Global Journal of Economics and Finance; Vol. 5 No. 1; June 2021
ISSN 2578-8809 (Print), ISSN 2578-8795 (Online)
Published by Research Institute for Progression of Knowledge

Assessing the Effects of Armed Conflict on Agricultural Output in Africa

Onyumbe Enumbe Ben Lukongo, PhD[+]
Associate Professor
Department of Public Policy
Nelson Mandela College of Government and Social Sciences
Southern University and A & M College, USA

Abstract

Civil wars, insecurity, and ethnic disputes have imposed a high human and economic toll in Africa. This study examines the destructive impacts of war on agricultural output across the continent. Poor agricultural sector performance is more likely discernable around or during times of conflict. Using a panel of 54 countries from 1961-2009, results suggest that war impedes agricultural output, but a decline in production is not associated with the incidence of war. History, armed conflicts, natural resources, political development or decay, misleading development policies, and weakly institutionalized polity pose a serious challenge for the development of Africa. This study begs for elevating the role of institutions and constitutions to curtail armed conflicts motivated by control or access to natural resources to promote Africa's economic growth, development, and peace.

JEL Codes: C23, D74, O11, O47

Keywords: Agricultural Production; Africa; War

Introduction

Over the years, agricultural output in African agriculture has been erratic, with many studies showing that growth in the region has lagged the rest of the world (Rezek et al., 2011; Dercon & Gollin, 2014, Lukongo & Rezek, 2018). While there is a myriad of potential causes, research indicates that the unstable political and institutional environment has been responsible for at least part of African underperformance (Easterly & Levine, 1997; Rodrik, 1999; Miguel et al., 2004; Reitschuler & Loening, 2005; Gong & Zou, 2003; Aisen & Veiga, 2013). The recent armed conflict in North Africa and the Sahel, as well as ongoing violence in other parts of the continent, have underscored the need for a better grasp of the interplay of violence, food security, and agricultural production.

This study contributes to the existing literature on armed conflict and development by examining the impacts of war on the agricultural output and investigating the reverse causality, if any exists, between agricultural output and armed conflict. It is reasonable to assume that war causes production to decline; but it is also plausible that a decline in production leads to increased scarcity, food insecurity, tensions, and conflict. Build upon the econometric analysis of panel data, this study covers 54 African countries over the period 1961-2009. The choice for 1961 as the start year is explained by the availability of data on agricultural output. The Food and Agricultural Organization's (FAO) database has a series of agricultural output, which only goes to 1961, and inputs such as tractors and livestock are available for all 54 countries up to 2009. This study argues that while war has been cited as a major problem undermining the economic performance and social progress in this region (Lukongo & Rezek, 2018; Aisen & Veiga, 2013; Guillaumont et al., 1999; Fulginiti et al., 2004; Gong & Zou, 2003; Alesina et al., 1996), its effects have not been quantified adequately in the agricultural sector. This research tries to fill this gap.

The data analysis suggests that the majority of countries performing poorly by international standards have been involved in civil wars and are affected by political instability and intermittent violence. The main question of this study is that—in the absence of civil war and sporadic violence, how much better off would these countries have been? How costly is the war on agriculture? The study pursues three objectives: (1) estimate the effects of the incidence of war on agricultural production in the same panel of 54 African countries using both a linear regression model estimated by the OLS techniques; (2) estimate the effects of agricultural production of the incidence of war using a probability linear model. The best effort is to test for potential reverse causality; and, (3) identify the model (fixed effects vs. random effects) that represents better the relationship between agricultural production and war in Africa. The rest of the study proceeds as follows. Section 2 provides an overview of the existing empirical literature. Section 3 discusses the methods and section 4 presents the results under various specifications. The final section provides a brief discussion of the findings and future research directions by elevating the role of well-functioning institutions and well-designed constitutions that promote wealth creation, protect property rights, foster economic growth and development, and nurture peace.

Related Studies

Though human history, agricultural production has been seen as central to economic development. However, low agricultural production growth in Africa has resulted in poverty and continued food insecurity in many parts of the continent even today. Several researchers have found that civil wars, political violence, and ethnic disputes have been detrimental to economic growth (Easterly & Levine, 1997; Rodrik, 1999) in general and the agricultural sector (Fulginiti et al., 2004; Glaser et al., 2019; Olsson & Svensson, 2010) in particular. For various political reasons, thirty-eight African countries have experienced wars since 1970 according to the Department of Peace and Conflict Research at Uppsala University (2016) and the Peace Research Institute Oslo (2016). Another twenty-one countries have experienced minor armed conflicts over that period. According to the Department of Peace and Conflict Research at Uppsala University (2016) and the Peace Research Institute Oslo (2016), wars are defined as political conflicts with more than 1,000 battle-related deaths per year while minor conflicts are defined as political conflicts with more than 10 but less than 1,000 battle-related deaths per year.

Wars and political crises often lead to economic regression, political instability, and social unrest, which cause the propagation of hunger and disease and the humanitarian crisis (Nafziger & Auvinen, 2001; 2002). Steward and Fitzgerald (2001) find that eighty percent of countries with high infant mortality rates and low per capita incomes have experienced civil wars; the authors conclude that civil conflict is a major cause of poverty and underdevelopment.

