5 Conclusion

We have shown that drought has a strong effect on the incidence of civil war and that this effect is not only channeled through economic growth. Drought, in altering crops and devastating livestock, reduces drastically households home consumption and increases competition for resources as drinking water and arable land. We have shown that drought has a positive and robust effect on the incidence of civil war over the 1977-2005 period in Sub-Saharan Africa. The risk of civil war increases by more than 42% from a “normal” climate to an “extremely drought” climate and only 2.5% of this effect is channeled through economic growth.

# Appendix

Table 5: The Effect of Drought on Growth

	Palmer	Constant	Observations	R-squared
Growth	-0.329* (0.186)	0.105*** (0.0301)	1426	0.003

Note: Standard errors in parentheses with \*\*\*, \*\* and \* respectively denoting significance at the 1%, 5% and 10% levels.

Table 6: Drought and Civil War: Direct and Indirect Effects

	(1) Incidence	(2) Incidence	(3) Incidence	(4) Incidence	(5) Incidence	(6) Incidence
Drought (PDSI)	1.338*** (0.262)	1.468*** (0.281)	0.704** (0.289)	0.651** (0.271)	0.576** (0.280)	0.883** (0.374)
Residual GDP Growth	-0.0711 (0.0483)	-0.0597 (0.0465)	-0.0537 (0.0434)	-0.0588 (0.0456)	-0.0418 (0.0434)	-0.0320 (0.0466)
Log Population	0.0256*** (0.00548)	0.0193*** (0.00585)	0.0381*** (0.0120)	0.114*** (0.0316)	-0.553*** (0.186)	-0.641* (0.362)
Peace Years	-0.00790*** (0.000593)	-0.00660*** (0.000601)	-0.00950*** (0.00154)	-0.00549*** (0.000970)	-0.00869*** (0.00183)	-0.00449 (0.00276)
Polity 2	0.0272 (0.0229)	0.0677 (0.110)	0.102 (0.106)	0.0710 (0.0998)	0.206 (0.143)	0.160 (0.238)
Polity 2 Sq.		-0.0647 (0.113)	-0.102 (0.116)	-0.0937 (0.102)	-0.245 (0.151)	-0.170 (0.229)
Log % Mountain		0.00691 (0.00425)	-0.00831 (0.00768)			
U.k Colony		-0.142*** (0.0351)	-0.300*** (0.0671)			
French Colony		-0.183*** (0.0333)	-0.357*** (0.0651)			
Oil		0.0375* (0.0217)	0.0565 (0.0391)			
Observations	1426	1426	1426	1426	1426	954
R-squared	0.258	0.294	0.461	0.454	0.514	0.623
Year :	1960 - 2005	1960 - 2005	1960 - 2005	1960 - 2005	1960 - 2005	1977 - 2005
Country Fixed Effect :	No	No	No	Yes	Yes	Yes
Country Specific						
Time Trends :	No	No	Yes	No	Yes	Yes

Note: Standard errors in parentheses with \*\*\*, \*\* and \* respectively denoting significance at the 1%, 5% and 10% levels.