War studies provide evidence of several pathways through which armed conflict can inhibit the economic productivity of a country. Rodrik (1999) attributes the lack of persistent growth in Africa, and particularly the slowdown in the mid-1970s, to the interaction of social conflicts and external shocks, while weak institutions were unable to effectively respond to those shocks. Gupta et al. (2004) note the adverse effects of civil conflict on economic growth and inflation, which lead to lower tax revenues and investment. Reitschuler and Loening (2005) and Gong and Zou (2003) focus on the detrimental impacts of war as increasing military expenditures cause a diversion of public resources from more productive economic activities and supportive welfare programs. Other studies attribute the detrimental effects of civil war on economic outcomes to the destruction of capital and assets (Collier, 1999; Arunatilake et al., 2001), the disruption of labor markets (Steward & Fitzgerald, 2001; Keen, 2001), and the increased uncertainty that undermines property rights (Collier, 1999).

The bulk of empirical studies examining the impacts of violence on a country have focused on the negative relationship between sociopolitical instability or related institutional change and overall economic growth through a variety of channels. North (1990, p.4) highlights the role of institutions in reducing transaction costs and establishing a business environment with less uncertainty. It is believed that well-functioning institutions contribute to economic stability by defining and enforcing property rights, while political instability threatens property rights and increases uncertainty impairing investment and growth. To be specific, Barro (1991) shows that economic growth rates are negatively associated with various measures of political instability including the number of revolutions and coups per year and political assassinations per capita. Similarly, Venieris and Gupta (1986) find a negative association between political instability and the savings rate, a key for boosting investment, capital accumulation, and economic growth. Knack and Keefer (1995) also suggest that sociopolitical instability impairs economic growth.

The authors also highlight the importance of secure property rights and the resulting positive impacts this has on both the magnitude of investment and efficiency in the allocation of inputs. Furthermore, Easterly and Levine (1997) find that political instability has spillovers or diffusion effects on neighboring countries. They identify a systematic contagion of favorable and unfavorable growth performance in neighboring countries and suggest that collective and coordinated action on the part of African countries is required to reverse Africa's growth decline.

While many of the seminal works link war to overall economic decline, the study focuses on the specific impact of war and other control variables on agricultural production. Violent civil conflicts, disorder, and wars negatively affect the overall performance of the agricultural sector. However, an issue that must be addressed in conducting this analysis is reverse causality, which has been cited in studies that relate violence to natural resources, institutions, and economic growth (Alexeev & Conrad, 2009). Researchers often ask, does war cause economic slowdown, stagnation, and decline, or is war the result of economic stagnation and decline? Unidirectional causality from civil conflict to economic decline and economic decline to the incidence of civil conflict have both been reported in applied studies in sub-Saharan Africa. For example, using conflict as an explanatory variable, Rodrik (1999) highlights the role of social disruption coupled with external shocks and weak conflict resolution institutions in explaining the mid-70s growth collapse and the lack of persistence in economic growth around the world. Miguel et al. (2004) note the lack of discussion regarding the endogeneity of economic variables in civil war regressions and choose economic growth as the explanatory variable and use variation in rainfall as an instrument for income growth to establish a causal relationship. These authors find that a decline in economic growth resulted in an increased incidence of a civil war in sub-Saharan Africa between 1991 and 1999. The issue related to the endogeneity of economic growth is unsettled. Some attempts have been but there is a need for more research. In the re-examining Miguel et al. (2004) study on the impact of growth on civil war, Jensen and Gleditsch (2009) argue that "*The extension to participate in civil war elsewhere in Africa does not seem consistent with the logic of the mechanisms through which economic growth may be linked to conflict, and we conclude that conflict should be restricted to the locations where conflict occurs, to properly evaluate the effects of growth shocks empirically*."

This study acknowledges previous literature on war and productivity but solely focuses on the effects of war on the agricultural output. That is, armed conflict is one of the important determinants of poor agricultural output in Africa beyond fluctuations of production partly explained by the environmental conditions. This study includes rainfall, rainfall anomalies, temperatures, and temperature anomalies to control for environmental conditions. Some qualitative observations suggest that war is a major cause of poor agricultural production, even if, after adjusting for other factors such as labor, tractors, rainfall, rainfall anomalies, and war history. An investigation of the relationship between war and agricultural production allows policymakers additional insight into the importance of both a flourishing agricultural sector for political stability and a stable political environment for continued progress in food security and economic development.

Methods

This section briefly describes the nature and source of the data and the way rainfall anomalies were constructed. The study covers 54 African countries between 1961 and 2009. The second part of the methods presents the modeling strategy.