Figure 2: Estimated Distributions for the year 2004

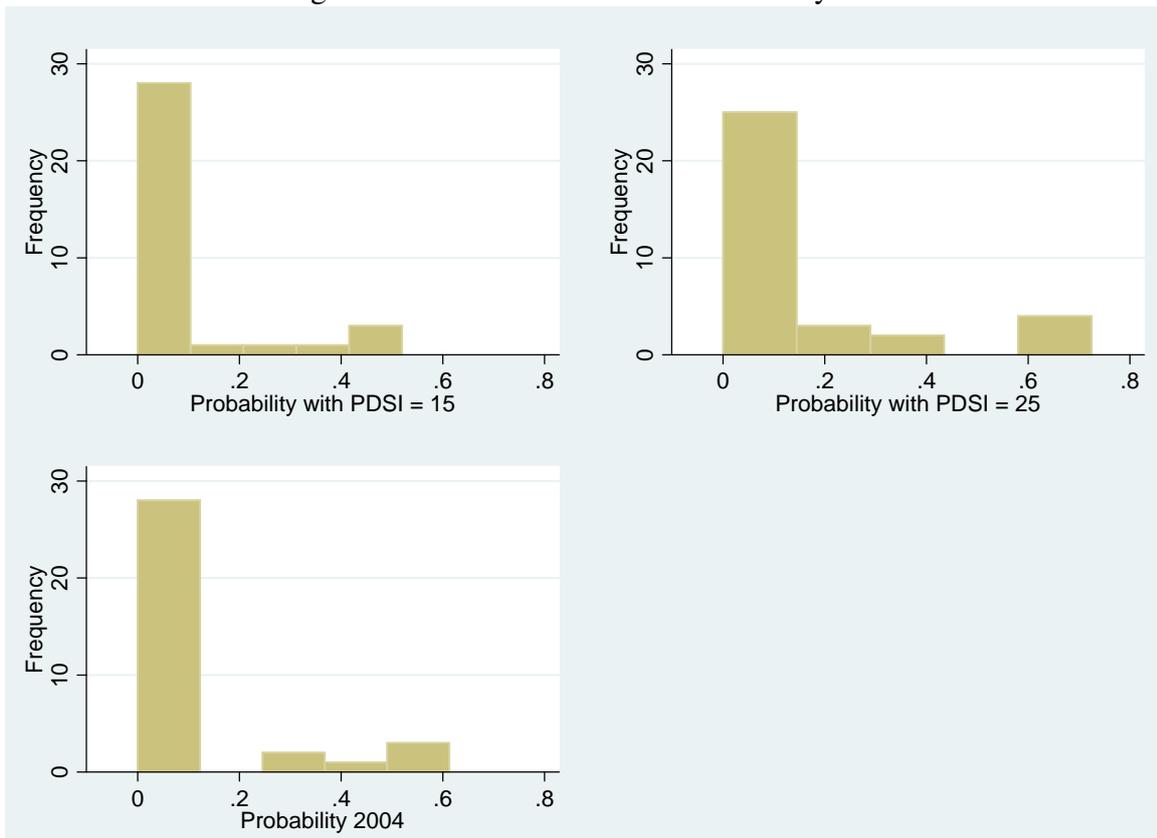


Figure 3: Cases

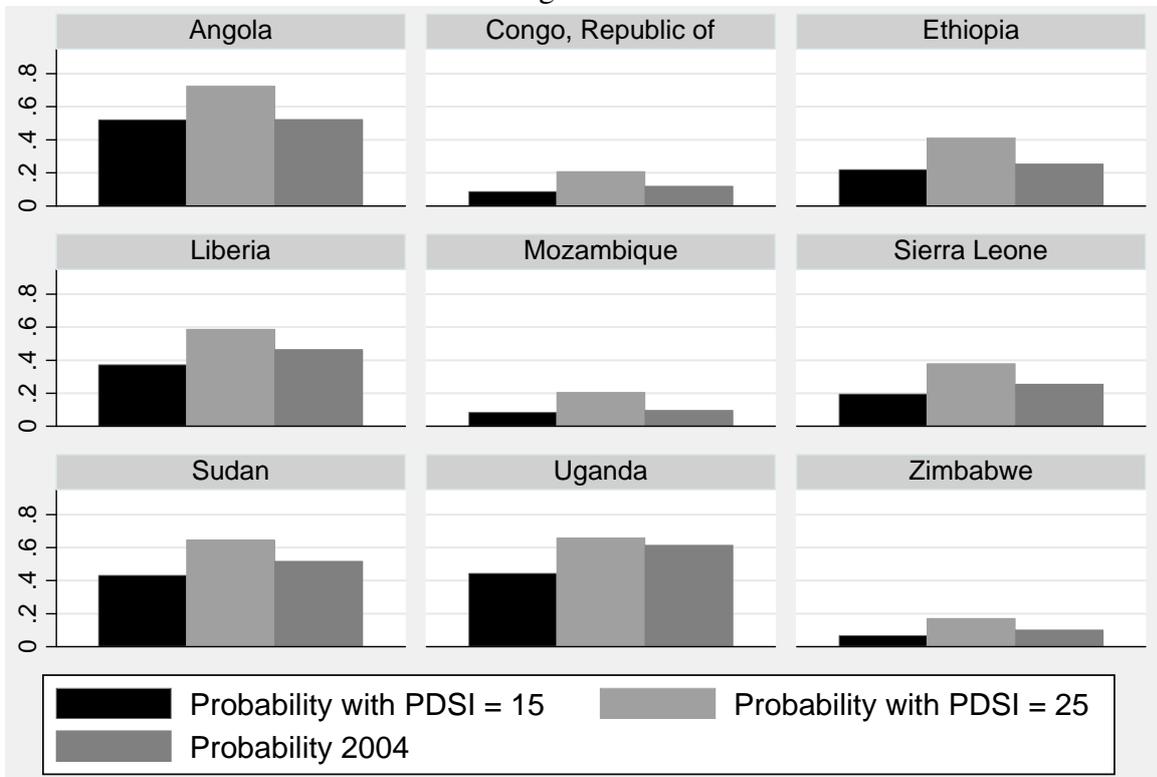


Table 7: Probabilities and Climatic Scenarii (%)