Data Sources, Variables Description, and Variables Construction

Three datasets are used in this study. The first set is composed of aggregated agricultural input and output data for 54 African countries for the years 1961 to 2009 and is gathered from the Food and Agricultural Organization of the United Nations (FAO). The agricultural output is expressed in thousands of constant international dollars as of 2004-2006. The four inputs in the model include total rural population (labor), arable land and land in permanent crops (land expressed in 1,000 hectares), tractors in use (physical capital), and total livestock (livestock capital). In other studies, the total economically active is used as a measure of labor in the sector. However, this series is no longer available back through 1960. The rural population is a proxy for the labor force. The output is the total production in the agriculture of the country. Labor which is the rural population refers to people living in rural areas. The figures are expressed in thousands. This rural population is the difference between the total population and the urban population. Data comes from the World Bank World Development Indicators. Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures.

Arable land includes land defined by the FAO as "land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded." Livestock denotes animals such as cattle and sheep which are kept on the holding or otherwise for agricultural production. It is measured by livestock units. This study adopts the Hayami and Ruttan's (1985) aggregation method to convert various species of livestock into a single, horse-equivalent. The benchmark is one buffalo, horse, camel, or mule equals represents ascending order 0.01 poultry, the tenth of sheep and goats, the eighth of cattle and ass. The livestock is a proxy of internal capital accumulation.

The second dataset consists of war data gathered from the Peace Research Institute of Oslo (PRIO). A war event occurs if the threshold number of battle-related deaths is reached or exceeded during a predefined period. Following PRIO, the study categorizes an armed conflict incidence when a country experiences ongoing war, which leads to at least 25 battle-related deaths. It is a binary variable, which takes on a value of one when there is an ongoing armed conflict and zero, elsewhere. On the other hand, the war history variable is a count variable by design and measures the number of armed conflict onsets a country has previously experienced. Using these designations allows researchers to assess the differential impacts of wars of various intensities without relying heavily on imprecise death count data.

The third dataset used here includes potential determinants of agricultural production. Rainfall and temperatures were collected from the World Bank Climate Data Portal (2017), and are reported as the average annual precipitation depth, expressed in millimeters, and the average annual temperature, expressed in degrees Celsius. As noted in the literature review, several other variables have been used in agricultural production studies but unfortunately are not available for a wide sample of countries or years.

Barrios et al. (2010) highlight the relevance of rainfall as a key input into agricultural production. In the same fashion, other researchers also indicated that agriculture is widely rain-fed in Africa (Jensen & Gleditsch, 2009; Blanc, 2012). Likewise, Blanc (2012) notes that about 97 percent of sub-Saharan Africa's agriculture is rain-fed. Hsiang (2010) links economic decline to an increase in temperature. Two additional variables were constructed following the definitions proposed by NASA's Exploring Environment Global Climate Change project, that is, "temperature anomaly" and "rainfall anomaly." As an example, temperature anomaly is obtained from the difference between the 1961 temperature and the long-run average temperature or called the base or reference average temperature. It is important to note the World Bank Climate Data Portal temperature and rainfall series started in 1901 and any departure from the long-run average is considered an anomaly. For this reason, 1901 is used as the reference year and its related average temperature and average rainfall are considered as the long-run averages. As for temperature, notice that when the difference is positive, this means that a country's temperature was warmer than normal and a negative difference means that the temperature was cooler than normal. The same rationale applies to rainfall anomalies. That is, a positive difference means a country had more rainfall than normal and a negative difference means a country had less rainfall than normal.

Modeling Agricultural Production and War

Agricultural output is often linked to outside factors including weather patterns, growing conditions, or political and economic disturbances. This study examines the effect of wars on agricultural production after controlling for rainfall (Miguel et al., 2004; Ciccone, 2011), rainfall anomalies (Barrios et al., 2010), temperatures and temperature anomalies (Hsiang, 2010), and the commonly used inputs, namely, labor, tractors, land, and livestock in the received literature. Four reasons motivate the choice for the fixed effects specification : (1) time-invariant factors such as culture, quality of institutions, culture, luck, trust, geography, various freedom measures, ethnic fractionalization, public policy, are country-specific and are not correlated with other countries' culture and institutions; (2) a sample of 54 African countries is utilized throughout the study period; (3) country intercepts are assumed to be different; and, (4) unobserved covariates such cultural modes, corruption, lack of economic, political, and social freedom, bad institutions and constitutions. The general model used to estimate agricultural production is given as:

$$Output_{it} = \alpha_i + \lambda war_{it} + X'_{it}\beta + \varepsilon_{it} \quad (1)$$

An alternative specification was introduced to obtain elasticities assuming that the production function follows an exponential functional form.

As a result, seven new variables were created using the monotonic transformation with logarithm except for war_{it} and $warhistory_{it}$. Both results are presented in columns 6 and 7 of Table 2. Note that α_i represents the unknown intercept for each country and ε_{it} is the error term. As for subscript, *i* represents an African country, and *t* stands for the year. Both *i* and *j* provide a strongly balanced panel of 54 countries for 49 year-span. *X* is a matrix of covariates and β is the unknown vector of parameters associated with the covariates included in the model. λ is the coefficient associated with the incidence of war.

To account for the issue of reverse causality between agricultural production and the incidence of war, a model of war was built with agricultural production as a dependent variable and a set of control variables commonly used in the existing literature. These variables include the war history, temperatures, temperature anomalies, rainfall, and rainfall anomalies. The general form of the linear probability model is the following:

$$P(War_{it} = 1 | output, warhistory, temperatures...) = \alpha_i + \gamma\, output_{it} + Z'_{it}\,\phi + \mu_{it}. \quad (2)$$

where α_i represents the unknown intercept for each country and μ_{it} is the error term. Z is a matrix of covariates and ϕ is the unknown vector of parameters associated with the covariates included in the model. Notice that γ is the coefficient associated with agricultural output.

After several estimations of the main models, findings are reported in columns 1-8 of Table 2. The best results were retained after the evaluation of different specifications in light of the literature and the research objectives. The next section presents the descriptive statistics, discusses the regression analysis, and provides a brief discussion of the selection of the model that best portrays the data.

Results

Descriptive statistics are reported in Table 1. Columns 1-5 of Table 1 display the following descriptive statistics: the number of observations, the average, the standard deviation, the minimum, and the maximum. The average agricultural output is 1.86 billion dollars between 1961 and 2009 using the constant international dollars of 2004-2006. Figures related to production are expressed in international dollars throughout the study. Notice that Western Sahara had the lowest average agricultural output of about 1.06 million dollars as of 1965. This figure is the all-time minimum output recorded in Africa. The top performer is Nigeria, which achieved record-high agricultural output totaling $ 36.2 billion in 2006. Regarding war, about 16 percent of African countries had experienced ongoing wars between 1961 and 2009. Historically speaking, Africa had on average at least one war ongoing during the period under analysis.

On the other spectrum of war counts, data suggest that Ethiopia had 10 ongoing wars between 1996 and 2007 followed by the Democratic Republic of Congo with 7 war counts between 2005 and 2008. Pursuing the same account of wars in Africa, Angola posted 6 war counts in 2008, Sudan had 4 war counts in 1990, Niger had 4 war counts in 1999, and both Somalia and Chad had 3 war counts individually. Overall, Africa received about 81.86 millimeters of rainfall between 1961 and 2009. The fortunate one is Liberia with a record high of 256.95 millimeters of rainfall in 1963. The driest country in the continent was Western Sahara with 0.93 millimeters of rainfall in 1983. Droughts combined with limited arable land of about 1,000 hectares put Western Sahara at disadvantage compared with other countries in the continent. As it stands, findings lend support to the notion that rainfall is one of the main inputs into agricultural production in Africa where irrigation is erratic. Estimates from the World Bank's World Development Indicator dataset (2013) suggest that irrigated land is relatively scarce and thus the agricultural sector heavily relies on rains.

Table 1: Descriptive Statistics

Variables	Number of Observations (1)	Mean (2)	Standard Deviation (3)	Minimum (4)	Maximum (5)
All 54 countries & 1961-2009					
Agricultural output(in $1,000)	2,646	1,856,961	3,371,129	1,061	36,167,101
Agricultural output per (in 1,000 ha)	2,646	1,214.012	4,649.143	51.19	68,593
Labor (in 1,000)	2,646	7,393.94	11,375.82	24	78,662
Land (1,000 hectares)	2,646	3,762.995	5,398.37	1	40,500
Livestock	2,646	4,280,546	7,124,330	2114	57,881,637
Tractors	2,646	8,386.86	22,743.72	0	175,557
Temperatures (°C)	2,646	24.07	3.28	12.03	35.27
Rainfall (in millimeters)	2,646	81.86	55.44	0.93	256.95
Temperature anomaly	2,646	0.76	3.05	-2.32	22.60
Rainfall anomaly	2,646	-4.74	18.60	-95.27	75.64
Incidence of war	2,646	0.16	0.37	0	1
War history	2,646	0.77	1.30	0	10

Testing for Potential Reverse Causality in Agricultural Production-War Relationship

While not the primary focus of this study, war may cause production to decline, a decline in production may lead to increased tensions and violence. Anecdotal evidence suggests that low agricultural sector production is more common during times of conflict. Recall that the relationship between production and the incidence of civil war is summarized in Equation (2). The latter is a linear probability model of war incidence with agricultural production as the dependent variable after controlling for the war history and the environmental conditions measured by rainfall, temperatures, rainfall anomaly, and temperature anomaly. Rainfall and temperature are both correlated with agricultural output and the incidence of war. Applied researchers would argue that finding a strong instrument is an empirical challenge. This study is not an exception. In light of the empirical evidence, this study hypothesizes that low agricultural production does not instigate wars in Africa.

Concerning reverse causality, results of Equations (1) and (2) are summarized in columns 1 and 2 of Table 2. These equations were estimated by the OLS (ordinary least squares) techniques. Reading from column 1 of Table 2, estimates suggest that the incidence of war reduces agricultural output by slightly above 512 million dollars per year on average. War history also reduces agricultural output by 426.5 million dollars while extra 1,000 hectares of arable land and additional tractor increase agricultural production by 108.5 million dollars and 35.2 million dollars, respectively. Likewise, adding 1,000 workers in agricultural production and getting an extra millimeter of rainfall per year yield 225.3 million dollars and 1.7 million dollars more to Africa, respectively. As for the war model (Equation 2), column 2 of Table 2 suggests that agricultural production is not associated with the incidence of war in Africa even though the sign is negative. That is, agricultural production seems not to be an endogenous variable when one evaluates the significance of the coefficient associated with agricultural production in the incidence of war linear probability model at the conventional levels of significance (*p*-value is less than 0.01, 0.05, and 0.10). As expected, war history is associated with war incidence. Looking at the bottom panel of column 2 of Table 2, results indicate that on average an increase in rainfall somewhat reduces the likelihood of war in Africa.