Country	PDSI in 2004	Ongoing Civil War in 2004	Estimated Probability in 2004	Estimated Probability with Drought = 15 ("normal" climate)	Estimated Probability with Drought = 25 ("extremely dry" climate)	Variation between "normal" climate and "extremely dry" climate
Uganda	22.8	Yes	61.3	44.3	65.7	48
Angola	15.1	No	52.2	52	72.5	39
Sudan	19	Yes	51.6	43.1	64.6	49
Liberia	19.3	No	46.4	37.1	58.7	58
Sierra Leone	18.6	No	25.4	19.5	37.8	93
Ethiopia	17	No	25.3	22	41.1	87
Congo, Republic of	18.3	No	11.9	8.6	20.8	140
Zimbabwe	19	No	10	6.6	17	155
Mozambique	16.3	No	9.6	8.5	20.4	141
South Africa	16.9	No	3.1	2.4	7.7	217
Chad	16.6	No	1.5	1.2	4.4	264
Nigeria	17.6	No	<1%	<1%	2	328
Cameroon	18.9	No	<1%	<1%	<1%	609
Kenya	16.5	No	<1%	<1%	<1%	673
Swaziland	22	No	<1%	<1%	<1%	843
Tanzania	18	No	<1%	<1%	<1%	831
Namibia	15.8	No	<1%	<1%	<1%	955
Lesotho	18.3	No	<1%	<1%	<1%	1034
Malawi	16	No	<1%	<1%	<1%	1026
Ghana	23.2	No	<1%	<1%	<1%	1342
Zambia	17.4	No	<1%	<1%	<1%	1191
Gabon	20	No	<1%	<1%	<1%	1329
Guinea	21.1	No	<1%	<1%	<1%	1440
Central African Republic	19.3	No	<1%	<1%	<1%	1422
Botswana	17.5	No	<1%	<1%	<1%	1375
Madagascar	16.4	No	<1%	<1%	<1%	1331
Cote d'Ivoire	21.2	No	<1%	<1%	<1%	1608
Togo	19.5	No	<1%	<1%	<1%	1596
Mauritania	17.1	No	<1%	<1%	<1%	1540
Burkina Faso	19.2	No	<1%	<1%	<1%	1649
Benin	21.3	No	<1%	<1%	<1%	1969
Niger	16.4	No	<1%	<1%	<1%	1844
Mali	16.8	No	<1%	<1%	<1%	1922
Senegal	19.2	No	<1%	<1%	<1%	2079
Equatorial Guinea	19.3	No	-	-	-	-
Eritrea	16.1	No	-	-	-	-
Somalia	15.6	No	-	-	-	-

## References

- Bruckner, M. (2009). Population size and civil conflict risk: Is there a causal link? Working Papers in Economics 211, Universitat de Barcelona. Espai de Recerca en Economia.
- Cicccone, A. (2010, February). Transitory economic shocks and civil conflict. Working papers.
- Collier, P. and A. Hoeffler (2004, October). Greed and grievance in civil war. *Oxford Economic Papers* 56(4), 563–595.
- Davis, B., P. Winters, G. Carletto, K. Covarrubias, E. Quinones, A. Zezza, K. Stamoulis, G. Bonomi, and S. DiGiuseppe (2007). Rural income generating activities; a cross country comparison. Working papers, Agricultural and Development Economics Division of the Food and Agriculture Organization of the United Nations (FAO - ESA).
- Deaton, A. (2005, 04). Measuring poverty in a growing world (or measuring growth in a poor world). *The Review of Economics and Statistics* 87(1), 1–19.
- Fearon, J. D. and D. Laitin (2003). Ethnicity, insurgency, and civil war. *American Political Science Review* 97(14), 75–91.
- Intergovernmental Panel on Climate Change (2007). *IPCC Special Report: Emission Scenario*.
- Landon-Lane, J., H. Rockoff, and R. H. Steckel (2009, December). Droughts, floods and financial distress in the united states. NBER Working Papers 15596, National Bureau of Economic Research, Inc.
- Miguel, E., S. Satyanath, and E. Sergenti (2004). Economic shocks and civil conflict: An instrumental variables approach. *Journal of Political Economy* 112(4), 725–53.

Palmer, W. (1965). Meteorological drought. Research Paper 45, US Dept. of Commerce.

Papyrakis, E. and R. Gerlagh (2007, May). Resource abundance and economic growth in the united states. *European Economic Review* 51(4), 1011–1039.

Young, A. (2009). The african growth miracle. Lse working paper.

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