Table 2: Agricultural Production and War Results

	Linear Model OLS	Probability Linear Model	Panel (Linear model)		Hausman Test	Panel (Log-linear model)		Hausman Test
Dependent variable	Output (1)	War (2)	Fixed Effects (3)	Random Effects (4)	Difference (5)	Fixed Effects (6)	Random Effects (7)	Difference (8)
Incidence of war	-512,137.80***		-293,552***	-333,242.4***	39,690	-0.0555***	-0.0557***	0.0002
	(87,680.97)		(68,412.6)	(73,913.79)	(8,587.55)	(0.0127)	(0.0129)	(0.0007)
Output		-1.04x10-9						
		(2.0x10-9)						
Covariates								
War history	-426,514.40***	0.14***	-430,208.3***	-326,623.1***	-103,585.20			
	(29,371.72)	(0.005)	(30,948.47)	(32,514.9)	(8,712.80)			
Land	108.47***		751.48***	381.00***	370.48	0.3798***	0.2848***	0.0950
	(9.26)		(26.67)	(21.70)	(19.28)	(0.023)	(0.0201)	(0.0119)
Tractors	35.17***		37.12***	36.23***	0.89	0.0851***	0.0943***	-0.0092
	(1.37)		(2.25)	(2.29)	(0.84)	(0.007)	(0.0065)	(0.0017)
Livestock						0.4633***	0.4450***	0.0183
						(0.0147)	(0.0144)	
Labor	225.31***		251.60***	254.04***	-2.44	0.3570***	0.3601***	-0.0031
	(4.75)		(7.24)	(7.49)	(2.43)	(0.0167)	(0.0169)	(0.0028)
Rainfall	1,661.57***	-0.0007***	3,007.45*	4,576.26***	-1,568.81	0.1741***	0.1873***	-0.0132
	(528.14)	(0.0001)	(1,576.15)	(1,408.41)	(977.43)	(0.0242)	(0.0225)	(0.0103)
Constant	-235,877.70***	0.1162***	-3,008,696***	-1,827,371***		0.1301	0.9097***	
	(59,794.20)	(0.0125)	(156,136.4)	(190,665.1)		(0.1930)	(0.1880)	
R-squared [overall†]	0.82	0.23	0.76†	0.80†		0.92†	0.92†	
F-statistic	2,025.59***	263.20***	856.67***			1,341***		
RE-GLS Wald $chi^2(6)$				4,389.30***			8,564.43***	
Hausman test $Chi^2(5)$					406.10***			121.35***
Number of groups			54	54	54	54	54	54
Observations	2,646	2,646	2,646	2,646	2,646	2,646	2,646	2,646

Note: *** means *p*-value is less than 0.01; ** 0.01 < *p*-value < 0.05; * 0.05< *p*-value < 0.10; the Hausman's specification test ch^2 (5) is evaluated at 0.05; RE-GLS stands for Random Effects Generalized Least Squares; † represents the overall R-squared from the fixed effect

The Relationship between Incidence of War and Agricultural Production viewed in Panel Lens

Since the evidence did not suggest a reverse causality, the rest of the discussion of the results is around the agricultural output model (Equation 1). Columns 3–8 of Table 2 summarize the overall results. The dependent variable in each model specification is agricultural production while the dependent variable is a war incidence dummy. Besides, a set of control variables employed at this stage are war history, land, tractors, livestock, labor, and rainfall. Taken together, columns 3-5 of Table 2 summarize the results of the fixed-effects model, the random-effects model, and the Hausman's specification test, respectively.

Since there are two competing models in the panel econometric analysis, it is imperative to conduct the Hausman's specification test to see which specification between the fixed effects and random effects models would be appropriate for this study. Following the standard procedures in the applied econometrics, researchers shall base their judgment on the *p*-value associated with the Hausman's specification test chi-squared (χ^2) statistic (see Baltagi, 2008, p.77 for more details). The latter should be less than 0.05 to select the fixed effects model as the best model specification compared to the random-effects model. The chi-squared statistic is located in the second row reading from the bottom of columns 5 and 8 of Table 2.

The proposed model is a linear regression model with the same explanatory and the same control variables. It should be also noted that columns 6-8 of Table 2 present the results of a log-linear regression model specified as a fixed-effects model is shown in column 6 and a random-effects model shown in column 7. Column 8 of Table 2 reports the Hausman's specification test results as the difference between the coefficients associated with the fixed effects model and the random-effects model as well as the corresponding standard deviations are underneath. Since all variables are expressed in logarithms except the incidence of war dummy, figures associated with the transformed variables represent their related elasticities.

A close look at the results in columns 5 and 8 of Table 2 suggest that the fixed effects models are the appropriate model specifications for the relationship between agricultural production and the incidence of war in Africa during the period 1961-2009. Looking at the very bottom of Table 2, the chi-squared statistic for the linear model has a value of 406.10 with a *p*-value of 0.0000 as shown in column 5. Likewise, the chi-squared for the log-linear model has a value of 121.35 with a *p*-value of 0.0000 as shown in column 8. These two statistics provide evidence for selecting the fixed effects model as the appropriate specification because the *p*-values are less than 0.05.

Continuing the discussion of the results, column 3 of Table 2 indicates that an additional armed conflict in Africa reduces agricultural production by 293.6 million dollars per year. All the results presented here are statistically significant at the 1 percent level except the coefficient associated with rainfall, which is marginally significant at the 10 percent level. War history has reduced agricultural production by 430.2 million dollars annually. Additional thousand hectares of arable land, additional tractor, and 1 thousand more agricultural workers provide 751.5 million dollars, 37.17 million dollars, and 251.6 million dollars to the agricultural sector in Africa per year, respectively. Extra millimeters of rainfall across Africa provides about 3 billion dollars per year to the agricultural sector. Overall, results suggest that the incidence of war has impaired Africa's agricultural production. Shifting the attention to column 6 of Table 2, elasticities are applied as a new lens through which to interpret the results. The model allows researchers to discuss the extent to which a 10 percent increase in the incidence of war would likely reduce agricultural production by about 0.5 percent per year on average.

These findings imply that war is bad for agricultural production and the overall economic activity but its effects are somewhat small. Given the estimated elasticities associated with land, tractors, livestock, labor, and rainfall, results indicate that a 10 percent increase in these variables would increase agricultural production by 3.8 percent, 0.85 percent, 4.6 percent, 3.6 percent, and 1.7 percent per year on average.

Conclusions and Discussion

To conclude, recall that this study investigates the effects of war on agricultural production. Results reveal that decline in agricultural production does not affect the incidence of armed conflict in Africa. However, war does reduce agricultural production by 293.5 million per year. It should be noted that the cumulative effects of previous wars reduce agricultural production by 430.2 million per year. Research indicates that armed conflict imposes economic setbacks where it is present. Given how poorly African agricultural production has performed relative to other areas of the world, results tend to suggest that conflict is only responsible for a relatively small part of African agricultural underperformance. In the short-term wars have devastating transitory impacts on African agricultural production. This study brings together some elements of the recent development in the political economy of development and war in Africa.

To put this study in the political economy of development perspective, it is reasonable to argue for a shift in the scholarship. Beyond the findings of this study, researchers have explained how institutions shape individual behaviors, the way society evolves, and affects economic performance (Fukuyama, 2014, p.40; North, 1990, p.4; North & Weingast, 1989; Boettke et al., 2005; Boettke & Fink, 2011; Kopstein & Lichbach, 2005, p.29).

Research suggests that a lack of commitment to the constitutional arrangement, a lack of enforcement of the existing constitutional arrangement, and ease of changing or revising the constitutions have a significant impact on the performance of a country compared to places where one is tied by the constitution to commit to or abide by the constitutional arrangement (North & Weingast, 1989). Jones and Olken (2005) conclude that "individual leaders can play crucial roles in shaping the growth of nations." Scholars in or focusing on war-torn countries shall pay attention to this scholarship and shall become proactive. In his book entitled, "The Next Decade: Where We've Been …and Where We're Going", Friedman (2011, pp.1-2) stresses that:

"…human beings don't live in the long run. We live in the much shorter span in which our lives are shaped not so much by vast historical trends by the specific decisions of specific individuals…But in the shorter time frame of a decade, individual decisions made by individual people, particularly those with political power, can matter enormously…A decade is the point at which history and statesmanship meet, and a span in which policies still matter."

Wars have inflicted significant damage to agriculture and the overall economy in Africa. This study is relevant because it addresses one of the development challenges of mineral-rich Africa and its spillovers in neighboring countries—armed conflicts. In March 2016 the World Bank Group hosted a global fragility forum at its headquarters in Washington, D.C. to address a very daunting challenge of economic development in a world stricken by fragility, conflict, and violence. According to the World Bank (2016) by 2030 half of the people living in poverty will be the residents of fragile states, and conflict- and violence-prone countries. The Bank also indicates that "one billion people live in countries where conflict has devastated health, education, economic systems, and lives. Citizens of *fragile states* need rapid and effective help. But too often international aid produces only short-term gains that do not last, is not responsive to local conditions, or is slow in arriving." Hence, the best research effort should enhance our understanding of the role of global politics (Clapham, 1996, p.3; Thies & Sobek, 2010), foreign interests (Lamborn & Lepgold, 2003, p.45; Kopstein & Lichbach, 2005, p.22; Bjorvatn & Farzanegan, 2015), history (Meredith, 2014, pp.xiii-xvii.), state, law, and accountability and its relation to the economics of development in Africa (Fukuyama, 2014, pp.23-25; Huntington, 1968, pp.xiii-xvii). That is, scholars shall initiate research programs, which intentionally articulate the discourse of economic growth and development in problem-solving terms through the lens of a cross-disciplinary framework in the lieu of the widespread post-conflict or misguided recovery economic policy anchored in monetary and fiscal policies (Boettke & Fink, 2011). Various development policies have not delivered their promises. This is one of the reasons the development theory is in crisis (Manzo, 1991; Pieterse, 2010, p.1). Is there any time soon when Africa could resurrect its splendor as aptly put in Meridith (2014, p.viii) on "The fortunes of Africa: A 5000-year history of wealth, greed, and endeavor?" Early on, Pakenham (1991, p.xxi) discussed 'The Scramble for Africa: White man's conquest of the dark continent from 1876 to 1912,' which contributed to the political and economic decay of Africa. Of 'The White man's burden: Why the west's efforts to aid the rest have done so much ill and so little good,' Easterly (2006, pp.112-162) paints a clear picture of greed, external penetration, corruption, and predation in a weakly institutionalized polity where gangsters, planners, and bad governments hinder any efforts for growth and development and reap the benefits of local assets and foreign debts to the detriment of the people. War is bad for agriculture and the overall economy. The study pleads for a critical holistic and reflective approach to Africa's political and economic development.

References

Aisen, A., & Veiga, F. J. (2013). How does political instability affect economic growth? *European Journal of Political Economy, 29*, 151–167.

Alesina, A., Özler, S., Roubini, N., & Swagel, P. (1996). Political instability and economic growth. *Journal of Economic Growth, 1*(2), 189–211.

Alexeev, M., & Conrad, R. (2009). The Elusive Curse of Oil. *The Review of Economics and Statistics*, 91(3), 586 – 598.

Arunatilake, S., Jayasuriya, S., & Kelegama, S. (2001). The Economic Cost of the Sri Lanka Civil War: The Case of Sri Lanka, *World Development*, 29(9), 1483 – 1500.

Baltagi, D. (2008). *Econometric Analysis of Panel Data*. John Wiley & Sons Inc. Chichester, West Sussex, UK.

Barrios, S., Bertinelli, L., & Strobl, E. (2010). Trends in Rainfall and Economic Growth in Africa: A Neglected Cause of the Growth Tragedy, *Review of Economics and Statistics*, 92(2), 350-366.

Barro, R. J. (1991). Economic Growth in a Cross Section of Countries Robert J. Barro The *Quarterly Journal of Economics*, 106(2), 407-443.

Bjorvatn, K., & Farzanegan, M. R. (2015). Resource rents, balance of power, and political stability. *Journal of Peace Research, 52*(6), 758–773.

Blanc, E. (2012). The Impact of Climate Change on Crop Yields in Sub-Saharan Africa, *American Journal of Climate Change*: 1(1): 1–13.

Boettke, P., & Fink, A. (2011). Institutions first. *Journal of Institutional Economics*, 7, 499-504.

Ciccone, A. (2011). Economic Shocks and Civil Conflict: A Comment. *Applied Economics*, 3, 215–227.

Clapham, C. (1996). *Africa and the international system: The politics of state survival*. Cambridge University Press, Cambridge: MA.

Collier, P. (1999). On the economic Consequences of Civil War. *Oxford Economic Papers*, 51, 168 – 183.

Dercon, S., & Gollin, D. (2014). Agriculture in African Development: Theories and Strategies. *Annual Review of Resource Economics, 6*, 471-492.

Easterly, W. (2006). *The white man's burden: Why the west's efforts to aid the rest have done so much ill and so little good*. The Penguin Press, New York:NY.

Easterly, W., & Levine, R. (1997). Africa's Growth Tragedy: Policies and Ethnic Divisions. *Quarterly Journal of Economics*, 112(4), 1203–1250.

Food and Agricultural Organization of the United Nations (2017, November 4) FAOSTAT. Retrieved from http://faostat.fao.org/

Friedman, G. (2011). *The Next Decade: Where We've Been…and Where We're Going*. New York: Doubleday.

Fukuyama, F. (2014). *Political order and political decay: From the industrial revolution to the globalization of democracy.* Farrar, Straus and Giroux, New York: NY.

Fulginiti, L., Perrin, R., & Yu, B. (2004). Institutions and agricultural productivity in Sub-Saharan Africa. *Agricultural Economics*, 31, 169 – 180.

Glaser, S., Hendrix, C., Franck, B., Wedig, K., & Kaufman, L. (2019). Armed conflict and fisheries in the Lake Victoria basin. *Ecology and Society*, 24(1).

Gong, L., & Zou, H. (2003). Military Spending and Stochastic Growth. *Journal of Economic Dynamics & Control*, 28, 153 – 170.

Guillaumont, P., Guillaumont Jeanneney, S., & Brun, J. F. (1999). How instability lowers African growth. *Journal of African Economies, 8*(1), 87–107.

Gupta, S., Clements, B., Bhattacharya, R., & Chakravarti, S. (2004). Fiscal Consequences of Armed Conflict and Terrorism in Low –and middle – income Countries. *European Journal of Political Economy*, 20, 403 – 421.

Hsiang, S. M., (2010). Temperatures and cyclones strongly associated with economic production in the Caribbean and Central America. Proceedings of the National Academy of Sciences of the United States of America, 107(35), 15367-15372.

Jensen, D. P., & Gleditsch, S. K. (2009). Rain, Growth, and Civil War: The Importance of Location. *Journal of Defence and Peace Economics*, 20(5), 359-372.

Jones, F. B., & Olken, A. B. (2005). Do Leaders Matter? National Leadership and Growth since World War II, *The Quarterly Journal of Economics*, 120(3), 835-864.

Keefer, P., & Knack, S. (1997). Why don't Poor Countries Catch Up? A Cross-National Test of an Institutional Explanation. *Economic Inquiry*, 35, 590-602.

Keen, D. (2001). The Political Economy of War. In *War and Underdevelopment: The Economic and Social Consequences of Conflict* Vol.1, eds. F. Steward, V. Fitzgerald, and Associates, New York: Oxford University Press Inc.

Knack, S., & Keefer, P. (1995). Institutions and Economic Performance: Cross-Country Tests Using Alternative Institutional Measures. *Economics and Politics*, 7(3), 207-227.

Kopstein, J., & Lichbach, M. (2005). Comparative Politics: Interests, identities, and institutions in a changing global order. 2nd Ed. In J. Kopstein, & M. Lichbach, *The framework of analysis* (2nd Ed., pp.16-38). Cambridge University Press.

Lamborn, C.A., & Lepgold, J. (2003). *World politics into the twenty-first century: Unique contexts, enduring patterns*. Pearson Education Inc., Upper Saddle: New Jersey.

Lukongo, O.E, & Rezek, P. J. (2018). Investigating Spatial Dependence and Spatial Spillovers in African Agricultural Total Factor Productivity Growth. *The American Economist, 63*(1), 41-58.

Manzo, K. (1991). Modernist discourse and the crisis of development theory. *Studies in Comparative International Development*, 26(2), 3-36.

Meredith, M. (2014). *The fortunes of Africa: A 5000-year history of wealth, greed, and endeavor*. Public Affairs, New York: NY.

Miguel, E., Satyanath, S., & Sergenti, E.(2004). Economic Shocks and Civil Conflict: An Instrumental Variables Approach. *The Journal of Political Economy*, 112(4), 725 – 753.

Nafziger, E.W., & Auvinen, J. (2002). Economic Development, Inequality, War, and State Violence, *World Development*, 30(2), 153 – 163.

Nafziger, E.W., & Auvinen, V. (2001). Assessing the Economic Costs of War. In *War and Underdevelopment: The Economic and Social Consequences of Conflict* Vol.1, eds. F. Steward, V. Fitzgerald, and Associates, New York: Oxford University Press Inc.

North, C.D., & Weingast, R.B. (1989). Constitutions and Commitment: The Evolution of Institutions Governing Public Choice in Seventeenth Century England, *Journal of Economic History*, 49(4), 803-832.

North, D. (1990). *Institutions, Institutional Change and Economic Performance*. New York, NY: Cambridge University Press.

Olsson, M., & Svensson, P. (2010). Agricultural growth and institutions: Sweden, 1700–1860. European Review of Economic History, 14(2), 275-304.

Pakenham, T. (1991). *The sramble for Africa: White man's conquest of the dark continent from 1876 to 1912*. Avon Books, New York:NY.

Pieterse, N. J. (2010). *Development Theory*, 2nd Ed. SAGE Publications Inc. Thousand Oaks: CA.

Reitschuler, G., & Loening, J. (2005). Modeling the Defense-Growth Nexus in Guatemala. *World Development*, 33(3), 513 – 526.

Rezek, P.J, Campbell, C. R., & Rogers, E. K. (2011). Assessing total factor productivity growth in Sub-Saharan African agriculture. *Journal of Agricultural Economics, 62*(2), 351-374.

Rodrik, D. (1999). Where Did All the Growth Go? External Shocks, Social Conflict, and Growth Collapses. *Journal of Economic Growth*, 4, 385 – 412.

Steward, F., & Fitzgerald, V. (2001). Assessing the Economic Costs of War. In *War and Underdevelopment: The Economic and Social Consequences of Conflict* Vol.1, eds. F. Steward, V. Fitzgerald, and Associates, New York: Oxford University Press Inc.

The World Bank Group. (2017, November 25). Climate Change Knowledge Portal for Development Practitioners and Policy Makers. Retrieved from http://sdwebx.worldbank.org/climateportal/

Thies, C., & Sobek, D. (2010). War, Economic Development, and Political Development in the Contemporary International System. *International Studies Quarterly, 54*(1), 267-287.

Venieris, Y., & Gupta, D. (1986). Income Distribution and Socio-political Instability as Determinants of Savings: A Cross-Sectional Model. *Journal of Political Economy*, 94(4), 873 – 883.

World Bank. (2013, September 22). World Development Indicators, Agricultural irrigated land as a % of total agricultural land. Retrieved from http://data.worldbank.org